

V.S.B. ENGINEERING COLLEGE, KARUR.

(An Autonomous Institution)

Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai.

NH – 67, Covai Road, Karudayampalayam PO, Karur - 639 111.



CURRICULUM AND SYLLABI

REGULATIONS – 2023

Department of Civil Engineering

I. Vision and Mission of the Institute

Vision

We endeavor to impart futuristic technical education of the highest quality to the student community and to inculcate discipline in them to face the world with self-confidence and thus we prepare them for life as responsible citizens to uphold human values and to be of service at large. We strive to bring of the Institution as an Institution of academic excellence of International standard.

Mission

We transform persons into personalities by the state-of the art infrastructure, time consciousness, quick response and the best academic practices through assessment and advice.

II. Vision and Mission of the Department

Vision

To become a centre of academic excellence and to bring out quality civil engineers with global standards and social responsibility

Mission

•	Developing competent engineers by integrating excellent teaching, learning and research activities.
•	Creating interaction with industries to meet global challenges.
•	Motivating the students for higher studies and entrepreneurship.
•	Inculcating moral and ethical values in students.

III. Program Educational Objectives (PEOs)

PEO1:	Graduates of Civil Engineering will continuously update their knowledge gained for professional development as an employee of an organization or as an employer.
PEO2:	Graduates of Civil Engineering will be capable of working in a professional environment and providing innovative to the latest technological problems.

PEO3:	Graduates of Civil Engineering will discharge their duties as Professional Civil Engineers with quality and ethics.

IV. Program Outcomes (POs)

Graduates of the Civil Engineering will be able to

PO1:	Engineering knowledge Apply the knowledge of mathematics, science, engineering fundamentals to the solution of complex engineering problems in the major areas of Civil Engineering.
PO2:	Problem analysis Identify, formulate, review research literature, and analyze complex problems of Civil Engineering reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3:	Design/development of solutions Design solutions for complex Civil engineering problems and design construction related components and processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4:	Conduct investigations of complex problems Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5:	Modern tool usage Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6:	The engineer and society Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional Civil engineering practice.
PO7:	Environment and sustainability Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8:	Ethics Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9:	Individual and team work Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10:	Communication Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11:	Project management and finance Demonstrate the acquisition of the body of engineering knowledge and insight and management principles and apply them as member /leader in teams and multidisciplinary environments.
PO12:	Life-long learning Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

V. Program Specific Outcomes (PSOs)

Graduates of the Civil Engineering will be able to

PSO1:	Applying the mathematical and the problem solving knowledge to identify and provide solutions for solving complex Civil Engineering problems.
PSO2:	Apply the knowledge of Mechanics, Design of structures and Construction techniques to meet the various basic needs of the industry and the society.
PSO3:	Enable the students to use their technical expertise in latest technologies and apply their knowledge continuously in Civil Engineering to be excellent in their career.

VI. PEOs mapped with POs and PSOs

Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
PEO	3	3	2	2	1	1	1	1	1	1	1	3	3	1	1
PEO	2	3	3	3	3	1	1	1	2	2	1	1	1	3	2
PEO	1	2	3	2	2	3	3	3	1	1	2	1	1	1	3

1-low 2-medium 3-high ‘-’ – no correlation

VII. Mapping of Course Outcomes (Cos) with Program Outcomes (POs)

Sem	Course Name	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I	Induction Programme	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Professional English I	1	-	2	-	1	1.4	-	1	2	3	1	2	-	-	2
	Matrices and Calculus	3	3	1.6	1	-	-	-	-	-	-	-	-	1	-	1
	Engineering Physics	3	2	2	1	1	-	-	-	-	1	-	1	3	2	2
	Engineering Chemistry	3	2	2	1.4	-	2	-	-	-	-	-	-	-	-	-
	Programming in C	3	3	3	-	3	-	-	2	2	-	-	2	1	-	1
	தமிழர் மரபு /Heritage of Tamils	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Programming in C Laboratory	3	3	3	-	3	-	-	2	2	-	-	2	1	-	1
	Physics and Chemistry Laboratory	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-

Sem	Course Name	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	English Laboratory	2	1	1	-	-	-	-	-	-	-	-	-	1	-	-
II	Professional English – II	-	-	-	-	-	-	-	-	1	2.2	-	3	-	-	-
	Computational Methods	3	2	1	1.2	-	-	-	-	-	-	-	1	1	-	1
	Physics for Civil Engineering	2.4	2.8	1.8	1.8	2.2	1.6	1.2	-	-	-	-	2	2	2	2.2
	Basic Electrical, Electronics and Instrumentation Engineering	2	1	1	-	-	-	-	-	-	-	-	-	1	-	-
	Engineering Graphics	3	1	1	1	-	-	1	-	-	-	-	-	3	2	2
	NCC Credit Course	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Engineering Practices Laboratory	2.8	2.6	1.6	3	1	2	2	1	2.6	1	1	2	2.8	1.6	1
	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	2	1	1	-	-	-	-	-	-	-	-	-	1	-	-
	Communication Laboratory / Foreign Language	2.8	2.6	1.6	3	1	2	2	1	2.6	1	1	2	2.8	1.6	1

Sem	Course Name	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
III	Transforms and Partial Differential Equations	3	2	1.2	1	-	-	-	-	-	-	-	1	1	-	1
	Engineering Mechanics	1.8	1.6	0.6	2	2.2	2	2.4	2	-	1	2	1	2.6	2.4	0.6
	Fluid Mechanics	2	2	1	3	2	2	2	2	-	1	2	1	3	2	1
	Building Materials and Construction	3	2	2.5	2	2	2	2	-	-	-	-	2	-	2	2
	Water Supply and Wastewater Engineering	3	3	2	1.8	0.6	1.4	-	3	0.4	1	-	1	3	2	1.6
	Surveying and Leveling	2	2	2	2	2	2	3	1	1	1	2	2	1	2	2
	Surveying and Leveling Laboratory	3	3	3	2	3	3	2	2	2	2	2	2	3	3	3
	Water and Waste water Analysis Laboratory	2	3	3	-	3	-	2	1	2	-	1	3	2	3	3
	Professional Development															
IV	Applied Hydraulics Engineering	3	3	-	3	2	2	1	2	-	-	2	2	3	2	-
	Strength of Materials	3	3	3	3	1	1	1	-	1	1	1	3	3	3	1
	Concrete Technology	3	3	2	2	1	1	-	3	1	1	1	1	3	2	2
	Soil Mechanics	3	3	1	3	2	2	2	-	1	2	2	2	3	3	2
	Highway and Railway Engineering	2.4	2.75	2.6	2.8	1.8	1.2	1.4	1.4	-	1.4	1	1.6	2	1.8	2

Sem	Course Name	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	Environmental Science and Engineering	2.4	1.4	1.4	1	1.4	1	1	1.4	1	1	1	1	1	1	1
	NCC Credit Course Level															
	Hydraulic Engineering Laboratory	2.8	2.6	1.6	3	1	2	2	1	2.6	1	1	2	2.8	1.6	1
	Material Testing Laboratory	3	2	1	3	2	2	2	1	2	1	3	3	2	2	3
	Soil Mechanics Laboratory	3	3	1	3	2	2	2	-	1	2	2	2	3	3	2
V	Design of Reinforced Concrete Structural Elements	3	2.6	3	2	2	-	2	-	-	-	-	2	3	3	2
	Structural Analysis I	3	3	2	1.6	-	1.6	-	3	0.6	1	-	1	3	2	1.8
	Foundation Engineering	2.4	3	3	3	1	2	1.2	1	1	1	1.6	3	2.2	2.8	2.6
	Highway Engineering Laboratory	2	2	2	2	2	2	2	1	1	2	1	1	2	2	2
	Survey Camp	2.5	2.8	2.2	2	2.6	2.2	1.8	1.6	2.4	1.3	2	2.4	2.8	2.6	2.8
VI	Design of Steel Structural Elements	1	2	3	1	1	3	1	2	1	2	2	3	3	3	2
	Structural Analysis II	2.4	2.75	2.6	2.8	1.8	1.2	1.4	1.4	-	1.4	1	1.6	2	1.8	2

Sem	Course Name	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	Engineering Geology	2	3	3	1	1	3	1	2	1	2	3	3	2	3	2
	Building Drawing and Detailing Lab	3	3	1	-	3	1	2	2.4	1.8	1.6	2	2	3	-	3
	Mini Project	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
VII	Estimation, Costing and Valuation Engineering	3	2.75	2.67	2	3	-	-	3	2	3	-	2	3	2	3
	Hydrology and Water Resources Engineering	2.8	2.6	1.6	3	1	2	2	1	2.6	1	1	2	2.8	1.6	1
	Human Values and Ethics	3	-	-	-	-	3	2	3	2	2	1	2	-	-	-
	Total Quality Management	2.6	2.6	2.6	1.8	1.4	2.8	2	1.4	3	2.2	1.2	3	2.8	2.8	3
	Design Project	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
VIII	Project Work/Internship with Industry	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1-low 2-medium 3-high '-' – no correlation

B.E. CIVIL ENGINEERING
Regulations 2023
For the students admitted from 2023 onwards
CHOICE BASED CREDIT SYSTEM
CURRICULUM FOR I – VIII SEMESTERS
SEMESTER I

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1.	23IP101	Induction Programme	-	-	-	-	-	-	0
THEORY									
2.	23HST101	Professional English – I	HSMC	40 / 60	3	0	0	3	3
3.	23MAT101	Matrices and Calculus	BSC	40/60	3	1	0	4	4
4.	23PHT101	Engineering Physics	BSC	40/60	3	0	0	3	3
5.	23CYT101	Engineering Chemistry	BSC	40/60	3	0	0	3	3
6.	23GET101	Programming in C	ESC	40/60	3	0	0	3	3
7.	23GET102	தமிழர் மரபு /Heritage of Tamils	HSMC	40/60	1	0	0	1	1
PRACTICALS									
8.	23GEP101	Programming in C Laboratory	ESC	60/40	0	0	4	4	2
9.	23BSP101	Physics and Chemistry Laboratory	BSC	60/40	0	0	4	4	2
10.	23HSP102	English Laboratory	EEC	100	0	0	2	2	1
TOTAL				-	16	1	10	28	22

SEMESTER II

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
THEORY									
1.	23HST201	Professional English– II	HSMC	40/60	2	0	0	2	2
2.	23MAT201	Computational Methods	BSC	40/60	3	1	0	4	4
3.	23PHT202	Physics for Civil Engineering	BSC	40/60	3	0	0	3	3
4.	23EET203R	Basic Electrical, Electronics and Instrumentation Engineering	ESC	40/60	3	0	0	3	3
5.	23GET201	Engineering Graphics	ESC	40/60	2	0	4	6	4
6.		NCC Credit Course Level 1 [#]	-	-	2	0	0	2	2 [#]
7.	23GET202	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HSMC	40/60	1	0	0	1	1
PRACTICALS									
8.	23GEP201	Engineering PracticesLaboratory	ESC	60/40	0	0	4	4	2
9.	23EEP202	Basic Electrical, Electronicsand Instrumentation Engineering Laboratory	ESC	60/40	0	0	4	4	2
10.	23GEP202	Communication Laboratory /	EEC	60/40	0	0	4	4	2

		Foreign Language \$							
TOTAL				-	16	1	16	33	23

NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA. \$ Skill Based Course

SEMESTER III

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
THEORY									
1.	23MAT301	Transforms and Partial Differential Equations	BSC	40/60	3	1	0	4	4
2.	23MET301	Engineering Mechanics	ESC	40/60	3	0	0	3	3
3.	23CET302	Fluid Mechanics	PCC	40/60	3	0	0	3	3
4.	23CET303	Building Materials and Construction	PCC	40/60	3	0	0	3	3
5.	23CET304	Water Supply and Wastewater Engineering	PCC	40/60	4	0	0	4	4
6.	23CET305	Surveying and Leveling	PCC	40/60	3	0	0	3	3
PRACTICALS									
7.	23CEP301	Surveying and Leveling Laboratory	PCC	60/40	0	0	3	3	1.5
8.	23CEP302	Water and Wastewater Analysis Laboratory	PCC	60/40	0	0	3	3	1.5
9.	23GEP301	Professional	EEC	100	0	0	2	2	1

		Development ^{\$}							
TOTAL				-	19	1	8	28	24

^{\$} Skill Based Course**SEMESTER IV**

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
THEORY									
1.	23CET401	Applied Hydraulics Engineering	PCC	40/60	3	1	0	4	4
2.	23CET402	Strength of Materials	PCC	40/60	3	0	0	3	3
3.	23CET403	Concrete Technology	PCC	40/60	2	0	2	4	3
4.	23CET404	Soil Mechanics	PCC	40/60	3	0	0	3	3
5.	23CET405	Highway and Railway Engineering	PCC	40/60	3	0	0	3	3
6.	23GET401	Environmental Science and Engineering	BSC	40/60	2	0	0	2	2
PRACTICALS									
8.	23CEP401	Hydraulic Engineering Laboratory	PCC	60/40	0	0	3	3	1.5
9.	23CEP402	Material Testing Laboratory	PCC	60/40	0	0	4	4	2
10.	23CEP403	Soil Mechanics Laboratory	PCC	60/40	0	0	3	3	1.5
TOTAL				-	17	1	10	28	23

NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

SEMESTER V

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
THEORY									
1.	23CET501	Design of Reinforced Concrete Structural Elements	PCC	40/60	3	0	0	3	3
2.	23CET502	Structural Analysis I	PCC	40/60	3	0	0	3	3
3.	23CET503	Foundation Engineering	PCC	40/60	3	0	0	3	3
4.		Professional Elective I	PEC	40/60	3	0	0	3	3
5.		Professional Elective II	PEC	40/60	3	0	0	3	3
6.		Professional Elective III	PEC	40/60	3	0	0	3	3
PRACTICALS									
8.	23CEP501	Highway Engineering Laboratory	PCC	60/40	0	0	4	4	2
9.	23CEP502	Survey Camp (2weeks)	EEC	100	0	0	0	0	1
TOTAL				-	21	0	4	25	21

& Mandatory Course is a Non-credit Course (Student shall select one course from the list given under MC-I)

SEMESTER VI

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
THEORY									
1.	23CET601	Design of Steel Structural Elements	PCC	40/60	3	0	0	3	3
2.	23CET602	Structural Analysis II	PCC	40/60	3	0	0	3	3
3.	23CET603	Engineering Geology	PCC	40/60	3	0	0	3	

									3
4.		Professional Elective IV	PEC	40/60	3	0	0	3	3
5.		Professional Elective V	PEC	40/60	3	0	0	3	3
6.		Professional Elective VI	PEC	40/60	3	0	0	3	3
7.		Open Elective – I*	OEC	40/60	3	0	0	3	3
8.		Mandatory Course-II ^{&}	MC	40/60	3	0	0	3	0
9.		NCC Credit Course Level 3 [#]		-	3	0	0	3	3 [#]
PRACTICALS									
10.	23CEP601	Building Drawing and Detailing Lab	PCC	60/40	0	0	4	4	2
11.	23CEP602	Mini Project	EEC	60/40	0	0	4	4	2
TOTAL				-	27	0	8	35	25

*Open Elective – I shall be chosen from the emerging technologies

[&]Mandatory Course-II is a Non-credit Course (Student shall select one course from the list given under MC-II)

[#]NCC Credit Course level 3 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA

SEMESTER VII

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
THEORY									
1.	23CET701	Estimation, Costing and Valuation Engineering	PCC	40/60	3	0	0	3	3
2.	23CET702	Hydrology and Water Resources Engineering	PCC	40/60	3	0	0	3	3
3.	23GET701	Human Values and Ethics	HSMC	40/60	2	0	0	2	2
4.	23GET702	Total Quality Management	HSMC	40/60	3	0	0	3	3
5.		Open Elective – II**	OEC	40/60	3	0	0	3	3

PRACTICAL									
6.	23CEP701	Project Work I	EEC	60/40	0	0	8	8	4
TOTAL				-	14	0	0	14	18

**Open Elective – II shall be chosen from the emerging technologies

SEMESTER VIII

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
THEORY									
1.		Open Elective – III***	OEC	40/60	3	0	0	3	3
2.		Open Elective – IV***	OEC	40/60	3	0	0	3	3
PROJECT WORK									
1.	23CEP801	Project Work II	EEC	60/40	0	0	12	12	6
TOTAL					6	0	12	18	12

***Open Elective III and IV (Shall be chosen from the list of open electives offered by other Programmes.

TOTAL CREDITS: 168

MANDATORY COURSES I

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
THEORY									
1.	23MCT001	Introduction to Women and Gender Studies	MC	100	3	0	0	3	0
2.	23MCT002	Elements of Literature	MC	100	3	0	0	3	0
3.	23MCT003	Film Appreciation	MC	100	3	0	0	3	0
4.	23MCT004	Disaster Management	MC	100	3	0	0	3	0
TOTAL				-	12	0	0	12	0

MANDATORY COURSES II

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
THEORY									
1.	23MCT006	Well Being with traditional Practices (Yoga, Ayurveda and Siddha)	MC	100	3	0	0	3	0
2.	23MCT007	History of Science and Technology in India	MC	100	3	0	0	3	0
3.	23MCT008	Political and Economic Thought for a Humane Society	MC	100	3	0	0	3	0
4.	23MCT009	State, Nation Building and Politics in India	MC	100	3	0	0	3	0
5.	23MCT010	Industrial Safety	MC	100	3	0	0	3	0
TOTAL					15	0	0	15	0

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL I (Structures)	VERTICAL II (Construction techniques and Practices)	VERTICAL III (Geotechnical)	VERTICAL IV (Geo Informatics)	VERTICAL V (Transportation infrastructure)	VERTICAL VI (Environment)	VERTICAL VII (Water Resources)	VERTICAL VIII (Ocean Engineering)	VERTICAL IX (Diversified Course)
Concrete Structures	Formwork Engineering	Geo-Environmental Engineering	Total Station and GPS Surveying	Airports and Harbours	Climate Change Adaptation and Mitigation	Participatory Water Resources Management	Ocean Wave Dynamics	Steel Concrete Composite Structures
Steel Structures	Construction Equipment and Machinery	Ground Improvement Techniques	Remote Sensing Concepts	Traffic Engineering and Management	Air and Noise Pollution Control Engineering	Groundwater Engineering	Marine Geotechnical Engineering	Finance For Engineers
Prefabricated Structures	Sustainable Construction and Lean Construction	Soil Dynamics and Machine Foundations	Satellite Image Processing	Urban Planning and Development	Environmental Impact Assessment	Water Resources Systems Engineering	Coastal Engineering	Earth and Rockfill Dams
Prestressed Concrete Structures	Digitalized Construction Lab	Rock Mechanics	Cartography and GIS	Smart cities	Industrial Wastewater Management	Watershed Conservation and Management	Off shore Structures	Computational Fluid Dynamics
Maintenance, Repair and Rehabilitation of Structures	Construction Management and Safety	Earth and Earth Retaining Structures	Photogrammetry	Intelligent Transport Systems	Solid and Hazardous Waste Management	Integrated Water Resources Management	Port and Harbour Engineering	Rainwater Harvesting
Dynamics and Earthquake Resistant Structures	Advanced Construction Techniques	Pile Foundation	Airborne and Terrestrial laser mapping	Pavement Engineering	Environmental Policy and Legislations	Urban Water Infrastructure	Coastal Hazards and Mitigation	Transport and Environment
Introduction to Finite Element Method	Energy Efficient Buildings	Tunneling Engineering	Hydrographic Surveying	Transportation Planning Process	Environment, Health and Safety	Water Quality and Management	Coastal Zone Management and Remote Sensing	Environmental Quality Monitoring

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V and VI. These courses are listed in groups called verticals that represent a particular area of specialisation / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI. The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to the Regulations 2021, Clause 4.10.

PROFESSIONAL ELECTIVE COURSES: VERTICALS**VERTICAL 1: STRUCTURES**

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1.	23CEE001	Concrete Structures	PEC	40/60	3	0	0	3	3
2.	23CEE002	Steel Structures	PEC	40/60	3	0	0	3	3
3.	23CEE003	Prefabricated Structures	PEC	40/60	3	0	0	3	3
4.	23CEE004	Prestressed Concrete Structures	PEC	40/60	3	0	0	3	3
5.	23CEE005	Maintenance, Repair and Rehabilitation of Structures	PEC	40/60	3	0	0	3	3
6.	23CEE006	Dynamics and Earthquake Resistant Structures	PEC	40/60	3	0	0	3	3
7.	23CEE007	Introduction to Finite Element Method	PEC	40/60	3	0	0	3	3

VERTICAL 2: CONSTRUCTION TECHNIQUES AND PRACTICES

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1.	23CEE008	Formwork Engineering	PEC	40/60	3	0	0	3	3
2.	23CEE009	Construction Equipment and Machinery	PEC	40/60	3	0	0	3	3
3.	23CEE010	Sustainable Construction and	PEC	40/60	3	0	0	3	3

		Lean Construction							
4.	23CEE011	Digitalized Construction Lab	PEC	60/40	0	0	6	6	3
5.	23CEE012	Construction Management and Safety	PEC	40/60	2	0	2	4	3
6.	23CEE013	Advanced Construction Techniques	PEC	40/60	3	0	0	3	3
7.	23CEE014	Energy Efficient Buildings	PEC	40/60	3	0	0	3	3

VERTICAL 3: GEOTECHNICAL

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1.	23CEE015	Geoenvironmental Engineering	PEC	40/60	3	0	0	3	3
2.	23CEE016	Ground Improvement Techniques	PEC	40/60	3	0	0	3	3
3.	23CEE017	Soil Dynamics and Machine Foundations	PEC	40/60	3	0	0	3	3
4.	23CEE018	Rock Mechanics	PEC	40/60	3	0	0	3	3
5.	23CEE019	Earth and Earth Retaining Structures	PEC	40/60	3	0	0	3	3
6.	23CEE020	Pile Foundation	PEC	40/60	3	0	0	3	3
7.	23CEE021	Tunneling Engineering	PEC	40/60	3	0	0	3	3

VERTICAL 4: GEO-INFORMATICS

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1.	23CEE022	Total Station and GPS Surveying	PEC	40/60	3	0	0	3	3
2.	23CEE023	Remote Sensing Concepts	PEC	40/60	3	0	0	3	3
3.	23CEE024	Satellite Image Processing	PEC	40/60	3	0	0	3	3
4.	23CEE025	Cartography and GIS	PEC	40/60	3	0	0	3	3
5.	23CEE026	Photogrammetry	PEC	40/60	3	0	0	3	3
6.	23CEE027	Airborne and Terrestrial Laser Mapping	PEC	40/60	3	0	0	3	3
7.	23CEE028	Hydrographic Surveying	PEC	40/60	3	0	0	3	3

VERTICAL 5: TRANSPORTATION INFRASTRUCTURE

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1.	23CEE029	Airports and Harbours	PEC	40/60	3	0	0	3	3
2.	23CEE030	Traffic Engineering and Management	PEC	40/60	3	0	0	3	3
3.	23CEE031	Urban Planning and Development	PEC	40/60	3	0	0	3	3
4.	23CEE032	Smart Cities	PEC	40/60	3	0	0	3	3
5.	23CEE033	Intelligent Transport Systems	PEC	40/60	3	0	0	3	3

6.	23CEE034	Pavement	PEC	40/60	3	0	0	3	3
7.	23CEE035	Transportation Planning Process	PEC	40/60	3	0	0	3	3

VERTICAL 6: ENVIRONMENT

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1.	23CEE036	Climate Change Adaptation and Mitigation	PEC	40/60	3	0	0	3	3
2.	23CEE037	Air and Noise Pollution Control Engineering	PEC	40/60	3	0	0	3	3
3.	23CEE038	Environmental Impact Assessment	PEC	40/60	3	0	0	3	3
4.	23CEE039	Industrial Wastewater Management	PEC	40/60	3	0	0	3	3
5.	23CEE040	Solid and Hazardous Waste Management	PEC	40/60	3	0	0	3	3
6.	23CEE041	Environmental Policy and Legislations	PEC	40/60	3	0	0	3	3
7.	23CEE042	Environment, Health and Safety	PEC	40/60	3	0	0	3	3

VERTICAL 7: WATER RESOURCES

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1.	23CEE043	Participatory Water Resources Management	PEC	40/60	3	0	0	3	3
2.	23CEE044	Ground Water	PEC	40/60	3	0	0	3	3

		Engineering							
3.	23CEE045	Water Resources Systems Engineering	PEC	40/60	3	0	0	3	3
4.	23CEE046	Watershed Conservation and Management	PEC	40/60	3	0	0	3	3
5.	23CEE047	Integrated Water Resources Management	PEC	40/60	3	0	0	3	3
6.	23CEE048	Urban Water Infrastructure	PEC	40/60	3	0	0	3	3
7.	23CEE049	Water Quality and Management	PEC	40/60	3	0	0	3	3

VERTICAL 8: OCEAN ENGINEERING

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1.	23CEE050	Ocean Wave Dynamics	PEC	40/60	3	0	0	3	3
2.	23CEE051	Marine Geotechnical Engineering	PEC	40/60	3	0	0	3	3
3.	23CEE052	Coastal Engineering	PEC	40/60	3	0	0	3	3
4	23CEE053	Off shore Structures	PEC	40/60	3	0	0	3	3
5	23CEE054	Port and Harbour Engineering	PEC	40/60	3	0	0	3	3
6	23CEE055	Coastal Hazards and Mitigation	PEC	40/60	3	0	0	3	3
7	23CEE056	Coastal Zone Management and Remote Sensing	PEC	40/60	3	0	0	3	3

VERTICAL 9: DIVERSIFIED COURSES

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1.	23CEE057	Steel Concrete Composite Structures	PEC	40/60	3	0	0	3	3
2.	23CEE058	Finance for Engineers	PEC	40/60	3	0	0	3	3
3.	23CEE059	Earth and Rock fill Dams	PEC	40/60	3	0	0	3	3
4.	23CEE060	Computational Fluid Dynamics	PEC	40/60	3	0	0	3	3
5.	23CEE061	Rainwater Harvesting	PEC	40/60	3	0	0	3	3
6.	23CEE062	Transport and Environment	PEC	40/60	3	0	0	3	3
7.	23CEE063	Environmental Quality Monitoring	PEC	40/60	3	0	0	3	3

OPEN ELECTIVES

(Students shall choose the Open Elective Courses, such that the course contents are not similar to any other course contents/title under other course categories)

OPEN ELECTIVE – I and II

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1.	23CSO 001	Artificial Intelligence and Machine Learning Fundamentals	OEC	50/50	2	0	2	4	3
2.	23CSO 002	IoT Concepts and Applications	OEC	50/50	2	0	2	4	3

3.	23CSO 003	Data Science Fundamentals	OEC	50/50	2	0	2	4	3
4.	23CSO 004	Augmented and Virtual Reality	OEC	50/50	2	0	2	4	3

OPEN ELECTIVE – III

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1.	23HSO 001	English for Competitive	OEC	40/60	3	0	0	3	3
2.	23MGO 001	NGOs and Sustainable	OEC	40/60	3	0	0	3	3
3.	23MGO 002	Democracy and Good Governance	OEC	40/60	3	0	0	3	3
4.	23EEO 001	Renewable Energy Technologies	OEC	40/60	3	0	0	3	3
5.	23MEO 001	Applied Design Thinking	OEC	50/50	2	0	2	4	3
6.	23MEO 002	Reverse	OEC	40/60	3	0	0	3	3
7.	23MEO 003	Sustainable Manufacturing	OEC	40/60	3	0	0	3	3
8.	23EEO 002	Electric and Hybrid Vehicle	OEC	40/60	3	0	0	3	3
9.	23ECO 002	Space Engineering	OEC	40/60	3	0	0	3	3
10.	23MGO 004	Industrial	OEC	40/60	3	0	0	3	3
11.	23MGO 003	Quality	OEC	40/60	3	0	0	3	3
12.	23CHO 001	Fire Safety	OEC	40/60	3	0	0	3	3
13.	23CEO 001	Introduction to non- destructive testing	OEC	40/60	3	0	0	3	3
14.	23MEO 004	Mechatronics	OEC	40/60	3	0	0	3	3

15.	23MEO 005	Foundation of Robotics	OEC	40/60	3	0	0	3	3
16.	23MEO 006	Fundamentals of Aeronautical engineering	OEC	40/60	3	0	0	3	3
17.	23CEO 002	Remote Sensing Concepts	OEC	40/60	3	0	0	3	3
18.	23CEO 003	Urban Agriculture	OEC	40/60	3	0	0	3	3
19.	23CEO 004	Drinking Water Supply and	OEC	40/60	3	0	0	3	3
20.	23EEO 003	Electric Vehicle technology	OEC	40/60	3	0	0	3	3
21.	23EEO 004	Introduction to PLC Programming	OEC	40/60	3	0	0	3	3
22.	23CHO 002	Nano Technology	OEC	40/60	3	0	0	3	3
23.	23MEO 007	Functional	OEC	40/60	3	0	0	3	3
24.	23BMO 001	Biomedical Instrumentation	OEC	40/60	3	0	0	3	3
25.	23BTO 001	Traditional Indian Foods	OEC	40/60	3	0	0	3	3
26.	23BTO 002	Introduction to food processing	OEC	40/60	3	0	0	3	3
27.	23BTO 003	IPR for Pharma Industry	OEC	40/60	3	0	0	3	3
28.	23CHO 003	Basics of Textile Finishing	OEC	40/60	3	0	0	3	3
29.	23CHO 004	Industrial Engineering for	OEC	40/60	3	0	0	3	3
30.	23CHO 005	Basics of Textile Manufacture	OEC	40/60	3	0	0	3	3
31.	23CHO 006	Introduction to Petroleum Refining and Petrochemicals	OEC	40/60	3	0	0	3	3
32.	23EEO 005	Energy Conservation and	OEC	40/60	3	0	0	3	3
33.	23CHO 007	Basics of Plastics Processing	OEC	40/60	3	0	0	3	3

34.	23ECO 003	Signals and	OEC	40/60	3	0	0	3	3
35.	23ECO 004	Fundamentals of Electronic Devices and Circuits	OEC	40/60	3	0	0	3	3
36.	23MEO 008	Foundation Skills in integrated product Development	OEC	40/60	3	0	0	3	3
37.	23BMO 002	Assistive	OEC	40/60	3	0	0	3	3
38.	23MAO 001	Operations	OEC	40/60	3	0	0	3	3
39.	23MAO 002	Algebra and	OEC	40/60	3	0	0	3	3
40.	23MAO 003	Linear Algebra	OEC	40/60	3	0	0	3	3

OPEN ELECTIVES – IV

S. No.	COURS E CODE	COURSE TITLE	CATE GORY	Int./Ext.	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
					L	T	P		
1.	23HSO002	Project Report Writing	OEC	40/60	3	0	0	3	3
2.	23MAO004	Advanced Numerical Methods	OEC	40/60	3	0	0	3	3
3.	23MAO005	Random Processes	OEC	40/60	3	0	0	3	3
4.	23MAO006	Queuing and Reliability Modelling	OEC	40/60	3	0	0	3	3
5.	23MGO004	Production and Operations Management for Entrepreneurs	OEC	40/60	3	0	0	3	3
6.	23MGO005	Multivariate Data Analysis	OEC	40/60	3	0	0	3	3
7.	23MEO009	Additive Manufacturing	OEC	40/60	3	0	0	3	3
8.	23MEO010	New Product Development	OEC	40/60	3	0	0	3	3
9.	23MEO011	Industrial Design & Rapid Prototyping Techniques	OEC	50/50	2	0	2	4	3

10.	23MEO012	Micro and Precision Engineering	OEC	40/60	3	0	0	3	3
11.	23MEO013	Cost Management of Engineering Projects	OEC	40/60	3	0	0	3	3
12.	23EEO011	Batteries and Management system	OEC	40/60	3	0	0	3	3
13.	23EEO006	Sensors and Actuators	OEC	40/60	3	0	0	3	3
14.	23ECO005	Space Vehicles	OEC	40/60	3	0	0	3	3
15.	23MGO006	Management Science	OEC	40/60	3	0	0	3	3
16.	23MEO014	Production Planning and Control	OEC	40/60	3	0	0	3	3
17.	23MGO007	Operations Management	OEC	40/60	3	0	0	3	3
18.	23BMO003	Industrial Hygiene	OEC	40/60	3	0	0	3	3
19.	23CHO008	Chemical Process Safety	OEC	40/60	3	0	0	3	3
20.	23EEO007	Electrical, Electronic and Magnetic materials	OEC	40/60	3	0	0	3	3
21.	23CHO009	Nanomaterials and applications	OEC	40/60	3	0	0	3	3
23.	23CEO010	Hydraulics and Pneumatics	OEC	40/60	3	0	0	3	3
23.	23EEO008	Sensors	OEC	40/60	3	0	0	3	3
24.	23MEO005	Foundation of Robotics	OEC	40/60	3	0	0	3	3
25.	23ECO006	Concepts in Mobile Robotics	OEC	40/60	3	0	0	3	3
26.	23MEO015	Marine Propulsion	OEC	40/60	3	0	0	3	3
27.	23MEO016	Marine Merchant Vehicles	OEC	40/60	3	0	0	3	3
28.	23MEO017	Elements of Marine Engineering	OEC	40/60	3	0	0	3	3
29.	23ECO007	Drone Technologies	OEC	40/60	3	0	0	3	3
30.	23CEO005	Geographical Information	OEC	40/60	3	0		3	3

		System					0		
31.	23CEO006	Agriculture Entrepreneurship Development	OEC	40/60	3	0	0	3	3
32.	23CEO009	Biodiversity Conservation	OEC	40/60	3	0	0	3	3
33.	23EEO009	Introduction to control systems	OEC	40/60	3	0	0	3	3
34.	23MEO021	Introduction to Industrial Automation Systems	OEC	40/60	3	0	0	3	3
35.	23EEO010	Energy Technology	OEC	40/60	3	0	0	3	3
36.	23BTO004	Fundamentals of Food Engineering	OEC	40/60	3	0	0	3	3
37.	23BTO005	Food safety and Quality Regulations	OEC	40/60	3	0	0	3	3
38.	23BTO006	Nutraceuticals	OEC	40/60	3	0	0	3	3
39.	23CHO010	Basics of Dyeing and Printing	OEC	40/60	3	0	0	3	3
40.	23CHO011	Fibre Science	OEC	40/60	3	0	0	3	3
41.	23CHO012	Garment Manufacturing Technology	OEC	40/60	3	0	0	3	3
42.	23CEO008	Industrial safety	OEC	40/60	3	0	0	3	3
43.	23CHO013	Unit Operations in Petro Chemical Industries	OEC	40/60	3	0	0	3	3
44.	23MEO018	Plastic Materials for Engineers	OEC	40/60	3	0	0	3	3
45.	23MEO019	Properties and Testing of Plastics	OEC	40/60	3	0	0	3	3
46.	23ECO008	VLSI Design	OEC	40/60	3	0	0	3	3
47.	23ECO009	Wearable devices	OEC	40/60	3	0	0	3	3
48.	23BMO004	Medical Informatics	OEC	40/60	3	0	0	3	3
49.	23CEO007	Basics of Integrated Water Resource Management	OEC	40/60	3	0	0	3	3

CIVIL DEPARTMENT OPEN ELECTIVE COURSES

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1.	23CEO 001	Introduction to Non-Destructive Testing	OEC	40/60	3	0	0	3	3
2.	23CEO 002	Remote Sensing Concepts	OEC	40/60	3	0	0	3	3
3.	23CEO 003	Urban Agriculture	OEC	40/60	3	0	0	3	3
4.	23CEO 004	Drinking Water Supply and Treatment	OEC	40/60	3	0	0	3	3
5.	23CEO 005	Geographical Information System	OEC	40/60	3	0	0	3	3
6.	23CEO 006	Agriculture Entrepreneurship Development	OEC	40/60	3	0	0	3	3
7.	23CEO 007	Basics of Integrated Water Resource Management	OEC	40/60	3	0	0	3	3
8.	23CEO 008	Industrial safety	OEC	40/60	3	0	0	3	3
9.	23CEO 009	Biodiversity Conservation	OEC	40/60	3	0	0	3	3
10.	23CEO 010	Hydraulics and	OEC	40/60	3	0	0	3	3

SUMMARY

Name of the Programme										
S.No	Subject Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII/VIII	VIII/VII	
1	HSMC	4	3					5		12
2	BSC	12	7	4	2					25
3	ESC	5	11	3						19
4	PCC			16	21	11	11	6		65
5	PEC					9	9			18
6	OEC						3	3	6	12
7	EEC	1	2	1		1	2	4	6	17

8	Non-Credit (Mandatory)					✓	✓			
Total		22	23	24	23	21	25	18	12	168

ENROLLMENT FOR B.E. / B. TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)

- A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor degree.
- For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only.
- For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes. Moreover, for minor degree the student can register for courses from any one of the following verticals also.
- Complete details are available in clause 4.10 of Regulations 2023.

VERTICALS FOR MINOR DEGREE

(In addition to all the verticals of other programmes)

Vertical I Fintech and Block chain	Vertical II Entrepreneurship	Vertical III Public Administration	Vertical IV Business Data Analytics	Vertical V Environment and Sustainability
Financial Management	Foundations of Entrepreneurship	Principles of Public Administration	Statistics for Management	Sustainable Infrastructure Development
Fundamentals of Investment	Team Building and Leadership Management for Business	Constitution of India	Data Mining for Business Intelligence	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity and Innovation in Entrepreneurship	Public Personnel Administration	Human Resource Analytics	Sustainable Bio Materials

Introduction to Block chain and its Applications	Principles of Marketing Management for Business	Administrative Theories	Marketing and Social Media Web Analytics	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurship	Indian Administrative System	Operation and Supply Chain Analytics	Green Technology
Introduction to Fintech	Financing New Business Ventures	Public Policy Administration	Financial Analytics	Environmental Quality Monitoring and Analysis
-	-	-	-	Integrated Energy Planning for Sustainable Development
-	-	-	-	Energy Efficiency for Sustainable Development

**Vertical I : FINTECH AND BLOCK
CHAIN**

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1.	23CMG001	Financial Management	PEC	40/60	3	0	3	3	3
2.	23CMG002	Fundamentals of Investment	PEC	40/60	3	0	3	3	3
3.	23CMG003	Banking, Financial Services and Insurance	PEC	40/60	3	0	3	3	3
4.	23CMG004	Introduction to Blockchain and its	PEC	40/60	3	0	3	3	3

		Applications							
5.	23CMG005	Fintech Personal Finance and Payments	PEC	40/60	3	0	3	3	3
6.	23CMG006	Introduction to Fintech	PEC	40/60	3	0	3	3	3
TOTAL				-	18	0	18	18	18

Vertical II : ENTREPRENERUSHIP

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1.	23CMG007	Foundations of Entrepreneurship	PEC	40/60	3	0	3	3	3
2.	23CMG008	Team Building and Leadership Management for Business	PEC	40/60	3	0	3	3	3
3.	23CMG009	Creativity and Innovation in Entrepreneurship	PEC	40/60	3	0	3	3	3
4.	23CMG010	Principles of Marketing Management for Business	PEC	40/60	3	0	3	3	3
5.	23CMG011	Human Resource Management for Entrepreneurs	PEC	40/60	3	0	3	3	3
6.	23CMG012	Financing New Business Ventures	PEC	40/60	3	0	3	3	3
TOTAL				-	18	0	18	18	18

Vertical III : PUBLIC ADMINISTRATION

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1.	23CMG013	Principles of Public Administration	PEC	40/60	3	0	3	3	3
2.	23CMG014	Constitution of India	PEC	40/60	3	0	3	3	3
3.	23CMG015	Public Personnel Administration	PEC	40/60	3	0	3	3	3
4.	23CMG016	Administrative Theories	PEC	40/60	3	0	3	3	3
5.	23CMG017	Indian Administrative System	PEC	40/60	3	0	3	3	3
6.	23CMG018	Public Policy Administration	PEC	40/60	3	0	3	3	3
TOTAL				-	18	0	18	18	18

Vertical IV : BUSINESS DATA ANALYTICS

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1.	23CMG019	Statistics for Management	PEC	40/60	3	0	3	3	3
2.	23CMG020	Datamining for Business Intelligence	PEC	40/60	3	0	3	3	3
3.	23CMG021	Human Resource Analytics	PEC	40/60	3	0	3	3	3
4.	23CMG022	Marketing and Social Media Web Analytics	PEC	40/60	3	0	3	3	3
5.	23CMG023	Operation and Supply Chain Analytics	PEC	40/60	3	0	3	3	3

6.	23CMG024	Financial Analytics	PEC	40/60	3	0	3	3	3
TOTAL				-	18	0	18	18	18

Vertical V : ENVIRONMENT AND SUSTAINABILITY

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1.	23CES001	Sustainable infrastructure Development	PEC	40/60	3	0	3	3	3
2.	23CES002	Sustainable Agriculture and Environmental Management	PEC	40/60	3	0	3	3	3
3.	23CES003	Sustainable Bio Materials	PEC	40/60	3	0	3	3	3
4.	23CES004	Materials for Energy Sustainability	PEC	40/60	3	0	3	3	3
5.	23CES005	Green Technology	PEC	40/60	3	0	3	3	3
6.	23CES006	Environmental Quality Monitoring and Analysis	PEC	40/60	3	0	3	3	3
7.	23CES007	Integrated Energy Planning for Sustainable Development	PEC	40/60	3	0	3	3	3
8.	23CES008	Energy Efficiency for Sustainable Development	PEC	40/60	3	0	3	3	3
TOTAL				-	24	0	24	24	24

SEMESTER I

23IP101	INDUCTION PROGRAMME
Prerequisites	
This is a mandatory 2-week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over. The induction programme has been introduced by AICTE with the following objective: “Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have a broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed.” “One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character.” Hence, the purpose of this programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature. The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program. (i) Physical Activity This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.	

(ii) Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later.

(iii) Universal Human Values

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, make decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and don'ts, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing.

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

(iv) Literary Activity

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules

This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People

Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the underprivileged.

(viii) Familiarization to Dept./Branch & Innovations

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities

About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering / Technology / Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

Induction Programme is totally an activity based programme and therefore there shall be no tests / assessments during this programme.

References:

Guide to Induction program from AICTE

23HST101	PROFESSIONAL ENGLISH-I (Common to All BE/B.Tech students(Except CSBS))	Category: BSC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: • To improve the communicative competence of learners • To learn to use basic grammatic structures in suitable contexts • To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text • To help learners use language effectively in professional contexts					

To develop learners' ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.		
Unit I	Introduction to fundamentals of communication	9
Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails, Letter of introducing oneself, Grammar - Present Tense (simple and progressive); Question types: Wh / Yes or No questions Question Tags, Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).		
Unit II	Narration And Summation	9
Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. Writing - Guided writing-- Paragraph writing, Short Report on an event (field trip), Grammar - Past tense (simple); Subject-Verb Agreement, Prepositions, Vocabulary - Word forms (prefixes & suffixes) Synonyms and Antonyms, Phrasal verbs.		
Unit III	Description of a Product/Process	9
Reading - Reading advertisements, gadget reviews; user manuals. Writing definitions; instructions; and Product /Process description, Grammar - Imperatives; Adjectives, Degrees of comparison, Present & Past Perfect Tenses, Compound Nouns, Homonyms; and Homophones, Discourse markers (connectives & sequence words)		
Unit IV	Classification And Recommendations	9
Reading - Newspaper articles, Journal reports -and Non Verbal Communication (tables, pie charts etc.), Writing -Note-making/Note-taking(*Study skills to be taught, not tested, Writing recommendations; Transferring information from Non-verbal (chart , graph etc, to verbal mode), Articles, Pronouns, Possessive & Relative pronouns, Vocabulary - Collocations, Fixed / Semi fixed expressions.		
Unit V	Expression	9
Reading - Reading editorials , Opinion Blogs, Writing - Essay Writing (Descriptive or narrative). Grammar - Future Tenses, Punctuation, Negation (Statements & Questions); Simple, Compound & Complex Sentences. Vocabulary - Cause & Effect Expressions, Content vs Function words		
Total periods:45		
Text Books:		
1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition).		
2. English for Science & Technology Cambridge University Press, 2021.		
3. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.		

References:															
1. Technical Communication – Principles and Practices By Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.															
2. A Course Book on Technical English By Lakshmi Narayanan, Scitech Publications (India) Pvt. Ltd.															
3. English For Technical Communication (With CD) By Aysha Viswamohan, Mcgraw Hill Education, ISBN : 0070264244															
4. Effective Communication Skill, Kulbhusan Kumar, R S Salaria, Khanna Publishing House															
5. Learning to Communicate – Dr. V. Chellammal, Allied Publishing House, New Delhi, 2003.															
Course Outcomes:													Blooms Taxonomy		
CO 1: To use appropriate words in a professional context													Remember(K1)		
CO2: To gain understanding of basic grammatical structures and use them in right context													Understand(K2)		
CO3: To read and infer the denotative and connotative meanings of technical texts													Apply(K3)		
CO4: To write definitions, descriptions, narrations and essays on various topics													Apply(K3)		
CO5: To read and comprehend different types of reading materials													Apply(K3)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	3	3	3	1	3	-	3	-	-	-
CO2	1	1	1	1	1	3	3	3	1	3	-	3	-	-	-
CO3	2	3	2	3	2	3	3	3	2	3	3	3	-	-	-
CO4	2	3	2	3	2	3	3	3	2	3	3	3	-	-	-
CO5	2	3	3	3	-	3	3	3	2	3	-	3	-	-	-

1 - Low, 2 - Medium, 3 - High, '-' - no correlation

23MAT101	MATRICES AND CALCULUS (Common to BME,BT,CIVIL,CHEMICAL,ECE,EEE,MECH)	Category: BSC			
		L	T	P	C
		3	1	0	4
Prerequisites Basic Mathematical Knowledge					
Course Objectives: - To develop the use of matrix algebra techniques that is needed by engineers for practical applications. - To familiarize the students with differential calculus. - To familiarize the student with functions of several variables. This is needed in many branches of engineering. - To make the students understand various techniques of integration. - To understand various techniques of multiple integrals.					
Unit I	MATRICES				9+3
Characteristic equation - Eigenvalues and Eigenvectors of a real matrix - Properties of Eigenvalues and Eigenvectors – Cayley – Hamilton Theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms- Applications of Eigen value and Eigen vector in Engineering (for classroom discussion, assignments and term paper work).					
Unit II	DIFFERENTIAL CALCULUS				9+3
Derivatives – Differentiation rules (Sum, Product, Quotient, Chain rules) – Implicit differentiation – Logarithmic differentiation – Maxima and Minima of functions of one variables- Role of derivatives in Engineering Problems (for classroom discussion, assignments and term paper work).					
Unit III	FUNCTIONS OF SEVERAL VARIABLES				9+3
Partial differentiation – Total derivative - Jacobians – Partial differentiation of implicit functions – Taylor’s series for functions of two variables –Maxima and minima of functions of two variables and Lagrange’s method of undetermined multipliers-Engineering Problems using Partial derivatives (for classroom discussion, assignments and term paper work).					
Unit IV	INTEGRAL CALCULUS				9+3
The Definite and Indefinite integral – Integration techniques - Substitution methods-Integration by parts – Reduction formula ($\sin^n x, \cos^n x$) - Integration of rational functions (Partial fraction method) -Improper Integrals. Role of Integrations in Engineering Problems (for classroom discussion, assignments and term paper work.).					

Unit V	MULTIPLE INTEGRALS												9+3		
Double integrals– Double integrals in polar coordinates – Change of order of integration– Area enclosed by plane curves- Triple integrals – Volume of solids – Change of variable in double and triple integrals. Double integral models in Engineering (for classroom discussion, assignments and term paper work).															
Total periods: 60															
PERIODS															
Text Books:															
1. Kreyszig E, “Advanced Engineering Mathematics” John Wiley and 10 th Edition, New Delhi, 2016.															
2. Grewal B. S, “Higher Engineering Mathematics, New Delhi, 44 th Edition, 2018.															
3. James Stewart, “Calculus: Early Transcendentals“, Cengage Learning 8 th Edition, New Delhi, 2015.															
References:															
1. Jain R. K and Iyengar S.R.K, “Advanced Engineering Mathematics”, Narasa Publications, New Delhi, 5 th Edition, 2016.															
2. Narayanan S, and Manicavachagam Pillai T. K, “Calculus: Volume I and II”, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.															
3. Ramana B. V, “Higher Engineering Mathematics”, McGraw Hill Education Pvt. Ltd., New Delhi, 2016.															
4. Daniel T. Fink Beiger, “Introduction to matrices and Linear transformations”, Dover publications, 3 rd Edition, January 2011.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Use the matrix algebra methods for solving practical problems.													Apply(K3)		
CO2: Apply differential calculus tools in solving various application problems.													Apply(K3)		
CO3: Able to use differential calculus ideas on several variable functions.													Understand(K2)		
CO4: Apply different methods of integration in solving practical problems.													Apply(K3)		
CO5: Apply various techniques in multiple integrals.													Apply(K3)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	-	-	-	1	-	-	-
CO2	3	2	1	1	-	-	-	-	-	-	-	1	-	-	-
CO3	3	2	1	1	-	-	-	-	-	-	-	1	-	-	-
CO4	3	2	1	1	-	-	-	-	-	-	-	1	-	-	-
CO5	3	2	1	1	-	-	-	-	-	-	-	1	-	-	-
AVG	3	2	1	1	-	-	-	-	-	-	-	1	-	-	-

1 - Low, 2 - Medium, 3 - High, '-' - no correlation

23PHT101	ENGINEERING PHYSICS (Common to AIDS, BME, Biotech, CSE(AIML), CIVIL, CHEMICAL, CSE, CCE, CSBS, ECE, EEE, IT, MECH)	Category: BSC			
		L	T	P	C
		3	0	0	3
Prerequisites Basic Science Knowledge					
Course Objectives: - To make the students effectively to achieve an understanding of mechanics. - To enable the students to gain knowledge of electromagnetic waves and its applications. - To introduce the basics of oscillations, optics and lasers. - Equipping the students to be successfully understand the importance of quantum physics. - To motivate the students towards the applications of quantum mechanics.					
Unit I	MECHANICS				9
Multiparticle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of continuous bodies – M.I of a diatomic molecule - torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule - gyroscope - torsional pendulum – double pendulum – Introduction to nonlinear oscillations.					
Unit II	ELECTROMAGNETIC WAVES				9
The Maxwell’s equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.					
Unit III	OSCILLATIONS, OPTICS AND LASERS				9
Simple harmonic motion - resonance –analogy between electrical and mechanical oscillating systems - waves on a string - standing waves - traveling waves - Energy transfer of a wave - sound waves - Doppler effect. Reflection and refraction of light waves - total internal reflection - interference – Michelson interferometer –Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein’s coefficients - population inversion - Nd-YAG laser, CO ₂ laser, semiconductor laser –Basic applications of lasers in industry.					
Unit IV	BASIC QUANTUM MECHANICS				9

Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free particle - particle in a infinite potential well: 1D, 2D and 3D Boxes- Normalization, probabilities and the correspondence principle.		
Unit V	APPLIED QUANTUM MECHANICS	9
The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.		
Total periods: 45 PERIODS		
Text Books:		
1. D.Kleppner and R.Kolenkow. An Introduction to Mechanics. Mc Graw Hill Education (Indian Edition), 2017.		
2. E.M.Purcell and D.J.Morin, Electricity and Magnetism, Cambridge Univ. Press, 2013.		
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, Mc Graw-Hill (Indian Edition), 2017.		
References:		
1. R.Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition), 2009.		
2. Paul A. Tipler, Physic – Volume 1 & 2, CBS, (Indian Edition), 2004		
3. K.Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.		
4. D.Halliday, R.Resnick and J.Walker. Principles of Physics, Wiley (Indian Edition), 2015.		
5. N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer-Verlag, 2012.		
Course Outcomes:	Blooms Taxonomy	
CO1: Understand the importance of mechanics.	Understand(K2)	
CO2: Express their knowledge in electromagnetic waves	Understand(K2)	
CO3: Demonstrate a strong foundational knowledge in oscillations, optics and lasers.	Understand(K2)	
CO4: Understand the importance of quantum physics.	Remember(K1)	
CO5: Comprehend and apply quantum mechanical principles towards the formation of energy bands.	Apply(K3)	

CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS O1	PSO2	PSO3
CO1	3	3	2	1	1	1	-	-	-	-	-	-	-	-	-
CO2	3	3	2	1	2	1	-	-	-	-	-	-	-	-	-
CO3	3	3	2	2	2	1	-	-	-	-	-	-	-	-	-
CO4	3	3	1	1	2	1	-	-	-	-	-	1	-	-	-
CO5	3	3	1	1	2	1	-	-	-	-	-	-	-	-	
AVG.	3	3	1.6	1.2	1.8	1	-	-	-	-	-	1	-	-	-

1 - Low, 2 - Medium, 3 - High, '-' - no correlation

23CYT101	ENGINEERING CHEMISTRY (Common to BME,BT,CIVIL,CHEMICAL,ECE,EEE,MECH)		Category: BSC			
			L	T	P	C
			3	0	0	3
Prerequisites						
Course Objectives: - To understand water quality parameters, treatment process and corrosion. - To understand adsorption and phase rule - To evaluate engineering materials and the nature of polymers - To Apply recent advanced energy sources and batteries. - To observe various chemical composition in fuels and apply shock waves.						
Unit I	Universal Solvent (Water) and Corrosion					9
Water quality parameters of-color, odour, turbidity, pH, hardness, TDS, COD and BOD, Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination: Reverse Osmosis. Boiler troubles: Scale and sludge, Boiler corrosion. Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralization and zeolite process. Corrosion - causes- factors- types chemical, electrochemical corrosion (galvanic, differential aeration), corrosion control anodic and cathodic methods and corrosion inhibitors.						

Unit II	Surface Chemistry and Phase Rule	9
Adsorption: Types of adsorption – adsorption of gases on solids – adsorption of solute from solutions – adsorption isotherms. Langmuir’s adsorption isotherm –Catalysis: Catalyst – types of catalysis – criteria – autocatalysis acid base catalysis – enzyme catalysis– Michaelis – Menten equation. Phase rule: Introduction, definition of terms with examples. One component system – water system; Reduced phase rule;– Thermal analysis; Two component system: lead-silver system – Pattinson process.		
Unit III	Polymers and Alloys	9
Introduction- Definition- Properties of alloys- Significance and Functions and Ferrous alloys. Nichrome and Stainless steel – heat treatment of steel; Non-ferrous alloys – brass and bronze. Introduction: Classification of polymers – Natural and synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerization. Types and mechanism of polymerization: Addition (Free Radical, cationic and anionic); condensation and copolymerization. Preparation, properties and uses of Nylon 6,6, and Epoxy resin.		
Unit IV	Batteries and Energy Sources	9
Batteries: Types of batteries, Primary battery – dry cell, Secondary battery – lead acid battery and lithium-ion battery; Electric vehicles. Advanced Energy Sources-Recent developments in solar cell materials. Fuel cells: H ₂ -O ₂ fuel cell, microbial fuel cell; Super capacitors: Storage principle, types and examples.		
Unit V	Analytical Chemistry and Shock Wave	9
Proximate and ultimate analysis of coal. Accuracy, precision, sensitivity, detection limits, significant figures, rounding off. Types of errors, determinate and indeterminate errors. Petroleum process. Shock Wave - Description of a shock wave and its applications. Methods of creating shock waves in the laboratory using a shock tube, description of hand operated Reddy shock tube and its characteristics.		
Total periods:45		
Text Books:		
1. P. C. Jain and Monica Jain, “Engineering Chemistry”, 17th Edition, DhanpatRai, Publishing Company (P) Ltd, New Delhi, 2018.		
2. Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.		
3. S.S. Dara, “A text book of Engineering Chemistry”, S. Chand Publishing, 12th Edition, 2018.		
4. Skoog, D.A.; West, D.M.; Holler, F.J.; Crouch, S.R. (2014), Fundamentals of Analytical Chemistry, Cengage Learning.		
References:		
1. O.G. Palanna, “Engineering Chemistry” McGraw Hill Education (India) Private Limited, 2nd Edition,		

2017															
2. Friedrich Emich, “Engineering Chemistry”, Scientific International PVT, LTD, New Delhi, 2014.															
3. Shikha Agarwal, “Engineering Chemistry-Fundamentals and Applications”, Cambridge University Press, Delhi, Second Edition, 2019.															
4. O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013.															
5. Shock waves made simple- Chintoo S Kumar, K Takayama and KPJ Reddy: Willey India Pvt. Ltd. New Delhi 2014.															
Course Outcomes:													Blooms Taxonomy		
CO 1: To know well about water quality parameters and corrosive nature of metals													K1		
CO2: Understand adsorption, its types and phases, phase rule													K2		
CO3: To use alloys and polymers in day to day life													K3		
CO4: To Understand the advantages of batteries, super capacitors and solar cell fabrication													K2		
CO5: To Analyse chemical composition of coal and understand petroleum process and uses of shock waves in real life.													K4		
CO - PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	1	1	-	-	-	1	1			
CO2	3	1	-	-	-	1	1	-	-	-	-	1			
CO3	3	1	-	-	1	1	1	-	-	-	1	1			
CO4	3	1	-	-	1	1	1	-	-	-	1	1			
CO5	3	1	-	-	1	1	1	-	-	-	1	1			

1 - Low, 2 - Medium, 3 - High, '-' - no correlation

23GET101	PROGRAMMING IN C	Category: ESC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To understand the constructs of Language. - To develop C Programs using basic programming constructs - To develop C programs using arrays and strings - To develop modular applications in C using functions - To develop applications in C using pointers and structures - To do input/output and file handling in C					
Unit I	BASICS OF C PROGRAMMING				9
Introduction to programming paradigms–Applications of C Language-Structure of C program - C programming: Data Types - Constants – Enumeration Constants - Keywords – Operators:Precedence and Associativity - Expressions - Input/Output statements, Assignment statements –Decision making statements - Switch statement - Looping statements – Preprocessor directives –Compilation process					
Unit II	ARRAYS AND STRINGS				9
Introduction to Arrays: Declaration, Initialization – One dimensional array –Two dimensional arrays - String operations: length, compare, concatenate, copy – Selection sort, linear and binarysearch.					
Unit III	FUNCTIONS AND POINTERS				9
Modular programming - Function prototype, function definition, function call, Built-in functions(stringfunctions,mathfunctions)–Recursion,Binary Search using recursive functions–Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers –Parameter passing:Pass by value,Pass by reference.					
Unit IV	STRUCTURES AND UNION				9
Structure-Nested structures–Pointer and Structures–Array of structures–Self referential structures–Dynamic memory allocation-Singly linked list–typedef–Union-Storage classes and Visibility.					
Unit V	FILE PROCESSING				9
Files–Types of file processing:Sequential access,Random access–Sequential access file- Random access file-Command line arguments.					
Total periods: 45					
Text Books:					

1. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016.
2. Kernighan, B.W and Ritchie, D.M, "The C Programming language", Second Edition, Pearson Education, 2015.

References:

1. Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighth edition, Pearson Education, 2018.

2. Yashwant Kanetkar, Letus C, 17th Edition, BPB Publications, 2020.

3. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996.

4. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2013.

5. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", 1st Edition, Pearson Education, 2013.

Course Outcomes:**Blooms Taxonomy**

CO 1: Demonstrate knowledge on C Programming constructs

K3

CO2: Develop simple applications in C using basic constructs

K2

CO3: Design and implement applications using arrays and strings

K3

CO4: Develop and implement modular applications in C using functions.

K3

CO5: Develop applications in C using structures and pointers.

K3

CO-PO Mapping

Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	1	2	1	1	1	2	-	3	2	1	2	-
CO2	2	2	2	1	2	1	1	1	2	-	3	3	2	2	-
CO3	2	3	2	1	2	1	1	1	2	-	3	2	2	2	-
CO4	3	2	2	1	3	1	1	1	2	-	3	3	2	2	-
CO5	2	3	3	1	2	1	2	1	2	-	3	2	2	3	-
CO Avg.	2	2.4	2.2	1	2.2	1	1.2	1	2	-	3	2.4	1.8	2.2	-

1 - Low, 2 - Medium, 3 - High, '-' No correlation

23GET102	HERITAGE OF TAMILS (Common to All Programmes)		Category: HSMC			
			L	T	P	C
			1	0	0	1
Prerequisites NIL						
Unit I	LANGUAGE AND LITERATURE					3
Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.						
Unit II	HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE					3
Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.						
Unit III	FOLK AND MARTIAL ARTS					3
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.						
Unit IV	THINAI CONCEPT OF TAMILS					3
Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.						
Unit V	CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3 Contribution of Tamils to Ind					3
Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.						
Total periods: 15						
Text Books:						
1.Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)						
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute						

of Tamil Studies.
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
References:
1. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

23GET102	தமிழர்களின் பாரம்பரியம்	Category: HSMC			
		L	T	P	C
		1	0	0	1
Prerequisites					
• -					
அலகு I	மொழியும் இலக்கியமும்				3
இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – சிறப்பு மொழியாகத் தமிழ் – தமிழின் சங்ககால இலக்கியங்கள் – சங்க இலக்கியத்தின் மதச்சார்பின்மை – சங்க இலக்கியத்தில் பகிர்ந்தளிக்கும் நீதிக்கூறு – திருக்குறளில் மேலாண்மை கொள்கைகள் – தமிழ் காவியங்கள் மற்றும் தமிழகத்தில் பௌத்தம், ஜைன மதங்களின் தாக்கம் – பக்தி இலக்கியம் : ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கிய வகைகள் – தமிழில் நவீன இலக்கிய வளர்ச்சி – பாரதியார், பாரதிதாசன் ஆகியோரின் பங்களிப்பு					
அலகு II	பாரம்பரியம் – பாறை ஓவியங்களிலிருந்து நவீனக் கலை வரை – சிலைப்பண்கலை				3
வீரக்கல் முதல் நவீனச் சிலைக்கலை வரை – வெண்கலச் சின்னங்கள் – பழங்குடியினரும் அவர்கள் செய்யும் கைத்தொழில்களும் – கோயில் தேர் தயாரிப்பு கலை – மகத்தான டெராக்காட்டா (மண்) சிலைகள், கிராமத் தெய்வங்கள், கன்யாகுமரியில் திருவள்ளுவர் சிலை – இசைக்கருவிகள் தயாரித்தல்: மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக மற்றும் பொருளாதார வாழ்வில் கோயில்களின் பங்கு.					
அலகு III	ஜனகலைகளும் போர்க்கலைகளும்				3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கனியன் கூத்து, ஓயிலாட்டம், தோல் மரப்பட்டி (தோல்பாவைக் கூத்து), சிலம்பாட்டம், வளைரி, புலி நடனம் – தமிழர்களின் விளையாட்டுகள் மற்றும் போட்டிகள்.		
அலகு IV	தமிழர்களின் திணை கருத்து	3
தமிழர்களின் தாவர மற்றும் விலங்கியல் – தொல்காப்பியம் மற்றும் சங்க இலக்கியம் கூறும் அக-புறம் கருத்து – தமிழர்களின் அறம் கோட்பாடு – சங்ககால கல்வி மற்றும் எழுத்தறிவு – சங்ககால நகரங்கள் மற்றும் துறைமுகங்கள் – சங்ககால ஏற்றுமதி மற்றும் இறக்குமதி – சோழர்களின் கடல் கடந்த இராணுவ விரிவாக்கங்கள்.		
அலகு V	இந்திய தேசிய இயக்கத்திற்கும் இந்திய கலாசாரத்திற்கும் தமிழர்களின் பங்களிப்பு	3
இந்திய விடுதலைப் போராட்டத்தில் தமிழர்களின் பங்களிப்பு – இந்தியாவின் பிற பகுதிகளில் தமிழர்களின் கலாச்சாரத் தாக்கம் – சுயமரியாதை இயக்கம் – மரபுவழி மருத்துவ முறைகளில் சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள் மற்றும் கருவேலைச் சுவடிகள் – தமிழ் நூல்களின் அச்ச வரலாறு.		
Total Periods : 15		
TEXT-CUM-REFERENCE BOOKS:		
1. தமிழர்களின் சமூக வாழ்க்கை (டாக்டர் கே. கே. பிள்ளை) – TNTB & ESC மற்றும் RMRL ஆகியவற்றின் கூட்டு வெளியீடு – (அச்சிடப்பட்டுக் கொண்டிருக்கிறது)		
2. தமிழர்களின் சமூக வாழ்க்கை – சங்ககாலம் (டாக்டர் எஸ். சிங்காரவேலு) (வெளியீடு: சர்வதேசத் தமிழ் ஆய்வு நிறுவனம்)		
3. தமிழர்களின் வரலாற்றுப் பாரம்பரியம் (டா. எஸ். வி. சுப்பிரமணியன், டா. கே. டி. திருநாவுக்கரசு) (வெளியீடு: சர்வதேச தமிழ் ஆய்வு நிறுவனம்). இந்திய கலாசாரத்திற்கு தமிழர்களின் பங்களிப்புகள் (டா. எம். வள்ளர்மதி) (வெளியீடு: சர்வதேச தமிழ் ஆய்வு நிறுவனம்).		
4. கீழாடி – 'வைகை நதிக் கரையில் அமைந்த சங்க கால நகர நாகரிகம்' (வெளியீடு: தொல்பொருள் துறை & தமிழ்நாடு பாடநூல் மற்றும் கல்விச்சேவை கழகம் – கூட்டு வெளியீடு)		
5. இந்திய வரலாற்றில் ஆய்வுகள் – குறிப்பாக தமிழ்நாட்டைச் சார்ந்தவை (டாக்டர் கே. கே. பிள்ளை) (வெளியீடு: எழுத்தாளர் தாமே)		
6. பொருளை நாகரிகம் (வெளியீடு: தொல்பொருள் துறை & தமிழ்நாடு பாடநூல் மற்றும் கல்விச்சேவை கழகம் – கூட்டு வெளியீடு)		
7. நாகரிகப் பயணம்: இந்தஸ் முதல் வைகை வரை (ஆர். பாலகிருஷ்ணன்) (வெளியீடு: RMRL) – குறிப்பு நூல்		

23GEP101	PROGRAMMING IN C LABORATORY	Category: ESC			
		L	T	P	C
		0	0	4	2
Prerequisites					
Course Objectives: - To familiarize with C programming constructs. - To develop programs in C using basic constructs. - To develop programs in C using arrays. - To develop applications inC using strings,pointers,functions. - To develop applications in C using structures. To develop applications in C using file processing					
LIST OF EXPERIMENTS					
1	I/O statements,operators,expressions				
2	Decision-making constructs:if-else,goto,switch-case,break-continue				
3	Loops:for,while,do-while				
4	Arrays:1Dand2D,Multi-dimensional arrays,traversal				
5	Strings:operations				
6	Functions:call,return,passing parameters by(value,reference),passing arrays to function				
7	Recursion				
8	Pointers: Pointers to functions,Arrays,Strings,Pointers to Pointers,Array of Pointers				
9	Structures: Nested Structures,Pointers to Structures,Arrays of Structures and Unions.				
10	Files:reading and writing,File pointers,file operations,random access, process or directives.				
Total periods:60					
Text Books:					
1.ReemaThareja,“Programming in C”,Oxford University Press,Second Edition,2016					
2.Kernighan,B.Wand Ritchie,D.M,“The C Programming language”,Second Edition,Pearson Education,2015.					
References:					
1.Paul Deitel and Harvey Deitel, “C How to Program with an Introduction to C++”, Eighth edition, Pearson Education,2018.					
2.Yashwant Kanetkar, Letus C,17 th Edition, BPB Publications,2020.					
3.ByronS.Gottfried,"Schaum's Outline of Theory and Problems of Programming with C",McGraw-					

Hill Education, 1996.															
4. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2013.															
5. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", 1 st Edition, Pearson Education, 2013															
Course Outcomes:													Blooms Taxonomy		
CO1: Demonstrate knowledge on C programming constructs.													K3		
CO2: Develop programs in C using basic constructs.													K4		
CO3: Develop programs in C using arrays.													K4		
CO4: Develop applications in C using strings, pointers, functions.													K4		
CO5: Develop applications in C using structures.													K4		
CO – PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	3	1	1	1	-	-	2	1	2	2	2	2	-
CO2	2	3	3	2	1	1	-	-	2	1	2	2	2	3	-
CO3	2	2	2	1	1	2	-	-	2	-	2	2	2	2	-
CO4	2	2	2	2	1	2	-	-	3	-	3	3	3	2	-
CO5	2	2	3	2	3	2	-	-	2	-	3	3	3	3	-
CO Avg.	1.8	2.4	2.6	1.6	1.4	1.6			2.2	1	2.4	2.4	2.4	2.4	-
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23BSP101	PHYSICS LABORATORY (Common to All Branches)	Category: BSC			
		L	T	P	C
		0	0	2	1
Prerequisites					
Course Objectives: - To learn the proper use of various kinds of physics laboratory equipment. - To learn how data can be collected, presented and interpreted in a clear and concise manner. - To learn problem solving skills related to physics principles and interpretation of					

experimental data.

- To determine error in experimental measurements and techniques used to minimize such error.
- To make the student as an active participant in each part of all lab exercises.

LIST OF EXPERIMENTS

1	Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2	Simple harmonic oscillations of cantilever.
3	Non-uniform bending - Determination of Young's modulus.
4	Uniform bending – Determination of Young's modulus.
5	Laser- Determination of the wavelength of the laser using grating.
6	a) Optical fibre -Determination of Numerical Aperture and acceptance angle. b) Compact disc- Determination of width of the groove using laser.
7	Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids.

Total periods: 30 PERIODS

Text Books:

1. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, "Vogel's Textbook of Quantitative Chemical Analysis", Pearson Education, 2009.

Course Outcomes:													Blooms Taxonomy		
CO1: Understand the functioning of various physics laboratory equipment.													Understanding (K2)		
CO2: Use graphical models to analyze laboratory data.													Understanding (K2)		
CO3: Use mathematical models as a medium for quantitative reasoning and describing physical reality.													Remembering (K1)		
CO4: Access, process and analyze scientific information.													Analyzing (K4)		
CO5: Solve problems individually and collaboratively.													Applying (K3)		
CO – PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-

CO3	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-
CO4	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-
CO5	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-
CO Avg.	3	2.4	2.6	1	1	-	-	-	-	-	-	-	-	-	-
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23BSP101	CHEMISTRY LABORATORY (Common to All Branches)		Category: BSC			
			L	T	P	C
			0	0	2	1
Prerequisites NIL						
Course Objectives: - To estimate the amount of alkalinity and hardness by volumetric and analysis - To evaluate the skills of water quality of DO and chloride by volumetric analysis - To understand strength of mixture of acids by using instrumental analysis - To familiarize with conductometry in the determination of precipitation titration - To acquire techniques to determine Fe content by potentiometer.						
LIST OF EXPERIMENTS						
1	Determination of total, temporary & permanent hardness of water by EDTA method					
2	Determination of chloride content of water sample by Argentometric method					
3	Determination of types and amount of alkalinity in water sample					
4	Determination of DO content of water sample by Winkler’s method					
5	Determination of strength of acids in a mixture of acids using conductivity meter.					
6	Conductometric titration of barium chloride against sodium (precipitation titration).					
7	Estimation of iron content of the given solution using potentiometer.					
Total periods:						
Text Books:						
1. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, “Vogel’s Textbook of Quantitative Chemical Analysis”, Pearson Education, 2009.						
2. V. K. Ahluwalia, Sunitha Dhingra and Adarsh Gulati, “College Practical Chemistry”, Universities Press						

(India) Pvt. Ltd., 2018.															
Course Outcomes:													Blooms Taxonomy		
CO1: To analyse the quantity of hardness and Chloride in water sample													Analyze (K4)		
CO2: To analyze the quantity of alkalinity and DO in water sample													Analyze (K4)		
CO3: Using conductivity meter the strength and amount of acids are analyzed.													Analyze (K4)		
CO4: To Analyze quantitatively BaCl ₂ present in the given solution by conductivity meter.													Analyze (K4)		
CO5: To determine the amount of Fe content potentiometrically.													Analyze (K4)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	1	1	-	2	-	1	1	-	-	-
CO2	3	1	-	-	-	1	1	-	2	-	1	1	-	-	-
CO3	3	-	-	-	-	1	1	-	2	-	-	1	-	-	-
CO4	3	-	-	-	-	1	1	-	2	-	-	1	-	-	-
CO5	3	-	-	-	-	1	1	-	2	-	-	1	-	-	-
CO Avg.	3	1				1	1		2		1	1	-	-	-
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23HSP102	English Laboratory (Common to All Branches)	Category: EEC			
		L	T	P	C
		0	0	2	1
Prerequisites: NIL					
Course Objectives: • To improve the communicative competence of learners • To help learners use language effectively in academic /work contexts • To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos etc. • To build on students’ English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts. • To use language efficiently in expressing their opinions via various media.					
LIST OF EXPERIMENTS					

1	Listening for general information-specific details- conversation: Introduction to classmates - Audio / video (formal & informal); Telephone conversation;
2	Listening to voicemail & messages; Listening and filling a form. Speaking - making telephone calls- Self Introduction; Introducing a friend; - politeness strategies
3	Making polite requests, making polite offers, replying to polite requests and offers- understanding basic instructions (filling out a bank application for example).
4	Listening - Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities.
5	Speaking - Narrating personal experiences / events-Talking about current and temporary situations & permanent and regular situations*
6	Describing experiences and feelings- engaging in small talk- describing requirements and abilities.
7	Listening - Listen to product and process descriptions; a classroom lecture; and advertisements about products.
8	Speaking – Picture description- describing locations in workplaces- Giving instruction to use the product- explaining uses and purposes
9	Presenting a product- describing shapes and sizes and weights- talking about quantities(large & small)-talking about precautions.
10	Listening – Listening to TED Talks; Listening to lectures - and educational videos.
11	Speaking – Small Talk; discussing and making plans-talking about tasks-talking about progress-
12	Talking about positions and directions of movement-talking about travel preparations- talking about transportation-
13	Listening – Listening to debates/ discussions; different viewpoints on an issue; and panel discussions.
14	Speaking –making predictions- talking about a given topic-giving opinions
15	Understanding a website-describing processes

Total periods: 30

Text Books:

1. English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University.
2. English for Science & Technology Cambridge University Press 2021.
3. Authored by Dr. VeenaSelvam, Dr. SujathaPriyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

References:

1. Raman. Meenakshi, Sharma. Sangeeta (2019).Professional English.Oxford university press. New Delhi.															
2. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, NewDelhi															
3. Learning to Communicate – Dr. V. Chellammal. Allied Publishers, New Delhi, 2003															
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.															
5. Developing Communication Skills by Krishna Mohan, MeeraBannerji- Macmillan India Ltd. 1990, Delhi.															
Course Outcomes:													Blooms Taxonomy		
CO1: To listen and comprehend complex academic texts .													Remember (K1)		
CO2: To speak fluently and accurately in formal and informal communicative contexts													Apply (K3)		
CO3: To express their opinions effectively in both oral and written medium of communication													Understand (K2)		
CO4: Write critical reports to convey data and information with clarity and precision													Apply (K3)		
CO5: Give appropriate instructions and recommendations for safe execution of tasks													Apply (K3)		
CO – PO& PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	0	0	0	1	0	2	2	2	3	2	3	0	0	0
CO2	1	0	0	0	1	0	2	2	2	3	2	3	0	0	0
CO3	1	0	0	0	1	0	2	2	2	3	2	3	0	0	0
CO4	1	0	0	0	1	0	2	2	2	3	2	3	0	0	0
CO5	1	0	0	0	1	0	2	2	2	3	2	3	0	0	0
CO Avg.	1	0	0	0	1	0	2	2	2	3	2	3	0	0	0
1 - Low, 2 - Medium, 3 -High , ‘-‘ No correlation2															

SEMESTER II

23HST 201	PROFESSIONAL ENGLISH – II (Common to All BE/B.Tech(Except CSBS))	Category: HSMC			
		L	T	P	C
		2	0	0	2
Prerequisites Professional English I					
Course Objectives: - To engage learners in meaningful language activities to improve their reading and writing skills - To learn various reading strategies and apply in comprehending documents in professional context. - To help learners understand the purpose, audience, contexts of different types of writing - To develop analytical thinking skills for problem solving in communicative context - To demonstrate an understanding of job applications and interviews for internship and placements					
Unit I	UNIT I - MAKING COMPARISONS				6
Reading - Reading advertisements, user manuals, brochures; Writing – Professional emails, Email etiquette - Compare and Contrast Essay; Grammar – Mixed Tenses, Prepositional phrases					
Unit II	UNIT II - EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING				6
Reading - Reading longer technical texts– Cause and Effect Essays, and Letters / emails of complaint, Writing - Writing responses to complaints. Grammar - Active Passive Voice transformations, Infinitive and Gerunds					
Unit III	UNIT III - PROBLEM SOLVING				6
Reading - Case Studies, excerpts from literary texts, news reports etc. Writing – Letter to the Editor, Checklists, Problem solution essay / Argumentative Essay. Grammar – Error correction; If conditional sentences					
Unit IV	UNIT IV -REPORTING OF EVENTS AND RESEARCH				6
Reading –Newspaper articles; Writing – Recommendations, Transcoding, Accident Report, Survey Report Grammar – Reported Speech, Modals Vocabulary – Conjunctions- use of prepositions					

Unit V	UNIT V THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY	6
Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing – Job / Internship application – Cover letter & Resume; Grammar – Numerical adjectives, Relative Clauses.		
Total periods:30		
Text Books:		
1. English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University.		
2. English for Science & Technology Cambridge University Press 2021.		
3. Authored by Dr. VeenaSelvam, Dr. SujathaPriyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Jeevani, Department of English, Anna University.		
References:		
1. Raman. Meenakshi, Sharma. Sangeeta (2019).Professional English.Oxford university press. New Delhi.		
2. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, NewDelhi		
3. Learning to Communicate – Dr. V. Chellammal. Allied Publishers, New Delhi, 2003		
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.		
5. Developing Communication Skills by Krishna Mohan, MeeraBannerji- Macmillan India Ltd. 1990, Delhi.		
Course Outcomes:		Blooms Taxonomy
CO1: To compare and contrast products and ideas in technical texts.		Remember (K1)
CO2: To identify and report cause and effects in events, industrial processes through technical texts		Understand (K2)
CO3: Toanalyse problems in order to arrive at feasible solutions and communicate them in the written format.		Apply (K3)
CO4: To present their ideas and opinions in a planned and logical manner		Apply (K3)

CO5: To draft effective resumes in the context of job search.													Apply (K3)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	0	0	0	0	0	1	2	1	3	2	3	0	0	0
CO2	1	0	0	0	0	0	1	2	1	3	2	3	0	0	0
CO3	1	0	0	0	0	0	1	2	1	3	2	3	0	0	0
CO4	1	0	0	0	0	0	1	2	1	3	2	3	0	0	0
CO5	1	0	0	0	0	0	1	2	1	3	2	3	0	0	0
CO Avg.	1	0	0	0	0	0	1	2	1	3	2	3	0	0	0
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MAT201	COMPUTATIONAL METHODS (Common to all Branches B.E / B.TECH except B.E EEE)	Category: BSC			
		L	T	P	C
		3	1	0	4
Prerequisites • Basic Mathematical Knowledge • Matrices and Calculus					
Course Objectives: • To introduce the basic concepts of solving algebraic and transcendental equations. • To introduce the various numerical techniques for interpolation, differentiation and integration, this plays an important role in engineering and technology disciplines. • To acquaint the knowledge of various techniques and methods of solving ordinary differential equations. • To understand the knowledge of various techniques and methods of solving various types of partial differential equations. • To acquaint the knowledge of numerical methods by MATLAB.					

UNIT I	NUMERICAL SOLUTION OF EQUATIONS AND MATRIX PROBLEMS	9+3
Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.		
UNIT II	INTERPOLATION, APPROXIMATION AND INTEGRATION	9+3
Interpolation with unequal intervals - Lagrange's interpolation – Newton's divided difference interpolation –Newton's forward and backward difference formulae - Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's Method.		
UNIT III	NUMERICAL APPROACH FOR IVP IN ORDINARY DIFFERENTIAL EQUATIONS	9+3
Single step methods - Taylor's series method - Euler's method - Modified Euler's method – Fourth order Runge - Kutta method for solving first order equations - Multi step methods - Milne's and Adams - Bash forth predictor corrector methods for solving first order equations.		
UNIT IV	NUMERICAL APPROACH FOR BVP IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS	9+3
Finite difference methods for solving second order two - point linear boundary value problems – Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat equation (Crank Nicholson, Bender Schemidt's methods) and One dimensional wave equation.		
UNIT V	MAT LAB INTRODUCTION	9+3
Introduction – Basic features – MATLAB Session – Getting started – Mathematical functions – Basic plotting – Matrix generation-Solutions of algebraic and transcendental equations using MATLAB-Gauss elimination and Gauss Jordan method for system of linear equations by MATLAB.		
Total periods:60 Periods		
Text Books:		
1. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.		
2. Grewal, B.S., “Numerical Methods in Engineering & Science (with Programs in C,C++ & MATLAB)” Khanna Publishers, 10th Edition, New Delhi, 2015.		
3. William J. Palm III., “Introduction to MATLAB® for Engineers” , Published by McGraw-Hill,2005.		
References:		

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.															
2. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7th Edition, 2007.															
3. William Bober., "Numerical and analytical methods with MATLAB® for Engineers and Scientists" , Published by CRC press, November 2013.															
Course Outcomes:													Blooms Taxonomy		
CO1: Understand the basic concepts and techniques of solving algebraic and transcendental equations.													Understanding		
CO2: Appreciate the numerical techniques of interpolation, differentiation and integration for engineering problems.													Applying		
CO3: Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.													Understanding		
CO4: Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.													Applying		
CO5: Understand the basic concepts of MATLAB for Computational Methods.													Understanding		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1	-	-	-	-	-	1	-	-	-
CO2	3	2	2	2	2	1	-	-	-	-	-	1	-	-	-
CO3	3	2	2	2	2	1	-	-	-	-	-	1	-	-	-
CO4	3	2	2	2	2	1	-	-	-	-	-	1	-	-	-
CO5	3	2	2	2	2	1	-	-	-	-	-	1	-	-	-
AVG	3	2	2	2	2	1	-	-	-	-	-	1	-	-	-

1 - Low, 2 - Medium, 3 - High, '-' - No correlation

23PHT202	PHYSICS FOR CIVIL ENGINEERING (For Civil Engineering)	Category: BSC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic Science Knowledge					
Course Objectives: • To introduce the basics of heat transfer through different materials, thermal performance of build in and various thermal applications • To make knowledge on the ventilation and air conditioning of buildings • To introduce the concepts of sound absorption, noise insulation and lightings designs. • To give an introduction to the processing and applications of new engineering materials. • To create an awareness on natural disasters and safety measures.					
UNIT I	THERMAL APPLICATIONS				9
Principles of heat transfer, steady state of heat flow, conduction through compound media – Series and parallel – Conductivity of rubber tube and powder materials – Heat transfer through fenestrations, thermal insulation and its benefits – Heat gain and heat loss estimation – Factors affecting the thermal performance of buildings, thermal measurements, thermal comfort, indices of thermal comfort, climate and design of solar radiation, shading devices – Central heating.					
UNIT II	VENTILATION AND REFRIGERATION				9
Requirements, principles of natural ventilation - ventilation measurements, design for natural ventilation - Window types and packaged air conditioners - chilled water plant - fan coil systems - water piping - cooling load - Air conditioning systems for different types of buildings - Protection against fire to be caused by A.C.Systems.					
UNIT III	ACOUSTICS AND LIGHTING DESIGNS				9
Methods of sound absorptions - absorbing materials - noise and its measurements, sound insulation and its measurements, impact of noise in multi stored buildings. Visual field glare, colour - day light calculations - day light design of windows, measurement of day-light and use of models and artificial skies, principles of artificial lighting,supplementary artificial lighting.					
UNIT IV	NEW ENGINEERING MATERIALS				9
Composites – Definition and classification – Fibre reinforced plastics (FRP) and fiber reinforced metals (FRM) – Metallic glasses – Shape memory alloys – Ceramics – Classification – Crystalline – Non Crystalline – Bonded ceramics, Manufacturing methods – Slip casting – Isostatic pressing – Gas pressure bonding – Properties – Thermal, mechanical, electrical and chemical ceramic fibres – Ferroelectric and					

ferromagnetic ceramics – High aluminum ceramics.																
UNIT V		NATURAL DISASTERS												9		
Seismology and Seismic waves – Earth quake ground motion – Basic concepts and estimation techniques – site effects – Probabilistic and deterministic Seismic hazard analysis – Cyclone and flood hazards – Fire hazards and fire protection, fire-proofing of materials, fire safety regulations and firefighting equipment – Prevention and safety measures.																
Total periods: 45 PERIODS																
Text Books:																
1. Marko Pinteric, Building Physics, Springer 2017.																
2. D.S. Mathur. Elements of Properties of Matter. S. Chand & Company, 2010																
3. Hugo Hens, Building Physics: Heat, Air and Moisture, Wiley, 2017.																
REFERENCE BOOKS:																
1. W.R. Stevens. Building Physics: Lighting. Pergamon Press, 2013.																
2. Hugo Hens, Applied Building Physics, Wiley, 2016																
3. K.G. Budinski and M.K. Budinski. Engineering Materials: Properties and Selection. Pearson Education, 2016.																
4. Peter A. Claisse, Civil Engineering Materials, Elsevier, 2016.																
5. Patrick L. Abbott, Natural Disasters, McGraw–Hill, 2017.																
Course Outcomes:													Blooms Taxonomy			
• Acquire knowledge about heat transfer through different materials, thermal performance of building and thermal insulation.													Understanding			
• Gain knowledge on the ventilation and air conditioning of buildings.													Understanding			
• Understand the concepts of sound absorption, noise insulation and lighting designs													Understanding			
• Know about the processing and applications of composites, metallic glasses, shape memory alloys and ceramics.													Applying			
• Get an awareness on natural disasters such as earthquake, cyclone, fire and safety measures.													Remembering			
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	2	2	-	1	1	-	-	-	-	-	-	-	-	-	

CO2	3	2	2	-	1	1	-	-	-	-	-	-	-	-	-
CO3	3	2	2	-	1	1	-	-	-	-	-	-	-	-	-
CO4	3	-	2	2	2	1	-	-	-	-	-	-	-	-	-
CO5	3	1	-	-	1	3	-	-	-	-	-	-	-	-	-
AVG	3	1.7 5	2	2	1.2	1.4	-	-	-	-	-	-	-	-	-

1 - Low, 2 - Medium, 3 - High, '-' - No correlation

23EET203	BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING (Common to BIOTECH, CIVIL, CHEMICAL)	Category: BSC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To introduce the basics of electric circuits and analysis - To impart knowledge in domestic wiring - To impart knowledge in the basics of working principles and application of electrical machines - To introduce analog devices and their characteristics - To introduce the functional elements and working of sensors and transducers.					
Unit I	ELECTRICAL CIRCUITS				9
DC Circuits:Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm’s Law - Kirchhoff’s Laws – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state) Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only), Three phase supply – star and delta connection – power in three-phase systems.					
Unit II	MAGNETIC CIRCUITS AND ELECTRICAL INSTALLATIONS				9
Magnetic circuits-definitions-MMF, flux, reluctance, magnetic field intensity, flux density, fringing, self and mutual inductances-simple problems. Domestic wiring , types of wires and cables, earthing ,protective devices- switch fuse unit- Miniature circuit breaker-moulded case circuit breaker- earth leakage circuit breaker, safety precautions and First Aid.					

Unit III	ELECTRICAL MACHINES	9
Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, Working principle and Applications of Transformer, Three phase Alternator, Synchronous motor and Three Phase Induction Motor.		
Unit IV	ANALOG ELECTRONICS	9
Resistor, Inductor and Capacitor in Electronic Circuits- Semiconductor Materials: Silicon & Germanium – PN Junction Diodes, Zener Diode – Characteristics Applications – Bipolar Junction Transistor-Biasing, JFET, SCR, MOSFET, IGBT – Types, I-V Characteristics and Applications, Rectifier and Inverters, harmonics		
Unit V	SENSORS AND TRANSDUCERS	9
Sensors, solenoids, pneumatic controls with electrical actuator, mechatronics, types of valves and its applications, electro-pneumatic systems, proximity sensors, limit switches, piezoelectric, hall effect, photo sensors, Strain gauge, LVDT, differential pressure transducer, optical and digital transducers, Smart sensors, Thermal Imagers.		
Total periods: 45		
Text Books:		
1. D P Kothari and I.J Nagarath, “Basic Electrical and Electronics Engineering”, McGraw Hill Education (India) Private Limited, Second Edition, 2020		
2. A.K. Sawhney, Puneet Sawhney ‘A Course in Electrical & Electronic Measurements & Instrumentation’, Dhanpat Rai and Co, 2015.		
3. S.K. Bhattacharya, Basic Electrical Engineering, Pearson Education, 2019		
4. James A Svoboda, Richard C. Dorf, Dorf’s Introduction to Electric Circuits, Wiley, 2018		
References:		
1. John Bird, “Electrical Circuit theory and technology”, Routledge; 2017.		
2. Thomas L. Floyd, ‘Electronic Devices’, 10th Edition, Pearson Education, 2018.		
3. Albert Malvino, David Bates, ‘Electronic Principles, McGraw Hill Education; 7th edition, 2017		
4. Muhammad H. Rashid, “Spice for Circuits and electronics”, 4th Edition Cengage India, 2019.		
5. H.S. Kalsi, ‘Electronic Instrumentation’, Tata McGraw-Hill, New Delhi, 2010		
Course Outcomes:		Blooms Taxonomy
CO1: Compute the electric circuit parameters for simple problems		Apply (K3)
CO2: Explain the concepts of domestic wiring and protective devices		Understanding (K2)
CO3: Explain the working principle and applications of electrical machines		Understanding (K2)

CO4: Analyze the characteristics of analog electronic devices													Analyze (k4)		
CO5: Explain the types and operating principles of sensors and transducers													Understanding (K2)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	2	-	-	-	2	-	-	-	3	1	-	2
CO2	3	2	2	2	-	2	2	1	-	-	-	3	1	-	2
CO3	3	2	1	-	-	-	-	1	-	-	-	3	1	-	2
CO4	2	2	2	-	-	-	-	1	-	2	-	3	1	-	2
CO5	2	1	2	-	-	-	-	1	-	2	-	3	1	-	2
CO Avg.	2.2	1.6	1.6	2		2	2	1.2		2		3	1		2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23GET201	ENGINEERING GRAPHICS	Category: ESC			
		L	T	P	C
		2	0	4	4
Prerequisites • Basic knowledge of geometry at higher secondary level • Ability to visualize simple 2D and 3D shapes • Basic skills in freehand sketchingSS					
Course Objectives: • To draw engineering curves such as ellipse, parabola, hyperbola, cycloid, and involutes. • To draw freehand sketches of simple objects and multiple views from pictorial representations. • To construct orthographic projections of points, lines, planes, and solids, including inclined and sectioned solids. • To draw the development of lateral surfaces of simple and sectioned solids like prisms, pyramids, cylinders, and cones. • To draw isometric and perspective projections of simple solids and combinations of solids.					
Unit I	PLANE CURVES				6
Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.					

Unit II	PROJECTION OF POINTS, LINES AND PLANE SURFACE	6
Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.		
Unit III	PROJECTION OF SOLIDS	6
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Visualization concepts and Free Hand sketching: Visualization principles —Representation of Three Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects. Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)		
Unit IV	PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES	6
Sectioning of above solids in simple vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones. Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)		
Unit V	ISOMETRIC AND PERSPECTIVE PROJECTIONS	6
Principles of isometric projection — isometric scale — isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids - Prisms, pyramids and cylinders by visual ray method. Practicing three dimensional modeling of isometric projection of simple objects by CAD Software (Not for examination)		
Total periods: 60		
Text Books:		
1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 53rd Edition, 2019.		
2. Natarajan K.V., “A Text Book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2018.		
3. Parthasarathy, N. S. and Vela Murali, “Engineering Drawing”, Oxford University Press, 2015		
References:		
1. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, McGraw Hill, 2nd Edition, 2019.		
2. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Publications, Bangalore, 27th Edition, 2017.		

3. Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.															
4. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson Education India, 2nd Edition, 2009.															
5. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2008.															
Course Outcomes:												Blooms Taxonomy			
CO1: Use BIS conventions and specifications for engineering drawing.												Applying(K3)			
CO2: Construct the conic curves, involutes and cycloid.												Applying(K3)			
CO3: Solve practical problems involving projection of lines.												Analyze(K4)			
CO4: Draw the orthographic, isometric and perspective projections of simple solids.												Applying(K3)			
CO5: Draw the development of simple solids.												Applying(K3)			
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2			1	2								2	1	
CO2	2	1			2								2		
CO3	3	2	1		2								3	1	
CO4	3	1		1	3								3	2	
CO5	2				2								2	1	
1 - Low, 2 - Medium, 3 - High , ‘ ‘ No correlation															

23GET202	TAMILS AND TECHNOLOGY (Common to all Programmes)		Category: BSC			
			L	T	P	C
			1	0	0	1
Prerequisites						
Unit I	WEAVING AND CERAMIC TECHNOLOGY					3
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.						
Unit II	DESIGN AND CONSTRUCTION TECHNOLOGY					3
Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.						

Unit III	MANUFACTURING TECHNOLOGY	3
Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel - Copper and gold Coins as source of history - Minting of Coins – Beads making - industries Stone beads - Glass beads - Terracotta beads - Shell beads/ bone beads - Archeological evidences - Gem stone types described in Silappathikaram		
Unit IV	AGRICULTURE AND IRRIGATION TECHNOLOGY	3
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.		
Unit V	SCIENTIFIC TAMIL & TAMIL COMPUTING	3
Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.		
Total periods: 15		
Text Books:		
1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print) .		
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.		
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).		
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)		
5. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)		
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)		
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)		
References:		
2. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.		

23GET202	தமிழரும் தொழில்நுட்பமும்	Category: HSMC			
		L	T	P	C
		1	0	0	1
Prerequisites:Nil					
அலகு I	நெய்தல் மற்றும் செராமிக் தொழில்நுட்பம்				3
சங்ககாலத்தில் நெசவுத் தொழில் – செராமிக் தொழில்நுட்பம் – கருப்பு-சிவப்பு பாண்டங்கள் (BRW) – பாண்டங்களில் காணப்படும் குறியீட்டு எழுத்துகள் (கிராஃபிட்டி).					
அலகு II	வடிவமைப்பு மற்றும் கட்டுமான தொழில்நுட்பம்				3
சங்ககாலத்தில் வீடுகளின் வடிவமைப்பும் கட்டிடக் கட்டுமான தொழில்நுட்பமும் –சங்ககால கட்டிடப் பொருட்கள் மற்றும் வீரக்கற்கள் –சிலப்பதிகாரத்தில் மேடை அமைப்புகள் பற்றிய விவரங்கள் – மாமல்லபுரத்தின் சிற்பங்களும் கோவில்களும் – சோழர்களின் மகத்தான கோவில்கள் மற்றும் பிற வழிபாட்டு தலங்கள் –நாயக்கர் கால கோவில்கள் –வகை ஆய்வு (மதுரை மீனாட்சி அம்மன் கோவில்) –திருமலை நாயக்கர் மகால் –செட்டிநாடு வீடுகள் –பிரிட்டிஷ் காலத்தில் மதராசில் உருவான இந்தோ-சராசினிக் கட்டிடக்கலை.					
அலகு III	உற்பத்தி தொழில்நுட்பம்				3
கப்பல் கட்டும் கலை – உலோக அறிவியல் ஆய்வுகள் – இரும்புத் தொழில் – இரும்புக் கரைப்பு, எஃகு தயாரித்தல் – வரலாற்று ஆதாரங்களாகப் பயன்படும் செம்பு மற்றும் பொற்காசுகள் – நாணய உற்பத்தி (மின்டிங்) – மணிகள் தயாரிக்கும் தொழில்கள்: கல் மணிகள், கண்ணாடி மணிகள், டெராக் கோட்டா மணிகள், சிப்பி/எலும்பு மணிகள் – தொல்பொருள் ஆதாரங்கள் – சிலப்பதிகாரம் குறிப்பிடும் ரத்தினக் கற்களின் வகைகள்.					
அலகு IV	வேளாண்மை மற்றும் பாசன தொழில்நுட்பம்				3
அணை, குளம், குண்டங்கள், கலங்கரை (sluice), சோழர் காலத்தின் குமிழித் தூம்பின் முக்கியத்துவம், கால்நடைப் பராமரிப்பு – மாடுகளுக்கான தனி வடிவமைப்புப் போக்குகள் கொண்ட கிணறுகள் – விவசாயமும் வேளாண் செயலாக்கமும் – கடல் அறிவு – மீன்வளம் – முத்து – சங்கு மூழ்குதல் – கடல் தொடர்பான பண்டைய அறிவு – அறிவு சார்ந்த சமூக அமைப்பு.					
அலகு V	அறிவியல் தமிழ் மற்றும் தமிழ் கணினி				3
அறிவியல் தமிழின் வளர்ச்சி – தமிழ் கணினி பயன்பாடுகள் – தமிழ் நூல்களின் மின்னாக்கம் – தமிழ் மென்பொருள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் இணைய நூலகம் – இணையத் தமிழ் அகராதிகள் – சொற்குவை திட்டம்.					
Total Periods:15					
TEXT-CUM-REFERENCE BOOKS					

1.தமிழக வரலாறு – மக்களும் பண்பாடும் – க. கி. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2.கணினித் தமிழ் – முனைவர் இள. சுந்தரம் (விகடன் பிரசுரம்)
3.கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4.பொருணை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu)(Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by:International Institute of Tamil Studies.)
9. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,Tamil Nadu).
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay)(Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu TextBookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

23GEP201	ENGINEERING PRACTICES LABORATORY	Category: ESC			
		L	T	P	C
		0	0	4	2
Prerequisites ● Basic knowledge of workshop tools and safety procedures. ● Elementary understanding of electrical, plumbing, and mechanical concepts.					
Course Objectives: ● To draw plumbing line plans and lay various pipe connections using fittings commonly used in household plumbing.					

- To perform woodworking operations such as sawing, planing, and making joints like T-joint, mortise and tenon joint, and dovetail joint.
- To wire electrical circuits including basic switchboard wiring, staircase wiring, and fluorescent lamp wiring, and assemble household electrical appliances like fans, lamps, and emergency lights.
- To perform basic welding, machining (turning, drilling, tapping), sheet metal work, and mechanical assembly of simple household equipment.
- To assemble, solder, and test simple electronic circuits and components on printed circuit boards (PCB).

CIVIL ENGINEERING PRACTICES
(CIVIL & ELECTRICAL)

PART I:**LIST OF EXPERIMENTS****PLUMBING WORK:**

a)	Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
b)	Preparing plumbing line sketches.
c)	Laying pipe connection to the suction side of a pump.
d)	Laying pipe connection to the delivery side of a pump.
e)	Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK:

a)	Sawing,
b)	Planing and
c)	Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

Wood Work Study:

a)	Studying joints in door panels and wooden furniture.
b)	Studying common industrial trusses using models.

PART II :**ELECTRICAL ENGINEERING PRACTICES**

a)	Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket
b)	Staircase wiring
c)	Fluorescent Lamp wiring with introduction to CFL and LED types.

d)	Energy meter wiring and related calculations/ calibration														
e)	Study of Iron Box wiring and assembly														
f)	Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac)														
g)	Study of emergency lamp wiring/Water heater														
Total periods: 60															
Text Books:															
1.Engineering Practices Laboratory Manual, Anna University, 2023 Edition.															
2.Kalpakistan S., Manufacturing Engineering & Technology , 7th Edition, Pearson, 2014.															
3.R.K. Rajput, A Textbook of Engineering Workshop , Laxmi Publications, 2015.															
Reference Books:															
1. Hajra Choudhury S.K., Workshop Technology, Vol. I & II, Media Promoters & Publishers Pvt. Ltd., 2008.															
2. P.Kannaiah & K.Lakshminarayana, Workshop Practice, Scitech Publications, 2012.															
3. Bawa H.S., Workshop Technology, Tata McGraw Hill, 2003.															
4. Raghuwanshi B.S., Electrical and Electronics Engineering Practice Lab Manual, Wiley India, 2016.															
Course Outcomes:													Blooms Taxonomy		
CO1: Perform plumbing work, including pipe layout, connections, and fittings.													Applying(K3)		
CO2: Demonstrate woodworking skills including sawing, planning, and making joints.													Applying(K3)		
CO3: Carry out electrical wiring tasks for common household circuits.													Applying(K3)		
CO4;Perform basic welding, machining, sheet metal work, and mechanical assembly.													Applying(K3)		
CO5: Assemble, solder, and test simple electronic circuits.													Applying(K3)		
CO – PO& PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		3			2			1				2		
CO2	2		3			2			1				2		
CO3	2		3			2			1				2		
CO4	2		3			2			1				2		
CO5	2		3			2			1				2		
1 - Low, 2 - Medium, 3 -High , ‘ ‘ No correlation															

23EEP202	BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING LABORATORY	Category: ESC			
		L	T	P	C
		0	0	4	2
Prerequisites					
Course Objectives: - To train the students in conducting load tests electrical machines - To gain practical experience in experimentally obtaining the characteristics of electronic devices and rectifiers - To train the students to measure three phase power and displacement					
LIST OF EXPERIMENTS					
1	Verification of ohms and Kirchhoff’s Laws.				
2	Three Phase Power Measurement				
3	Load test on DC Shunt Motor.				
4	Load test on Self Excited DC Generator				
5	Load test on Single phase Transformer				
6	Load Test on Induction Motor				
7	Characteristics of PN and Zener Diodes				
8	Characteristics of BJT, SCR and MOSFET				
9	Design and analysis of Half wave and Full Wave rectifiers				
10	Measurement of displacement of LVDT				
Total periods:60					
Text Books:					
1. D P Kothari and I.J Nagarath, “Basic Electrical and Electronics Engineering”, McGraw Hill Education (India) Private Limited, Second Edition, 2020					
References:					
1. A.K. Sawhney, PuneetSawhney ‘A Course in Electrical & Electronic Measurements & Instrumentation’, Dhanpat Rai and Co, 2015.					
Course Outcomes:					Blooms Taxonomy
CO1: Use experimental methods to verify the Ohm’s law and Kirchhoff’s Law and to measure three phase power					Apply (K3)
CO2: Analyse experimentally the load characteristics of electrical machines					Analyze (k4)
CO3: Analyse the characteristics of basic electronic devices					Analyze (k4)
CO4: Design Half wave and Full Wave rectifiers					Apply (K3)

CO5: Use LVDT to measure displacement													Understanding (K2)		
CO – PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	-	-	1	3	-	-	-	2	2	-
CO2	3	3	2	1	-	-	-	1	3	-	-	-	2	2	-
CO3	3	3	2	1	-	-	-	1	3	-	-	-	2	2	-
CO4	3	3	2	1	-	-	-	1	3	-	-	-	2	2	-
CO5	3	3	2	1	-	-	-	1	3	-	-	-	2	2	-
CO Avg.	3	3	2	1	-	-	-	1	3	-	-	-	2	2	-
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23GEP202	COMMUNICATION LABORATORY (Common to All Branches)	Category: EEC			
		L	T	P	C
		0	0	4	2
Prerequisites					
Course Objectives: ● To identify varied group discussion skills and apply them to take part in effective discussions in a professional context. ● To analyze concepts and problems and make effective presentations explaining them clearly and precisely. ● To be able to communicate effectively through formal and informal writing. ● To be able to use appropriate language structures to write emails, reports and essays ● To give instructions and recommendations that are clear and relevant to the context					
LIST OF EXPERIMENTS					
1	Speaking-Role Play Exercises Based on Workplace Contexts				
2	Talking about competition- discussing progress toward goals-talking about experiences-				
3	Talking about events in life- discussing past events-Writing: writing emails (formal& semi-formal).				
4	Speaking: discussing news stories-talking about frequency-talking about travel problems- discussing travel procedures- talking about travel problems				
5	Making arrangements-describing arrangements-discussing plans and decisions-				
6	Discussing purposes and reasons- understanding common technology terms-Writing: - writing different types of emails.				
7	Speaking: discussing predictions-describing the climate-discussing forecasts and scenarios- talking				

	about purchasing-discussing advantages and disadvantages
8	Making comparisons- discussing likes and dislikes- discussing feelings about experiences-
9	Discussing imaginary scenarios Writing: short essays and reports-formal/semi-formal letters.
10	Speaking: discussing the natural environment-describing systems-describing position and movement-
11	Explaining rules-(example-discussing rental arrangements)- understanding technical instructions-
12	Writing: Writing instructions-writing a short article.
13	Speaking: describing things relatively-describing clothing
14	Discussing safety issues (making recommendations) talking about electrical devices
15	Describing controlling actions- Writing: job application (Cover letter + Curriculum vitae)-writing recommendations.

Total periods: 60

Text Books:

1. English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University.
2. English for Science & Technology Cambridge University Press 2021.
3. Authored by Dr. VeenaSelvam, Dr. SujathaPriyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Jovani, Department of English, Anna University.

References:

1. Raman. Meenakshi, Sharma. Sangeeta (2019).Professional English.Oxford university press. New Delhi.
2. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, NewDelhi
3. Learning to Communicate – Dr. V. Chellammal. Allied Publishers, New Delhi, 2003
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
5. Developing Communication Skills by Krishna Mohan, MeeraBannerji- Macmillan India Ltd. 1990, Delhi.

Course Outcomes:	Blooms Taxonomy
CO1: Speak effectively in group discussions held in a formal/semi formal contexts.	RE
CO2: Discuss, analyse and present concepts and problems from various perspectives to arrive at suitable solutions	AP
CO3: Write emails, letters and effective job applications	UN
CO4: Write critical reports to convey data and information with clarity and precision	AP
CO5: Give appropriate instructions and recommendations for safe execution of	AP

tasks															
CO – PO& PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	0	0	0	0	0	2	2	2	3	2	3	-	-	-
CO2	1	0	0	0	0	0	2	2	2	3	2	3	-	-	-
CO3	1	0	0	0	0	0	2	2	2	3	2	3	-	-	-
CO4	1	0	0	0	0	0	2	2	2	3	2	3	-	-	-
CO5	1	0	0	0	0	0	2	2	2	3	2	3	-	-	-
CO Avg.	1	0	0	0	0	0	2	2	2	3	2	3	-	-	-
1 - Low, 2 - Medium, 3 -High , ‘-‘ No correlation2															

SEMESTER III

23MAT301	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS (B.E. CIVIL, MECH, BIOMED, ECE, EEE & B.TECH. BIOTECH, CHEM)	Category: BSC			
		L	T	P	C
		3	1	0	4
Prerequisites • Basic Mathematical Knowledge • Matrices and Calculus					
Course Objectives: ➤ To introduce the basic concepts of PDE for solving standard partial differential equations. ➤ To introduce Fourier series analysis this is central to many applications in engineering apart from its use in solving boundary value problems. ➤ To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations. ➤ To acquaint the student with Fourier transform techniques used in wide variety of situations. ➤ To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.					
Unit I	PARTIAL DIFFERENTIAL EQUATIONS				9+3
Formation of partial differential equations –Solutions of standard types of first order partial differential equations - First orders partial differential equations reducible to standard types- Lagrange’s linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.					
Unit II	FOURIER SERIES				9+3
Dirichlet’s conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value – Parseval’s identity – Harmonic analysis.					
Unit III	APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS				9+3
Classification of PDE – Method of separation of variables - Fourier series solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (Cartesian coordinates only).					
Unit IV	FOURIER TRANSFORMS				9+3
Statement of Fourier integral theorem– Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval’s identity.					

Unit V	Z - TRANSFORMS AND DIFFERENCE EQUATIONS	9+3
Z-transforms - Elementary properties – Convergence of Z-transforms - – Initial and final value theorems - Inverse Z-transform using partial fraction and convolution theorem - Formation of difference equations – Solution of difference equations using Z - transforms.		
Total periods:60 PERIODS		
Text Books:		
1. Grewal B.S., "Higher Engineering Mathematics" 44th Edition, Khanna Publishers, New Delhi, 2018.		
2. Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2016.		
References:		
1. Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.		
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications Pvt. Ltd, 2015.		
3. James. G., "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, New Delhi, 2016.		
4. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.		
5. Wylie. R.C. and Barrett . L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.		
Course Outcomes:		Blooms Taxonomy
CO 1: Understand how to solve the given standard partial differential equations.		Understanding
CO2: Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.		Applying
CO3: Apply the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.		Applying
CO4: Conclude the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.		Analyzing
CO5: Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.		Understanding
CO-PO Mapping		

Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	1	-	-	-	-	-	1	-	-	-
CO2	3	3	3	3	-	1	-	-	-	-	-	1	-	-	-
CO3	3	3	3	3	-	1	-	-	-	-	-	1	-	-	-
CO4	3	3	3	3	-	1	-	-	-	-	-	1	-	-	-
CO5	3	3	3	3	-	1	-	-	-	-	-	1	-	-	-
AVG	3	3	3	3	-	1	-	-	-	-	-	1	-	-	-

23MET301	ENGINEERING MECHANICS	Category: ESC			
		L	T	P	C
		3	0	0	3
Prerequisites:					
Course Objectives: - To Learn the use scalar and vector analytical techniques for analyzing forces in Statically determinate structures - To introduce the equilibrium of rigid bodies - To study and understand the distributed forces, surface, loading on beam and intensity. - To learn the principles of friction, forces and to determine the apply the concepts of frictional forces at the contact surfaces of various engineering systems.					
Unit I	STATICS OF PARTICLES				9
Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles -Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors. Equilibrium of a Particle- Newton’s First Law of Motion, Space and Free-Body Diagrams.					
Unit II	EQUILIBRIUM OF RIGID BODIES				9
Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point, Varignon’s Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force -Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - Reactions at Supports and Connections.					

Unit III	DISTRIBUTED FORCES	9
Centroids of lines and areas — symmetrical and unsymmetrical shapes, Determination of Centroids by Integration, Theorems of Pappus-Guldinus, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies, Determination of Centroids of Volumes by Integration. Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration, Polar Moment of Inertia, Radius of Gyration of an Area, Parallel-Axis Theorem, Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates, Determination of the Moment of Inertia of a Three-Dimensional Body by Integration		
Unit IV	FRICTION	9
The Laws of Dry Friction, Coefficients of Friction, Angles of Friction, Wedge friction, Wheel Friction, Rolling Resistance, Ladder friction.		
Unit V	DYNAMICS OF PARTICLES	9
Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion -Equations of Motions, Projectiles - Principle of Work and Energy, Principle of Impulse and		
Total periods: 45 PERIODS		
Text Books:		
1. Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 11th Edition, 2017		
2. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.		
References:		
1. Boresi P and Schmidt J, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage Learning, 2008		
2. Hibbeler, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.		
3 Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, 4th Edition, Pearson Education Asia Pvt. Ltd., 2005		
4. Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013		
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.		
6. Timoshenko S, Young D H, Rao J V and Sukumar Pati, Engineering Mechanics, 5th Edition, McGraw Hill Higher Education, 2013.		
Course Outcomes:		Blooms Taxonomy
CO 1: Illustrate the vectorial and scalar representation of forces and moments.		K2
CO2: Analyse the rigid body in equilibrium.		K4

CO3: Evaluate the properties of distributed forces													K5		
CO4: Determine the friction and the effects by the laws of friction													K2		
CO5: Calculate dynamic forces exerted in rigid body													K4		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	0	0	0	0	0	0	0	0	0	0	3	0	0
CO2	3	3	0	2	0	0	0	0	0	0	0	0	3	0	0
CO3	3	2	0	2	0	0	0	0	0	0	0	0	3	0	0
CO4	2	2	0	1	0	0	0	0	0	0	0	0	2	0	0
CO5	3	3	0	2	1	0	0	0	0	0	0	0	3	0	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CET302	FLUID MECHANICS	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites: Nil					
Course Objectives: To introduce the students about properties and behaviour of the fluids under static conditions and to impart basic knowledge of the dynamics of fluids through the control volume approach and to expose to the applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on pipe bends with an exposure to the significance of boundary layer theory and its applications.					
Unit I	FLUIDS PROPERTIES AND FLUID STATICS				9
Scope of fluid mechanics – Definitions of a fluid – Methods of analysis – Continuum hypothesis – System and Control volume approach – Reynold’s transportation theorem – Fluid properties – Fluid statics					
Unit II	BASIC CONCEPTS OF FLUID FLOW				9
Kinematics: Classification of flows – Streamline, streak-line and path-lines – Stream function and velocity potentials — Flow nets; Dynamics: Application of control volume to continuity, energy and momentum – Euler’s equation of motion along a stream line – Bernoulli’s equation – Applications to velocity and discharge measurements – Linear momentum equation – Application to Pipe bends.					
Unit III	DIMENSIONAL ANALYSIS AND MODEL STUDIES				9

Fundamental dimensions – Dimensional homogeneity – Rayleigh’s method and Buckingham Pi theorem – Dimensionless parameters – Similitude and model studies – Distorted and undistorted		
Unit IV	INCOMPRESSIBLE VISCOUS FLOW	9
Reynolds experiment – Laminar flow in pipes and between parallel plates – Development of laminar and turbulent flows in pipes – Darcy-Weisbach equation – Moody diagram – Major and minor losses of flow in pipes – Total energy line – Hydraulic grade line – Siphon – Pipes in series and parallel – Equivalent pipes.		
Unit V	BOUNDARY LAYERS	9
Definition of boundary layers – Laminar and turbulent boundary layers – Displacement, momentum and energy thickness – Momentum integral equation – Applications – Separation of boundary layer Drag and Lift forces.		
Total periods: 45 PERIODS		
Text Books:		
1. Modi P.N and Seth Hydraulics and Fluid Mechanics including Hydraulic Machines Standard Book House New Delhi. Edition 22, 2015		
2. Streeter, V.L. Wylie, E. B. and Bedford K.W, Fluid Mechanics. (9 th Ed.) Tata McGraw Hill, New Delhi, 2017.		
References:		
1. S K Som; Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., Edition 3 rd , 2017.		
2. Pani B S, Fluid Mechanics: A Concise Introduction, Prentice Hall of India Private Ltd, 2016.		
3 Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.		
4. Narayana Pillai N. Principles of Fluid Mechanics and Fluid Machines, (3 rd Ed.) University Press (India) Pvt. Ltd. 2009.		
Course Outcomes:		Blooms Taxonomy
CO 1: Demonstrate the difference between solid and fluid, its properties and behaviour in static conditions.		K2
CO2: Apply the conservation laws applicable to fluids and its application through fluid kinematics and dynamics.		K3
CO3: Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performance of prototypes by model studies.		K4
CO4: Estimate the losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel.		K4

CO5: Explain the concept of boundary layer and its application to find the drag force exerted by the fluid on the flat solid surface													K2		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	0	0	0	0	0	0	0	0	0	3	0	0
CO2	3	3	0	2	1	0	0	0	0	0	0	0	3	0	0
CO3	3	3	2	2	0	0	0	0	0	0	0	0	3	2	0
CO4	3	3	2	2	0	0	0	0	0	0	0	0	3	0	0
CO5	3	2	2	1	0	0	0	0	0	0	0	0	3	2	0
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23CET303	BUILDING MATERIALS AND CONSTRUCTION	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites: Nil					
Course Objectives: To introduce students to various building materials and construction that are commonly used in civil engineering construction					
Unit I	STONES – BRICKS – CLAY PRODUCTS				9
Stones: Stone as building material – Criteria for selection – Tests on stones – Deterioration and Preservation of stonework. Bricks: Classification – Manufacturing of clay bricks – Tests on bricks. Clay products: Tiles, Terracotta, Stoneware, Earthenware, Porcelain.					
Unit II	LIME – CEMENT – AGGREGATES – CONCRETE				9
Lime: Constituents of Limestone, Classification of lime. Cement: Constituents of cement, Manufacturing of cement, Various types of cement and its importance in construction field. Aggregates: Types of aggregates, characteristics of aggregates. Concrete: Grading of concrete, Properties of Concrete. Concrete blocks.					
Unit III	MASONRY AND TIMBER				9
Masonry: Types of masonry - Types of stone masonry - Various bonds in Brick Masonry – Cavity walls and Partition walls. Timber: Requirements of a good timber, Seasoning of timber. Classification of timber and defects in timber.					

Unit IV	BASIC BUILDING COMPONENTS AND BUILDING FINISHING												9		
Basic Building Components: Roofs - Requirements of good roofs and Classification of roofs. Floors - Different types of floors - Damp proof course. Types of foundations. Building Finishing: Plastering, Pointing. Painting – Constituents of a paint – Types of paints, white washing and distempering. Form work and scaffolding.															
Unit V	MODERN AND SMART MATERIALS												9		
Modern Materials: Steel, Aluminum, Glass, Bitumen, Geosynthetics and their applications. Glass Fibre Reinforced Plastic - Bamboo reinforced concrete – Foam concrete. Smart Materials: Smart and Intelligent Materials for intelligent buildings - Case studies showing the applications of smart and Intelligent Materials.															
Total periods: 45 PERIODS															
Text Books:															
1 Varghese.P.C, “Building Materials”, Second Edition PHI Learning Ltd., 2015.															
2. Arora S.P and Bindra S.P “Building construction”, Dhanpat Rai and sons,2013															
3. Rajput. R.K., "Engineering Materials", S. Chand and Company Ltd., 2014.															
4. Duggal.S.K., "Building Materials", 4th Edition, New Age International, 2009															
References:															
1. Varghese.P.C, “Building Construction”, Second Edition PHI Learning ltd., 2016															
2. Punmia , B.C “Building construction”, Laxmi publication (p)ltd.,2008.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Identify the properties and applications of common building materials.													K2		
CO2: Demonstrate how materials are manufactured and assembled into building component parts.													K4		
CO3: Recognize the market forms of timber and various forms bond in building construction.													K4		
CO4: Illustrate various building components and finishing’s in building construction.													K2		
CO5: Understand the importance of modern and intelligent materials in building construction													K2		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	0	0	0	0	0	0	0	0	0	0	3	0	0
CO2	3	2	0	2	0	0	0	0	0	0	0	0	0	2	0

CO3	2	2	1	0	0	0	0	0	0	0	0	0	2	0	0
CO4	2	2	2	0	0	0	0	0	0	0	0	0	2	1	0
CO5	2	2	0	0	1	0	0	0	0	0	0	0	1	0	0
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CET304	WATER SUPPLY AND WASTEWATER ENGINEERING	Category: PCC			
		L	T	P	C
		4	0	0	4
Prerequisites					
Course Objectives: To introduce students to various components and design of water supply scheme, water treatment methods, water storage distribution system, sewage treatment and disposal and deign of intake structures and sewerage system					
Unit I	WATER SUPPLY				12
Estimation of surface and subsurface water resources - Predicting demand for water- Impurities of water and their significance - Physical, chemical and bacteriological analysis - Waterborne diseases Standards for potable water. Intake of water: Pumping and gravity schemes.					
Unit II	WATER TREATMENT				12
Objectives - Unit operations and processes - Principles, functions, and design of water treatment plant units, aerators of flash mixers, Coagulation and flocculation - sand filters - Disinfection - softening, removal of iron and manganese - Defluoridation - Softening - Desalination process - Residue Management - Construction, Operation and Maintenance aspects					
Unit III	WATER STORAGE AND DISTRIBUTION				12
Storage and balancing reservoirs - types, location and capacity. Distribution system: layout, hydraulics of pipelines, pipe fittings, valves including check and pressure reducing valves, meters, analysis of distribution systems, leak detection, maintenance of distribution systems, pumping stations and their operations.					
Unit IV	PLANNING AND DESIGN OF SEWERAGE SYSTEM				12
Characteristics and composition of sewage - Population equivalent - Sanitary sewage flow estimation - Sewer materials - Hydraulics of flow in sanitary sewers - Sewer design - Storm Drainage-Storm runoff estimation - Sewer appurtenances - Corrosion in sewers - Prevention and control — Sewage pumping-drainage in buildings - Plumbing systems for drainage					

Unit V	SEWAGE TREATMENT AND DISPOSAL	12
Objectives - Selection of Treatment Methods - Principles, Functions, - Activated Sludge Process and - Trickling filters - Sequencing Batch Reactor(SBR) - UASB - Reclamation and Reuse of sewage - Recent Advances in Sewage Treatment - Construction, Operation and Maintenance aspects. - Discharge standards-sludge treatment -Disposal of sludge		
PERIODS		Total periods: 60
Text Books:		
1. Garg, S.K. Environmental Engineering, Vol.I Khanna Publishers, New Delhi, 2010.		
2. Modi, P.N., Water Supply Engineering, Vol.I Standard Book House, New Delhi, 2016		
3. Garg, S.K., Environmental Engineering Vol.II, Khanna Publishers, New Delhi, 2015		
4. Duggal K.N., “Elements of Environmental Engineering” S. Chand and Co. Ltd., New Delhi,2014.		
5. Punmia, B.C., Jain, A.K., and Jain.A.K., Environmental Engineering, Vol.II, Laxmi Publications, 2010.		
References:		
1. Punmia B.C, Ashok Jain and Arun Jain, Water Supply Engineering, Laxmi Publications (P)Ltd., New Delhi 2010		
2. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999		
3. Syed R. Qasim and Edward M. Motley Guang Zhu, Water Works Engineering Planning, Design and Operation, Prentice Hall of India Learning Private Limited, New Delhi, 2009.		
4. Metcalf and Eddy – Waste water Engineering – Treatment and Reuse, Tata Mc. Graw – Hill Company, New Delhi, 2010		
5. Syed R.Qasim “Waste water Treatment Plants”, CRC Press, Washington D.C.,2010		
6. Gray N.F, “Water Technology”, Elsevier India Pvt. Ltd. New Delhi, 2006		
Course Outcomes:		Blooms Taxonomy
CO 1: Understand the various components of water supply scheme and design of intake structure and conveyance system for water transmission		K2
CO2: Understand on the characteristics and composition of sewage, ability to estimate sewage generation and design sewer system including sewage pumping stations		K2
CO3: Understand the process of conventional treatment and design of water and wastewater treatment system and gain knowledge of selection of treatment process		K2

and biological treatment process															
CO4: Ability to design and evaluate water distribution system and water supply in buildings and understand the self-purification of streams and sludge and septage disposal methods													K4		
CO5: Able to understand and design the various advanced treatment system and knowledge about the recent advances in water and wastewater treatment process and reuse of sewage													K2		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	0	0	0	0	0	0	0	1	3	2	0
CO2	3	3	2	2	0	0	0	0	0	0	0	1	3	2	0
CO3	3	2	2	2	1	0	0	0	0	0	0	1	3	2	2
CO4	3	3	2	2	1	0	0	0	0	0	0	1	3	2	1
CO5	3	2	2	2	1	0	0	0	0	0	0	1	3	2	3
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23CET305	SURVEYING AND LEVELLING	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites: Nil					
Course Objectives: - To introduce the rudiments of plane surveying and geodetic principles to Civil Engineers and to learn the various methods of plane and geodetic surveying to solve the real world problems. - To introduce the concepts of Control Surveying. To introduce the basics of Astronomical Surveying					
Unit I	FUNDAMENTALS OF CONVENTIONAL SURVEYING				9
Definition – Classifications – Basic principles – Equipment and accessories for ranging and chaining Methods of ranging – Well conditioned triangles – Chain traversing – Compass – Basic principles – Types – Bearing – Sources of errors and Local attraction – Magnetic declination – Dip – compass traversing – Plane table and its accessories – Radiation – Intersection – Resection – Plane table traversing					

Unit II	LEVELLING	9
Level line – Horizontal line – Datum – Benchmarks – Levels and staves – Temporary and permanent adjustments – Methods of leveling – Fly leveling – Check leveling – Procedure in leveling – Booking – Reduction – Curvature and refraction – Reciprocal leveling – Precise leveling – Contouring		
Unit III	THEODOLITE SURVEYING	9
Horizontal and vertical angle measurements – Temporary and permanent adjustments – Heights and distances – Tacheometric surveying – Stadia Tacheometry – Tangential Tacheometry – Trigonometric leveling – Single Plane method – Double Plane method.		
Unit IV	CONTROL SURVEYING AND ADJUSTMENT	9
Horizontal and vertical control – Methods – Triangulation – Traversing – Gale's table – Trilateration – Concepts of measurements and errors – Error propagation and Linearization – Adjustment methods - Least square methods – Angles, lengths and levelling network		
Unit V	MODERN SURVEYING	9
Total Station: Digital Theodolite, EDM, Electronic field book– Parts and accessories – Working principle – Observables – Errors - COGO functions – Field procedure and applications. GPS: Advantages – System components – Signal structure – Selective availability and antispoofing receiver components and antenna – Planning and data acquisition – Data processing – Errors in GPS – Field procedure and applications		
Total periods: 45 PERIODS		
Text Books:		
1. Dr. B. C. Punmia, Ashok K. Jain and Arun K Jain, Surveying Vol. I & II, Lakshmi Publications Pvt Ltd, New Delhi, Sixteenth Edition, 2016.		
T. P. Kanetkar and S. V. Kulkarni, Surveying and Levelling, Parts 1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 2008.		
References:		
1.R. Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012		
2. James M. Anderson and Edward M. Mikhail, Surveying, Theory and Practice, Seventh Edition, Mc Graw Hill 2001.		
3. Bannister and S. Raymond, Surveying, Seventh Edition, Longman 2004.		
4. S. K. Roy, Fundamentals of Surveying, Second Edition, Prentice^ Hall of India 2010.		
5. K. R. Arora, Surveying Vol I & II, Standard Book house, Twelfth Edition 2013.		
6.C. Venkatramaiah, Textbook of Surveying, Universities Press, Second Edition, 2011.		
Course Outcomes:		Blooms Taxonomy

CO 1: Introduce the rudiments of various surveying and its principles													K2		
CO2: Imparts knowledge in computation of levels of terrain and ground features													K2		
CO3: Imparts concepts of Theodolite Surveying for complex surveying operations													K2		
CO4: Understand the procedure for establishing horizontal and vertical control													K2		
CO5: Imparts the knowledge on modern surveying instruments													K2		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	0	0	0	0	0	0	0	0	0	1	3	1	0
CO2	3	2	1	2	0	0	0	0	0	0	0	1	3	1	0
CO3	3	2	2	2	1	0	0	0	0	0	0	1	3	2	1
CO4	3	2	2	2	1	0	0	0	0	0	0	1	3	2	1
CO5	3	2	2	2	2	0	0	0	0	0	0	1	3	2	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEP301	SURVEYING AND LEVELLING LABORATORY	Category: PCC			
		L	T	P	C
		0	0	3	1.5
Prerequisites • Surveying and levelling					
Course Objectives: • At the end of the course the student will possess knowledge about survey field techniques					
LIST OF EXPERIMENTS					
1	Study of chains and its accessories, Aligning, Ranging, Chaining and Marking Perpendicular offset				
2	Setting out works – Foundation marking using tapes single Room and Double Room				
3	Compass Traversing – Measuring Bearings & arriving included angles				
4	Fly levelling using Dumpy level & Tilting level				
5	Check levelling				
6	Measurements of horizontal angles by reiteration and repetition and vertical angles				
7	Determination of elevation of an object using single plane method when base is Accessible/inaccessible				
8	Determination of Tacheometric Constants				
9	Heights and distances by stadia Tacheometry				

10	Heights and distances by Tangential Tacheometry														
11	Traverse using Total station and Area of Traverse														
12	Determination of distance and difference in elevation between two inaccessible points using Total station														
Total periods: 45 Periods															
References:															
1. T. P. Kanetkar and S. V. Kulkarni, Surveying and Levelling, Parts 1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 24 th Reprint, 2015															
2. Dr. B. C. Punmia, Ashok K. Jain and Arun K Jain, Surveying Vol. I & II, Lakshmi Publications Pvt Ltd, New Delhi, 17 th Edition, 2016															
3. James M. Anderson and Edward M. Mikhail, Surveying, Theory and Practice, Seventh Edition, McGraw Hill 2001															
4. Bannister and S. Raymond, Surveying, Seventh Edition, Longman 2004 a. David Clark, Plane and Geodetic Surveying for Engineers, Volume I, Constable and Company Ltd, London, CBS, 6 th Edition, 2004.															
5. David Clark and James Clendinning, Plane and Geodetic Surveying for Engineers, Volume II, Constable and Company Ltd, London, CBS, 6 th Edition, 2004.															
6. S. K. Roy, Fundamentals of Surveying, Second Edition, Prentice 'Hall of India 2004															
7. K. R. Arora, Surveying Vol. I & II, Standard Book house, Eleventh Edition, 2013															
Course Outcomes:													Blooms Taxonomy		
CO1: Impart knowledge on the usage of basic surveying instruments like chain/tape, compass and levelling instruments													K2		
CO2: Able to use levelling instrument for surveying operations													K2		
CO3: Able to use theodolite for various surveying operations													K2		
CO4: Able to carry out necessary surveys for social infrastructures													K2		
CO5: Able to prepare planimetric maps													K2		
CO – PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	0	1	1	0	0	0	0	0	0	1	3	1	0
CO2	3	2	1	2	0	0	0	0	0	0	0	1	3	1	0
CO3	3	2	2	2	2	0	0	0	0	0	0	1	3	2	1
CO4	3	2	2	2	1	0	1	1	0	0	0	1	3	2	2
CO5	3	2	2	2	2	0	1	1	1	0	0	1	3	2	2

1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation					
23CEP302	WATER AND WASTEWATER ANALYSIS LABORATORY	Category: ESC			
		L	T	P	C
		0	0	3	1.5
Prerequisites Water supply and wastewater engineering					
Course Objectives: This subject includes the list of experiments to be conducted for characterization of water and municipal sewage. At the end of the course, the student is expected to be aware of the procedure for quantifying quality parameters for water and sewage.					
LIST OF EXPERIMENTS					
1	Sampling and preservation methods for water and wastewater (Demonstration only)				
2	Measurement of Electrical conductivity and turbidity				
3	Determination of fluoride in water by spectrophotometric method /ISE				
4	Determination of iron in water (Demo)				
5	Determination of Sulphate in water				
6	Determination of Optimum Coagulant Dosage by Jar test apparatus				
7	Determination of available Chlorine in Bleaching powder and residual chlorine in water				
8	Estimation of suspended, volatile and fixed solids				
9	Determination of Sludge Volume Index in wastewater				
10	Determination of Dissolved Oxygen				
11	Estimation of B.O.D				
12	Estimation of C.O.D				
13	Determination of TKN and Ammonia Nitrogen in wastewater				
14	Determination of total and faecal coliform (Demonstration only)				
Total periods: 45 Periods					
References:					
1. APHA, "Standard Methods for the Examination of Water and Waste water", 22 nd Ed. Washington, 2012					
2. "Laboratory Manual for the Examination of water, wastewater soil Rump", H.H. and Krist,H. – Second Edition, VCH, Germany, 3rd Edition, 1999					
3. "Methods of air sampling & analysis",James P.Lodge Jr(Editor) 3rd Edition, Lewis					

publishers,Inc,USA,1989.															
Course Outcomes:													Blooms Taxonomy		
CO1: Calibrate and standardize the equipment													K4		
CO2: Collect proper sample for analysis													K3		
CO3: To know the sample preservation methods													K2		
CO4: To perform field oriented testing of water, wastewater													K3		
CO5: To perform coliform analysis													K3		
CO – PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	0	1	1	0	0	0	0	0	0	1	3	1	0
CO2	3	2	1	2	0	0	0	0	0	0	0	1	3	1	0
CO3	3	2	2	2	2	0	0	0	0	0	0	1	3	2	1
CO4	3	2	2	2	1	0	1	1	0	0	0	1	3	2	2
CO5	3	2	2	2	2	0	1	1	1	0	0	1	3	2	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

SEMESTER IV

23CET401	APPLIED HYDRAULICS ENGINEERING	Category: PCC			
		L	T	P	C
		3	1	0	4
Prerequisites • Engineering Mechanics • Fluid Mechanics • Physics Fundamentals.					
Course Objectives: • To impart basic knowledge to the students about the open channel flows with analysis of uniform flow, gradually varied flow and rapidly varied flow and to expose them to basic principles of working of hydraulic machineries and to design Pelton wheel, Francis and Kaplan turbine, Centrifugal and Reciprocating pumps.					
Unit I	UNIFORM FLOW				9+3
Definition and differences between pipe flow and open channel flow - Types of Flow - Properties of open channel - Fundamental equations - Sub-critical, Super-critical and Critical flow – Velocity distribution in open channel - Steady uniform flow: Chezy’s equation, Manning equation - Best hydraulic sections for uniform flow - Computation in Uniform Flow - specific force.					
Unit II	VARIED FLOWS				9+3
Dynamic equations of gradually varied - Water surface flow profile classifications: Hydraulic Slope, Hydraulic Curve - Profile determination by Numerical method: Direct step method and Standard step method.					
Unit III	RAPIDLY VARIED FLOWS				9+3
Application of the momentum equation for RVF - Hydraulic jumps - Types - Energy dissipation — Positive and Negative surges.					
Unit IV	TURBINES				9+3
Turbines - Classification - Impulse turbine — Pelton wheel - Reaction turbines - Francis turbine - Kaplan turbine - Draft tube - Cavitation - Performance of turbine - Specific speed - Runaway speed.					
Unit V	PUMPS				9+3
Centrifugal pumps - Minimum speed to start the pump - NPSH - Cavitation’s in pumps - Operating characteristics - Multistage pumps - Reciprocating pumps - Negative slip - Indicator diagrams and its variations - Air vessels - Savings in work done.					
Total periods: 60 PERIODS					

Text Books:															
1. Jain. A.K., Fluid Mechanics, Khanna Publishers, Delhi, 2010															
2.Chandramouli P N, Applied Hydraulic Engineering, Yes Dee Publisher, 2017.															
References:															
1. Ven Te Chow, Open Channel Hydraulics, McGraw Hill, New York, 2009.															
2. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 19th edition, 2013.															
3. Mays L. W., Water Resources Engineering, John Wiley and Sons (WSE), New York, 2019															
4. Subramanya K., Flow in open channels, Tata McGraw Hill, New Delhi, 2019.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Describe the basics of open channel flow, its classification and analysis of uniform flow in steady state conditions with specific energy concept and its application.													K2		
CO2: Analyse steady gradually varied flow, water surface profiles and its length calculation using direct and standard step methods with change in water surface profiles due to change in grades.													K4		
CO3: Derive the relationship among the sequent depths of steady rapidly varied flow and estimating energy loss in hydraulic jump with exposure to positive and negative surges.													K3		
CO4: Design turbines and explain the working principle.													K2		
CO5: Differentiate pumps and explain the working principle with characteristic curves and design centrifugal and reciprocating pumps.													K5		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	–	–	–	–	1	–	2	3	2	1
CO2	3	3	2	3	2	–	–	–	–	1	–	2	3	3	2
CO3	3	3	2	3	2	–	–	–	–	1	–	2	3	3	2
CO4	3	2	3	2	2	–	–	–	–	1	–	2	2	3	3
CO5	3	2	3	2	3	–	–	–	–	1	–	2	2	3	3
1 - Low, 2 - Medium, 3 - High , ‘–’ No correlation															

23CET402	STRENGTH OF MATERIALS		Category: PCC			
			L	T	P	C
			3	0	0	3
Prerequisites Engineering Mechanics						
Course Objectives: To learn the fundamental concepts of Stress in simple and complex states and to know the mechanism of load transfer in beams and the induced stresses due to simple bending and unsymmetrical bending and to determine the deformation in determinate beams and to know the basic concepts of analysis of indeterminate beams.						
Unit I	STRESS, STRAIN AND DEFORMATION OF SOLIDS					9
Simple Stresses and Strains – Elastic constants – Relationship between elastic constants – Stress Strain Diagram – Deformation of axially loaded member – Composite Bars – Thermal Stresses – Principal Stresses and Principal Planes – Mohr's circle method (Concepts only).						
Unit II	SHEAR FORCE & BENDING MOMENT AND BENDING STRESS					9
Types of beams and transverse loadings– Shear force and bending moment for simply supported, cantilever and over-hanging beams - Theory of simple bending – Bending stress distribution – Shear stress distribution.						
Unit III	DEFLECTION OF BEAMS					9
Double Integration method – Macaulay’s method – Area moment method – Conjugate beam method						
Unit IV	INDETERMINATE BEAMS					9
Propped Cantilever and Fixed Beams – Fixed end moments, SFD and BMD for standard load cases – Simply Supported Continuous beams (Using Theorem of three moments) – support reactions and moments – Shear Force and Bending Moment Diagrams.						
Unit V	THEORIES OF FAILURE					9
Various Theories of Failures - Maximum Principal stress theory, Maximum Principal strain theory, Maximum shear stress theory, Maximum strain energy theory, Maximum shear strain energy theory – application problems.						
Total periods: 45PERIODS						
Text Books:						
1. Bansal R.K. "Strength of Materials (Mechanics of Solids)", Lakshmi Publication (P) LTD, New Delhi, VII – Edition, 2023.						

2. Rajput R.K. "Strength of Materials (Mechanics of Solids)", S.Chand & Company Ltd., New Delhi, 2018.															
3. Punmia B.C., Ashok Kumar Jain and Arun Kumar Jain,"Theory of Structures" (SMTS) Vol -II,Laxmi Publishing Pvt Ltd, New Delhi 2017.															
4. Vazirani.V.N, Ratwani.M.M, Duggal .S.K Analysis of Structures: Analysis, Design and Detailing of Structures-Vol.1, Khanna Publishers, New Delhi 2014.															
References:															
1. Kazimi S.M.A, "Solid Mechanics", Tata McGraw-Hill Publishing Co., New Delhi, 2017.															
2. William A . Nash, "Theory and Problems of Strength of Materials", Schaum's Outline Series,Tata McGraw Hill Publishing company, 2017.															
3. Singh. D.K., "Strength of Materials", Ane Books Pvt. Ltd., New Delhi, 2021															
4. Egor P Popov, "Engineering Mechanics of Solids", 2 nd edition, PHI Learning Pvt. Ltd., NewDelhi, 2015															
5. Irwing H.Shames, James M.Pitarresi, Introduction to Solid Mechanics, Prentice Hall of India, New Delhi, 2002.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Understand the concepts of stress and strain, principal stresses and principal planes.													K2		
CO2 Determine Shear force and bending moment in beams and understand concept of theory of simple bending.													K2		
CO3 Calculate the deflection of beams by different methods and selection of method for determining slope or deflection.													K4		
CO4 Analyze propped cantilever, fixed beams and continuous beams for external loadings.													K4		
CO5 Imparts the concepts of failures in the material considering different theories.													K4		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	-	-	-	-	1	1	2	3	2	1
CO2	3	3	3	2	1	-	-	-	-	1	1	2	3	3	1
CO3	3	2	3	3	1	-	-	-	-	1	1	3	3	2	2
CO4	3	3	3	3	1	-	-	-	-	1	1	3	3	3	2
CO5	3	2	2	1	-	-	-	-	-	1	1	2	2	3	1

1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation					
23CET403	CONCRETE TECHNOLOGY	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites Building Materials and Construction					
Course Objectives: - To study the properties of concrete making materials. - To have better knowledge about the chemical and mineral admixtures in concrete. - To familiarize with the IS method of mix design as per the latest code. - To understand the fresh and hardened properties of concrete. To know the importance and applications of special concretes.					
Unit I	CONSTITUENT MATERIALS				9
Chemical composition and Properties of cement - Tests on cement-IS Specifications- Aggregates- Classification-Mechanical properties and tests as per BIS Grading Requirements-Water- Quality of water for use in concrete.					
Unit II	CHEMICAL AND MINERAL ADMIXTURES				9
Accelerators-Retarders- Plasticizers- Super plasticizers- Water proofers - Mineral Admixtures like Fly Ash, Silica Fume, Ground Granulated Blast Furnace Slag and Metakaolin -Their effects on concrete properties.					
Unit III	PROPORTIONING OF CONCRETE MIX				9
Principles of Mix Proportioning-Properties of concrete related to Mix Design-Physical properties of materials required for Mix Design - Design Mix and Nominal Mix-BIS Method of Mix Design - Mix Design Examples.					
Unit IV	FRESH AND HARDENED PROPERTIES OF CONCRETE				9
Workability-Tests for workability of concrete-Slump Test and Compacting factor Test-Segregation and Bleeding-Determination of Compressive and Flexural strength as per BIS - Properties of Hardened concrete- Stress-strain curve for concrete-Determination of Modulus of elasticity.					
Unit V	SPECIAL CONCRETES				9
Light weight concretes - High strength concrete - Fibre reinforced concrete – Ferrocement - Ready mix concrete - SIFCON - Shotcrete — Polymer concrete - High performance concrete- self compacting concrete - Geopolymer Concrete.					
Total periods: 45 PERIODS					
Text Books:					

1. Shetty,M.S, "Concrete Technology", S.Chand and Company Ltd, New Delhi, 2003															
2. Gupta.B.L., Amit Gupta, "Concrete Technology", Jain Book Agency, 2010.															
References:															
1. Neville, A.M; "Properties of Concrete", Pitman Publishing Limited, London,1995															
2. Gambhir.M.L.Concrete Technology,Fifth Edition, McGraw Hill Education,2017.															
3. Job Thomas., Concrete Technology, Cengage learning India Private Ltd, New Delhi, 2015.															
4. IS10262-2019 Recommended Guidelines for Concrete Mix Design, Bureau of IndianStandards, New Delhi															
Course Outcomes:													Blooms Taxonomy		
CO 1 Understand the requirements of cement, aggregates and water for concrete.													K2		
CO2 Select suitable admixtures for enhancing the properties of concrete													K3		
CO3 Design concrete mixes as per IS method of mix design													K5		
CO4 Determine the properties of concrete at fresh and hardened state.													K5		
CO5 Know the importance of special concretes for specific requirements.													K2		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	–	–	–	–	–	1	1	2	3	3	2
CO2	3	3	2	2	–	–	–	–	–	1	1	2	3	3	2
CO3	3	3	3	3	–	–	–	–	–	1	1	3	3	3	3
CO4	3	3	3	3	–	–	–	–	–	1	1	3	3	3	3
CO5	2	2	2	1	–	–	–	–	–	1	1	3	2	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CET404	SOIL MECHANICS	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites • Engineering Mechanics					
Course Objectives: To impart knowledge to classify the soil based on index properties and to assess their engineering properties based on the classification. To familiarize the students about the fundamental concepts of compaction, flow through soil, stress transformation, stress distribution, consolidation and shear strength of					

soils. To impart knowledge of design of both finite and infinite slopes.		
Unit I	SOIL DESCRIPTION	9
Formation of soil - Soil description – Particle – Size shape and colour – Composition of gravel, sand, silt, clay particles – Particle behaviour – Soil structure – Phase relationship – Index properties – Significance – BIS classification system – Unified classification system.		
Unit II	EFFECTIVE STRESS AND PERMEABILITY	9
Soil - water – Static pressure in water - Effective stress concepts in soils – Capillary phenomena– Permeability interaction – Hydraulic conductivity – Darcy's law – Determination of Hydraulic Conductivity – Laboratory Determination (Constant head and falling head methods) and field measurement pumping out in unconfined and confined aquifer – Factors influencing permeability of soils – Seepage - Two-dimensional flow – Laplace's equation – Introduction to flow nets – Simple problems. (Sheet pile and weir).		
Unit III	STRESS DISTRIBUTION AND SETTLEMENT	9
Stress distribution in homogeneous and isotropic medium – Boussinesq theory – (Point load, Line load and udl) Use of New marks influence chart – Terzaghi's one dimensional consolidation theory – Computation of rate of settlement. - $\sqrt{t}$ and $\log t$ methods– e - $\log p$ relationship.		
Unit IV	SHEAR STRENGTH	9
Shear strength of cohesive and cohesion less soils – Mohr-Coulomb failure theory – Measurement of shear strength - Direct shear, Triaxial compression, UCC and Vane shear tests – Pore pressure parameters – Cyclic mobility – Liquefaction.		
Unit V	SLOPE STABILITY	9
Stability Analysis - Infinite slopes and finite slopes – Total stress analysis for saturated clay – Friction circle method – Use of stability number – Method of slices – Felonious and Bishop's method - Slope protection measures.		
Total periods: 45 PERIODS		
Text Books:		
1. Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd. New Delhi, 2005.		
References:		
1. McCarthy, D.F., "Essentials of Soil Mechanics and Foundations". Prentice-Hall, 2006.		
2. Coduto, D.P., "Geotechnical Engineering — Principles and Practices", Prentice Hall of India Pvt.Ltd. New Delhi, 2010.		

3. Das, B.M., “Principles of Geotechnical Engineering”. Brooks / Coles / Thompson Learning Singapore, 8th Edition, 2013.															
Course Outcomes:													Blooms Taxonomy		
CO 1 Demonstrate an ability to identify various types of soils and its properties, formulate and solve engineering Problems.													K3		
CO2 Show the basic understanding of flow through soil medium and its impact of engineering solution.													K2		
CO3 Understand the basic concept of stress distribution in loaded soil medium and soil settlement due to consolidation													K2		
CO4 Show the understanding of shear strength of soils and its impact of engineering solutions to the loaded soil medium and also will be aware of contemporary issues on shear strength of soils.													K2		
CO5 Demonstrate an ability to design both finite and infinite slopes, component and process as per needs and specifications													K3		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	1	1	1	–	–	–	–	3	2	1
CO2	3	3	2	3	2	1	2	1	–	–	–	–	3	2	1
CO3	3	3	2	2	1	1	2	1	–	–	–	–	3	2	1
CO4	3	3	3	2	2	2	2	1	–	–	–	–	3	3	2
CO5	3	3	3	2	2	2	2	1	–	–	–	–	3	3	2
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CET405	HIGHWAY AND RAILWAY ENGINEERING	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites • Surveying and Levelling • Building Materials and Construction • Strength of Materials					

Course Objectives:		
To give an overview about the highway and railway engineering with respect to, planning, design, construction and maintenance as per IRC standards, specifications and methods.		
Unit I	HIGHWAY ENGINEERING	9
History of Road construction in India - Institutions for Highway planning, design and construction at different levels – factors influencing highway alignment - Classification of highways and typical cross sections of Urban and Rural roads – Engineering surveys for alignment- Conventional and Modern method.		
Unit II	DESIGN OF HIGHWAY ELEMENTS	9
Cross sectional elements – Horizontal curves, super elevation, transition curves, widening of curves Sight distances – Vertical curves, gradients– pavement components and their role - Design practice for flexible and rigid pavements (IRC methods only).		
Unit III	HIGHWAY CONSTRUCTION AND MAINTENANCE	9
Highway construction materials, properties, testing methods – Construction practice of flexible and concrete pavement- Highway drainage – Evaluation and Maintenance of pavements.		
Unit IV	RAILWAY PLANNING AND CONSTRUCTION	9
Elements of permanent way — Rails, Sleepers, Ballast, rail fixtures and fastenings, Selection of gauges - Track Stress, coning of wheels, creep in rails, defects in rails – Route alignment surveys, conventional and modern methods-Geometric design of railway, gradient, super elevation, widening of gauge on curves (Problems)-Railway drainage- Level Crossings-Signaling.		
Unit V	RAILWAY TRACK CONSTRUCTION MAINTENANCE AND OPERATION	9
Points and Crossings - Design of Turnouts, Working Principle-Track Circuiting - Construction & Maintenance — Conventional, Modern methods and Materials, Lay outs of Railway Stations and Yards, Rolling Stock, Tractive Power, Track Resistance - Role of Indian Railways in National Development – Railways for Urban Transportation – LRT & MRTS Feasibility study, Planning and construction.		
Total periods: 45 PERIODS		
Text Books:		
1. Khanna.S. K., Justo.C.E.G and Veeraragavan A. "Highway Engineering", Nemchand Publishers, 2014.		
2. Saxena Subhash, C. and Satyapal Arora, A Course in Railway Engineering, Dhanapat Rai and Sons, Delhi, 1998.		
3. Kadiyali.L.R. "Principles and Practice of Highway Engineering", Khanna Technical Publications, 6th edition Delhi, 2015.		

4. C. Venkatramaiah., Transportation Engineering-Vol.2 Railways, Airports, Docks and Harbours,Bridges and Tunnels., Universities Press (India) Private Limited, Hyderabad, 2015.															
References:															
1. Indian Road Congress (IRC), Guidelines for the Design of Flexible Pavements, (Third Revision), IRC:37-2012.															
2. Indian Road Congress (IRC), Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, (Third Revision), IRC:58-2012.															
3.Yang H. Huang, "Pavement Analysis and Design", Pearson Education Inc, Nineth Impression, South Asia,2012															
4. IRC-37–2012,The Indian roads Congress, Guidelines for the Design of Flexible Pavements, NewDelhi.															
5. IRC 58-2012. The Indian Road Congress, Guideline for the Design of RigidPavements for Highways, New Delhi															
Course Outcomes:													Blooms Taxonomy		
CO1 Plan a highway according to the principles and standards adopted in various institutions inIndia.													K4		
CO2 Design the geometric features of road network and components of pavement.													K3		
CO3 Test the highway materials and construction practice methods and know its properties and able to perform pavement evaluation and management.													K5		
CO4 Understand the methods of route alignment and design elements in railway planning and constructions													K2		
CO5 Understand the construction techniques and maintenance of track laying and railway stations.													K2		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	2	2	1	–	–	–	–	3	2	1
CO2	3	3	3	2	2	1	2	1	–	–	–	–	3	3	2
CO3	3	3	2	3	2	1	2	1	–	–	–	–	3	3	2
CO4	3	2	2	2	1	2	2	1	–	–	–	–	2	3	1
CO5	3	2	2	2	1	2	2	1	–	–	–	–	2	3	1
1 - Low, 2 - Medium, 3 - High , ‘–’ No correlation															

23GET401	ENVIRONMENTAL SCIENCE AND ENGINEERING	Category: BSC			
		L	T	P	C
		2	0	0	2
Prerequisites Basic Chemistry.					
Course Objectives: - To study the nature of environment and biodiversity. - To impart knowledge on the causes, effects and control/prevention measures of environmental pollution. - To facilitate the understanding of renewable energy resources. - To understand the social aspects of environment. - To study the information related to environment and society					
Unit I	ENVIRONMENT AND BIODIVERSITY				6
Definition, scope and importance of environment – need for public awareness. Eco-system and energy flow– ecological succession. Ecosystems: Forest ecosystem and grassland ecosystem. Types of biodiversity: genetic, species and ecosystem diversity. Values of biodiversity, hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife and man- wildlife conflicts. Conservation of biodiversity: In-situ and ex-situ.					
Unit II	ENVIRONMENTAL POLLUTION				6
Causes, effects, prevention and treatment technologies for Air, Water, Soil. Solid waste management and R principle. Solid, hazardous and E-waste management, Industrial safety measures.					
Unit III	RENEWABLE ENERGY RESOURCES				6
Deforestation. New Energy Sources: Need of new energy resources. Different energy resources: Tidal, Solar, Wind, Nuclear and Biomass energy resources. Applications of Hydrogen energy, Ocean energy resources and Tidal energy conversion.					
Unit IV	SOCIAL ISSUES OF ENVIRONMENT				6
From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people. Environmental ethics: Issues and possible solutions – Climate change, Global warming, Acid rain, Ozone layer depletion, Central and state pollution control boards. Waste product and consumerism.					
Unit V	ENVIRONMENT AND HUMAN POPULATIONS				9
Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education, Professional ethics – HIV / AIDS –					

women and child welfare – Role of information technology in environment and human health.															
Total periods: 30 PERIODS															
Text Books:															
1. Benny Joseph, 'Environmental Science and Engineering', 3 rd edition, Tata McGraw-Hill, New Delhi, 2017.															
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2 nd edition, Pearson Education, 2004															
3. Anubha Kaushik and C.P. Kaushiks, 'Perspectives in Environmental Studies, 6 th edition, New Age International Publishers, 2018.															
4. A.K. De, 'Environmental Chemistry, New Age International Publishers, New Delhi, 2016.															
References:															
1. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia, Jaico Publishing House, Mumbai, 2001.															
2. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure, 'Oxford University Press, 3 rd edition, 2015.															
3. Erach Bharucha, 'Textbook of Environmental Studies for Undergraduate Courses, Orient Black swan Private limited, 2013															
Course Outcomes:													Blooms Taxonomy		
CO1: To familiar the functions of ecosystems, environment and biodiversity.													K1		
CO2: To know well about the effects of environmental pollutions.													K1		
CO3: To inculcate the basic knowledge of renewable energy resources.													K1		
CO4: To differentiate various social problems.													K2		
CO5: To know the importance/impacts of population growth.													K2		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	1	2	-	-	-	1	1			
CO2	3	1	1	-	-	1	2	-	2	-	1	1			
CO3	3	1	-	-	1	1	2	-	2	-	1	1			
CO4	3	1	-	-	1	1	2	-	2	-	1	1			
CO5	3	1	-	-	1	1	2	-	-	-	1	1			
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23CEP401	HYDRAULIC ENGINEERING LABORATORY	Category: PCC			
		L	T	P	C
		0	0	3	1.5
Prerequisites Applied Hydraulics Engineering					
Course Objectives: To provide hands on experience in calibration of flow meters, performance characteristics of pumps and turbines.					
LIST OF EXPERIMENTS					
1	Calibration of Rotameter.				
2	Flow through Orifice meter, Venturimeter.				
3	Bernoulli’s Experiment.				
4	Determination of friction factor in pipes.				
5	Determination of minor losses.				
6	Characteristics of Centrifugal pumps.				
7	Characteristics of Gear pump.				
8	Characteristics of Submersible pump.				
9	Characteristics of Reciprocating pump.				
10	Characteristics of Pelton wheel turbine.				
11	Characteristics of Francis turbine.				
12	Determination of metacentric height of floating bodies.				
Total periods: 45 PERIODS					
References:					
1. Hydraulic Laboratory Manual, Centre for Water Resources, Anna University, 2015.					
2. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics. Standard Book House. New Delhi, 2017.					
3. Subramanya K, Fluid Mechanics and Hydraulic Machines, Tata McGraw Hill Edu. Pvt. Ltd. 2011.					
Course Outcomes:					Blooms Taxonomy
CO1: Apply Bernoulli equation for calibration of flow measuring devices.					K4
CO2: Measure friction factor in pipes and compare with Moody diagram					K4
CO3: Determine the performance characteristics of rotodynamic pumps.					K4
CO4: Determine the performance characteristics of positive displacement pumps.					K4

CO5: Determine the performance characteristics of turbines.													K4		
CO – PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	0	1	1	2	1	0	1	3	2	2
CO2	3	2	1	2	1	0	1	1	2	1	0	1	3	2	2
CO3	3	2	2	2	1	0	1	1	2	1	0	1	2	3	2
CO4	3	2	2	2	1	0	1	1	2	1	0	1	2	3	2
CO5	3	2	2	2	1	0	1	1	2	1	0	1	2	3	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEP402	MATERIALS TESTING LABORATORY	Category: PCC			
		L	T	P	C
		0	0	4	2
Prerequisites • Strength of Materials / Mechanics of Solids • Concrete Technology					
Course Objectives: • To develop skills to test various construction materials.					
LIST OF EXPERIMENTS					
1	Tension test on steel rod.				
2	Deflection test on metal beam.				
3	Impact test on metal specimen (Izod and Charpy).				
4	Hardness test on metals (Rockwell and Brinell Hardness Tests).				
5	Determination of fineness of cement.				
6	Determination of consistency of cement.				
7	Determination of specific gravity of cement.				
8	Determination of initial and final setting time of cement.				
9	Determination of water absorption for fine aggregate.				
10	Determination of compacted and loose bulk density of coarse aggregate.				
11	Determination of elongation index of coarse aggregate.				
12	Determination of flakiness index of coarse aggregate.				
13	Determination of compressive strength of bricks.				

14	Determination of water absorption of bricks.														
15	Determination of slump of concrete.														
16	Determination of compressive strength of concrete.														
Total periods: 45 PERIODS															
Course Outcomes:													Blooms Taxonomy		
CO1: Determine the mechanical properties of steel.													K4		
CO2: Determine the physical properties of cement.													K4		
CO3: Determine the physical properties of fine and coarse aggregate.													K4		
CO4: Determine the workability and compressive strength of concrete.													K4		
CO5: Determine the strength of brick and wood.													K4		
CO – PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	0	0	1	2	1	0	1	3	2	1
CO2	3	2	1	2	1	0	0	1	2	1	0	1	3	2	1
CO3	3	2	1	2	1	0	1	1	2	1	0	1	3	2	2
CO4	3	2	2	2	1	0	1	1	2	1	0	1	3	3	2
CO5	3	2	1	2	1	0	0	1	2	1	0	1	2	3	1
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEP403	SOIL MECHANICS LABORATORY	Category: PCC			
		L	T	P	C
		0	0	3	1.5
Prerequisites • Soil Mechanics					
Course Objectives: • To develop skills to test the soils for their index and engineering properties and to characterize the soil based on their properties.					
LIST OF EXPERIMENTS					
1	Specific gravity of soil solids.				
2	Grain size distribution – Sieve analysis.				
3	Grain size distribution - Hydrometer analysis.				
4	Liquid limit and Plastic limit tests.				

5	Field density Test (Sand replacement method)
6	Determination of moisture – density relationship using standard proctor compaction test.
7	Permeability determination (constant head and falling head methods)
8	One dimensional consolidation test (Determination of co-efficient of consolidation only).
9	Direct shear test in cohesion less soil.
10	Unconfined compression test in cohesive soil.
11	Tri-axial compression tests in cohesion less soil.
12	California Bearing Ratio Test

Total periods: 45 PERIODS

References:

1. Soil Engineering Laboratory Instruction Manual” published by Engineering College Co- operative Society, Anna University, Chennai, 2010.
2. “Saibaba Reddy, E. Ramasastri, K. “Measurement of Engineering Properties of Soils”, New age International (P) limited publishers, New Delhi, 2008.
3. Lambe T.W., “Soil Testing for Engineers”, John Wiley and Sons, New York, 1951. Digitized 2008.
4. IS Code of Practice (2720) Relevant Parts, as amended from time to time, Bureau of Indian Standards, New Delhi
5. G.Venkatappa Rao and Goutham .K. Potable, “Geosynthetics Testing – A laboratory Manual”, Sai Master Geoenvironmental Services Pvt. Ltd., 1st Edition 2008.
6. Braja M.Das., “Soil Mechanics: Laboratory Manual”, Oxford University Press, eighth edition, 2012.

Course Outcomes:													Blooms Taxonomy		
CO1 Determine key properties like specific gravity, grain size and Atterberg limits.													K4		
CO2 Measure in-situ soil density and determine compaction characteristics													K4		
CO3: Determine soil permeability and consolidation behavior for stability and drainage analysis.													K4		
CO4: Assess soil shear strength using direct shear, unconfined compression, vane shear and Triaxial shear tests.													K4		
CO5: Evaluate soil bearing capacity for foundation and pavement design using CBR and related tests.													K4		
CO – PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	0	1	1	2	1	0	1	3	2	1

CO2	3	2	2	2	1	0	1	1	2	1	0	1	3	2	2
CO3	3	2	2	2	2	0	1	1	2	1	0	1	3	3	2
CO4	3	2	3	2	2	0	1	1	2	1	0	1	3	3	2
CO5	3	2	3	2	2	0	1	1	2	1	0	1	3	3	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

SEMESTER V

23CET501	DESIGN OF REINFORCED CONCRETE STRUCTURAL ELEMENTS	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites Building Materials and Construction					
Course Objectives: To introduce the different design philosophy for reinforced concrete and discuss the limit state method of design of RC rectangular beams and to learn the concept in the design of RC flanged beams and design for shear and torsion and design of RC slabs and staircase, short RC columns, RC footing for walls, pad, sloped and combined rectangular footings.					
Unit I	METHODS OF DESIGN OF CONCRETE STRUCTURES				9
Concept of Elastic method, ultimate load method and limit state method – Working stress method as detailed in IS code - Design of Singly Reinforced beam by working stress method - Limit State philosophy as detailed in IS code - Advantages of Limit State Method over other methods - Analysis and design of singly and doubly reinforced rectangular beams by limit State Method.					
Unit II	LIMIT STATE METHOD - FLANGED BEAM, SHEAR & TORSION				9
Analysis and design of flanged beams — Behaviour of RC members in bond and Anchorage - Behaviour of RC beams in shear and torsion - Design of RC members for combined bending, shear and torsion.					
Unit III	LIMIT STATE DESIGN OF SLABS AND STAIRCASE				9
Analysis and design of cantilever, one way, two way and continuous slabs subjected to uniformly distributed load for various boundary conditions- Types of Staircases — Design of dog-legged Staircase.					
Unit IV	LIMIT STATE DESIGN OF COLUMNS				9
Types of columns – Design of short Rectangular and circular columns for axial, uniaxial and biaxial bending.					
Unit V	LIMIT STATE DESIGN OF FOOTING				9

Design of wall footing — Design of axially and eccentrically loaded rectangular pad and sloped footings — Design of combined rectangular footing for two columns only.															
Total periods: 45															
Text Books:															
1. Gambhir.M.L., "Fundamentals of Reinforced Concrete Design", Prentice Hall of India Private Limited, New Delhi, 2006.															
2. Krishnaraju.N “ Design of Reinforced Concrete Structures “, CBS Publishers & Distributors Pvt. Ltd., New Delhi.															
References:															
1. Sinha, S.N., “Reinforced Concrete Design”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2017															
2. Unnikrishna Pillai, S., Devdas Menon, “Reinforced Concrete Design”, Tata McGraw Hill Publishing Company Ltd., 2021															
3. Punmia.B.C., Ashok Kumar Jain, Arun Kumar Jain, “Limit State Design of Reinforced Concrete”,Laxmi Publication Pvt. Ltd., New Delhi, 2016															
4. Shah V L Karve S R., "Limit State Theory and Design of Reinforced Concrete", Structures Publications, Pune, 2013															
Course Outcomes:													Blooms Taxonomy		
CO1 Know the various design concepts and design RC rectangular beams by working stress and limit state methods													K3		
CO2 Understand the design of flanged beams, design for shear and torsion, and bond & anchorage length.													K2		
CO3 Design a RC slabs and staircase and draw the reinforcement detailing													K3		
CO4 Design short columns for axial, uni-axial and bi-axial eccentric loadings													K3		
CO5 Design wall footings, isolated footings and combined rectangular footing.													K3		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	3	1	1	3	2	1	2	3	3	2
CO2	3	3	3	3	1	3	1	1	3	2	1	2	3	3	2
CO3	3	3	3	3	1	3	1	1	3	2	1	2	3	3	2
CO4	3	3	3	3	1	3	1	1	3	2	1	2	3	3	2
CO5	3	3	3	3	1	3	1	1	3	2	1	2	3	3	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CET502	STRUCTURAL ANALYSIS I	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites Engineering Mechanics and Strength of Materials					
Course Objectives: To introduce the students to the basic theory and concepts of classical methods of structural analysis.					
Unit I	ANALYSIS OF TRUSSES				9
Determinate and indeterminate trusses - analysis of determinate trusses - method of joints - method of sections - Deflections of pin-jointed plane frames - lack of fit - change in temperature method of tension coefficient - Application to space trusses.					
Unit II	SLOPE DEFLECTION METHOD				9
Slope deflection equations – Equilibrium conditions - Analysis of continuous beams and rigid frames – Support settlements - symmetric frames with symmetric and skew-symmetric loadings.					
Unit III	MOMENT DISTRIBUTION METHOD				9
Stiffness - distribution and carry over factors — Analysis of continuous Beams- Plane rigid frames with and without sway – Support settlement - symmetric frames with symmetric and skew-symmetric loadings.					
Unit IV	FLEXIBILITY METHOD				9
Primary structures - Compatibility conditions – Formation flexibility matrices - Analysis of indeterminate pin- jointed plane frames, continuous beams and rigid jointed plane frames by direct flexibility approach.					
Unit V	STIFFNESS METHOD				9
Restrained structure –Formation of stiffness matrices - equilibrium condition - Analysis of Continuous Beams, Pin-jointed plane frames and rigid frames by direct stiffness method.					
Total periods: 45					
Text Books:					
1. Bhavikatti, S.S,Structural Analysis,Vol.1,& 2, Vikas Publishing House Pvt.Ltd.New Delhi-4, 2014.					
2. Punmia.B.C, Ashok Kumar Jain & Arun Kumar Jain, Theory of structures, Laxmi Publications, New Delhi, 2004					
References:					
1. William Weaver, Jr and James M.Gere, Matrix analysis of framed structures, CBS Publishers & Distributors, Second Edition, Delhi, 2004					
2. Reddy .C.S, “Basic Structural Analysis”, Tata McGraw Hill Publishing Company, 2005.					

3. Negi L.S. and Jangid R.S., Structural Analysis, Tata McGraw Hill Publishing. Co. Ltd. 2004															
4. Bhavikatti, S.S, Matrix Method of Structural Analysis, I. K. International Publishing House Pvt.Ltd.,New Delhi-4, 2014.															
Course Outcomes:													Blooms Taxonomy		
CO1 Analyze the pin-jointed plane and space frames.													K4		
CO2 Analyse the continuous beams and rigid frames by slope deflection method.													K4		
CO3 Understand the concept of moment distribution and analysis of continuous beams and rigid frames with and without sway.													K2		
CO4 Analyse the indeterminate pin jointed plane frames continuous beams and rigid frames using matrix flexibility method.													K4		
CO5 Understand the concept of matrix stiffness method and analysis of continuous beams, pin jointed trusses and rigid plane frames.													K2		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	3	1	1	3	2	1	2	3	3	3
CO2	3	3	3	3	1	3	1	1	3	2	1	1	3	3	3
CO3	3	3	3	3	1	3	1	1	3	2	1	1	3	3	3
CO4	3	3	3	3	1	3	1	1	3	2	1	1	3	3	3
CO5	3	3	3	3	1	3	1	1	3	2	1	1	3	3	3
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23CET503	FOUNDATION ENGINEERING	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites • Soil Mechanics					
Course Objectives: • To impart knowledge to plan and execute a detail site investigation programme, to select geotechnical design parameters and type of foundations. Also to familiarize the students for the geotechnical design of different type of foundations and retaining walls.					
Unit I	SITE INVESTIGATION AND SELECTION OF FOUNDATION				9

Scope and objectives – Methods of exploration – Auguring and boring – Wash boring and rotary drilling – Depth and spacing of bore holes – Soil samples – Representative and undisturbed – Sampling methods – Split spoon sampler, Thin wall sampler, Stationary piston sampler – Penetration tests (SPT and SCPT) – Data interpretation - Strength parameters and Evaluation of Liquefaction potential - Selection of foundation based on soil condition- Bore log report.		
Unit II	BEARING CAPACITY OF SHALLOW FOUNDATION	9
Introduction – Location and depth of foundation – Codal provisions – Bearing capacity of shallow foundation on homogeneous deposits – Terzaghi's formula and BIS formula – Factors affecting bearing capacity – Bearing capacity from in-situ tests (SPT, SCPT and plate load) – Allowable bearing pressure – Seismic considerations in bearing capacity evaluation. Determination of Settlement of foundations on granular and clay deposits – Total and differential settlement – Allowable settlements – Codal provision – Methods of minimizing total and differential settlements.\		
Unit III	FOOTINGS AND RAFTS	9
Types of Isolated footing, Combined footing, Mat foundation – Contact pressure and settlement distribution – Proportioning of foundations for conventional rigid behaviour – Minimum depth for rigid behaviour – Applications – Floating foundation – Special foundations – Seismic force consideration – Codal provision.		
Unit IV	PILE FOUNDATION	9
Types of piles and their functions – Factors influencing the selection of pile – Carrying capacity of single pile in granular and cohesive soil – Static formula – Dynamic formulae (Engineering news and Hileys) – Capacity from insitu tests (SPT, SCPT) – Negative skin friction – Uplift capacity- Group capacity by different methods (Field's rule, Converse – Labarra formula and block failure criterion) – Settlement of pile groups – Interpretation of pile load test (routine test only), Under reamed piles – Capacity under compression and uplift – Codal provision		
Unit V	RETAINING WALLS	9
Plastic equilibrium in soils – Active and passive states – Rankine's theory – Cohesionless and cohesive soil – Coulomb's wedge theory – Condition for critical failure plane – Earth pressure on retaining walls of simple configurations – Culmann Graphical method – Pressure on the wall due to line load – Stability analysis of retaining walls – Codal provision.		
Total periods: 45		
Text Books:		
1. Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt.Ltd., New Delhi, 2017.		
2. Murthy, V.N.S., "Soil Mechanics and Foundation Engineering", CBS Publishers and Distributors Ltd., New Delhi, 2015.		

References:															
1. Das, B.M. “Principles of Foundation Engineering” (Eighth edition), Thompson Asia Pvt. Ltd., Singapore, 2017.															
2. Kaniraj, S.R. “Design aids in Soil Mechanics and Foundation Engineering”, Tata McGraw Hill publishing company Ltd., New Delhi, 2017.															
3. Varghese, P.C.,”Foundation Engineering”, Prentice Hall of India Private Limited, New Delhi, 2012.															
4. Gopal Ranjan and Rao A.S.R. “Basic and Applied soil mechanics”, New Age International (P) Ltd, New Delhi,2006.															
Course Outcomes:												Blooms Taxonomy			
CO1 Plan and execute a detailed site investigation to select geotechnical design parameters and type of foundation												K2			
CO2 Design shallow foundations, its component or process as per the needs and specifications.												K3			
CO3 Design combined footings and raft foundations, its component or process as per the needs and specifications.												K3			
CO4 Design deep foundations, its component or process as per the needs and specifications.												K3			
CO5 Design retaining walls, its component or process as per the needs and specifications.												K3			
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	3	1	2	1	-	-	-	1	3	3	2	3
CO2	2	3	3	3	1	2	2	-	-	-	1	3	2	3	2
CO3	2	3	3	3	1	2	1	-	-	-	2	3	2	3	2
CO4	3	3	3	3	1	1	1	-	-	-	2	3	2	3	3
CO5	3	3	3	3	1	2	1	-	-	-	2	3	2	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEP501	HIGHWAY ENGINEERING LABORATORY	Category: PCC			
		L	T	P	C
		0	0	4	2
Prerequisites					
Course Objectives: To learn the principles and procedures of testing of materials used in the construction of highways.					
LIST OF EXPERIMENTS					
I TEST ON AGGREGATES					
1	Specific gravity determination of the coarse aggregate sample				
2	Determination of water absorption capacity of the coarse aggregate sample.				
3	Determination of impact value of coarse aggregate				
4	Determination of aggregate crushing value of coarse aggregate				
II TEST ON BITUMEN					
5	Specific gravity determination of the bitumen/asphalt sample.				
6	Determination of consistency of the bituminous material.				
7	Determination of softening point of the asphalt/bitumen sample				
8	Determination of ductility value of the bitumen sample				
III BITUMINOUS MIXES					
9	Determination of stripping value of the bituminous mix Demonstration (Demonstration)				
10	Determination of bitumen content in the bituminous mix by cold solvent extraction method. (Demonstration)				
Total periods: 60					
Text Books:					
1. Highway Materials and Pavement Testing, Nem Chand and Bros., Roorkee, Revised Fifth Edition, 2009					
References:					
1. N.L.Arora, A Textbook of Transportation Engineering, New India Publication, 1997					
2. http://vlabs.iitb.ac.in/vlabsdev/labs/nitk_labs/Transportation_Engineering_Lab/index.html					
3. Laboratory Manual in Highway engineering published, Duggal, Ajay K 2017					
Course Outcomes:					Blooms Taxonomy
CO1: Characterize Pavement Aggregate through relevant test.					K2
CO2: Ascertain the Quality of Bitumen.					K2
CO3: Determine the Optimum Binder Content Using Marshall Method.					K3
CO4: Evaluate the Consistency and Properties of Bitumen.					K5

CO5: Determine the Bitumen Content in the Bituminous Mixes													K3		
CO – PO& PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	2	1	1	1	1	3	3	1	3	3	3	2
CO2	3	1	3	2	1	1	1	1	3	3	1	3	3	3	2
CO3	3	1	3	2	1	1	1	1	3	3	1	3	3	3	2
CO4	3	1	3	2	1	1	1	1	3	3	1	3	3	3	2
CO5	3	1	3	2	1	1	1	1	3	3	1	3	3	3	2
1 - Low, 2 - Medium, 3 -High , ‘-‘ No correlation															

23CEP502	SURVEY CAMP	Category: ESC			
		L	T	P	C
		0	0	0	1
Prerequisites • Surveying • Surveying Levelling					
Course Objectives: • The objective of the survey camp is to enable the students to get practical training in the field work. Groups of not more than six members in a group will carry out each exercise in survey camp. At the end of the camp, each student shall have mapped and contoured the area. The camp record shall include all original field observations, calculations and plots.					
LIST OF EXPERIMENTS					
1.	Traverse – using Theodolite / Total station (i). Contouring - Radial tachometric contouring - Radial Line at Every 45 Degree and Length not less than 60 Meter on each Radial Line (ii). Block Level/ By squares of size at least 100 Meter x 100 Meter atleast 20 Meter interval (iii). L.S & C.S - Road and canal alignment for a Length of not less than 1 Kilo Meter atleast L.S at Every 30M and C.S at every 90 M				
2.	Offset of Buildings and Plotting the Location				
3.	Sun observation to determine azimuth				

4.	Use of GPS to determine latitude and longitude and locate the survey camp location														
5.	Traversing using GPS														
6.	Curve setting by deflection angle														
TOTAL Periods : 60															
Text Books:															
1. Ankar, F. Robert Jacobs, Nicholas J. Aquilano, Operations andSupply Management, Tata McGraw Hill, 12 th Edition, 2010.															
2. Norman Gaither and Gregory Frazier, Operations Management, South Western Cengage Learning, 2002.															
References:															
1. William J Stevenson, Operations Management, Tata McGraw Hill, 9 th Edition, 2009.															
2. Russel and Taylor, Operations Management, Wiley, Fifth Edition, 2006.															
3. Kanishka Bedi, Production and Operations Management, Oxford University Press, 2004.															
Course Outcomes:													Blooms Taxonomy		
CO1: Handle the modern surveying instruments like Total station and GPS													K2		
CO2 Apply modern surveying techniques in field to establish horizontal control.													K3		
CO3: Understand the surveying techniques in field to establish vertical control													K2		
CO4: Apply different survey adjustment techniques													K3		
CO5: Carry out different setting out works in the field													K4		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3		3	3	2	2	3	2	2	2	3	3	3	3
CO2	3	3		3	3	2	2	3	2	2	2	3	3	3	3
CO3	3	3	2	3	3	3	2	2	2	2	2	3	3	3	3
CO4	3	3	2		3	2	2	2	2	2	2	3	3	3	3
CO5	3	3	2		3	2	2	2		2	2	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation3															

SEMESTER VI

23CET601	DESIGN OF STEEL STRUCTURAL ELEMENTS	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: To introduce the students to limit state design of structural steel members subjected to compressive, tensile and bending loads, including connections and to provide the students the tools necessary for designing structural systems such as roof trusses and gantry girders as per provisions of current code (IS 800 - 2007) of practice.					
Unit I	INTRODUCTION AND BOLTED CONNECTION				9
Fundamental concepts of limit state design of structures - Different types of rolled steel sections available to be used in steel structures - stress strain relationship for mild steel. Connections: Behavior of bolted joints - Design strength of ordinary black bolts -high strength friction grip bolts - Pin connections - simple connections -Eccentric connections, Rivet connection.					
Unit II	WELDED CONNECTION				9
Advantages of welding - Types and properties of welds - Types of joints - welded specifications - Design of welded joints subjected to axial load - Eccentric welded connections.					
Unit III	TENSION AND COMPRESSION MEMBERS				9
Types of tension members - slenderness ratio - displacement of tension members - behaviour of tension members - modes of failure - factors affecting strength of tension members - angles under tension - design of tension members - Lug angles - splices. Possible failure modes - classification of cross section -behavior of compression members - Effectives length - radius of gyration slenderness of compression members - allowable stresses in compression - Design of axially loaded compression members - Built up compression members - Laced and Battened columns - eccentrically loaded columns.					
Unit IV	DESIGN OF FLEXURAL MEMBERS				9
Beams types - section classifications - lateral stability of beams - allowable stress in bending - Shear and Bearing stresses - Effective length of compression flange - Laterally supported and unsupported beams - Design of built up beams.					
Unit V	FOUNDATIONS AND TRUSSES				9
Allowable stress in bearing - slab base - Gusset base - Types of trusses - Economical spacing of roof trusses - loads on roof trusses - Estimation of wind load on roof trusses as per IS: 875. Design of roof truss-					

Design of purlins.															
Total periods: 45 Periods															
Text Books:															
1. 1. Duggal S.K., Design of Steel Structures, Tata McGraw Hill, Publishing Co. Ltd., New Delhi, 2010															
2. Bhavikatti S.S, Design of Steel Structures, Ik International Publishing House, New Delhi, 2017.															
References:															
1. Gambhir M L, Fundamentals of Structural Steel Design, McGraw Hill Education India Pvt Limited, 2013															
2. Jack C. McCormac and Stephen F Csernak, Structural Steel Design, Pearson Education Limited, 2013.															
3. SarwarAlamRaz, Structural Design in Steel, New Age International Publishers, 2014															
4. Subramanian N, Design of Steel Structures, Oxford University Press, New Delhi, 2016															
5. IS 800 (2007): General Construction in Steel - Code of Practice [CED 7: Structural Engineering and structural sections]															
6. IS 875-1 (1987): Code of Practice for Design Loads (Other Than Earthquake) For Buildings and Structures, Part 1: Dead Loads - Unit Weights of Building Material and Stored Materials (Incorporating IS 1911: 1967) [CED 37:Structural Safety]															
Course Outcomes:													Blooms Taxonomy		
CO 1: Recognize the design philosophy of steel structures and identify the different failure modes of bolted and welded connections, and determine their design strengths													K2		
CO2: Select the most suitable section shape and size for tension and compression members and beams according to specific design criteria													K3		
CO3: Apply the principles, procedures and current code requirements to the analysis and design of steel tension members, columns, column bases and beams													K3		
CO4: Identify and compute the design loads on Industrial structures, and gantry girder													K3		
CO5: Find out ultimate load of steel beams and portal frames using plastic analysis													K3		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	2							1	3	3	2
CO2	3	3	3	1	2							1	3	3	2
CO3	3	3	3	2	2							1	3	3	2
CO4	3	3	3	2	2					1	1	1	3	2	2

CO5	3	3	3	2	2						1	1	3	3	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CET602	STRUCTURAL ANALYSIS –II	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: To learn the method of drawing influence lines and its uses in various applications like beams, bridges and plane trusses and to analyse arches and suspension bridges.					
Unit I	INFLUENCE LINES FOR DETERMINATE STRUCTURES				9
Introduction to moving loads, Concept of Influence Lines, Influence lines for reactions in statically determinate structures –Influence lines for shear force and bending moment in beam section – Calculation of critical stress resultants due to concentrated and distributed moving loads - Influence lines for member forces in pin jointed plane frames.					
Unit II	INFLUENCE LINES FOR INDETERMINATE BEAMS				9
Muller Breslau’s principle - Influence line for support reactions, shearing force and bending moments for indeterminate beams - propped cantilevers, fixed beams and continuous beams.					
Unit III	ARCHES				9
Arches - Eddy’s theorem - Types of arches – Analysis of three-hinged, two-hinged and fixed arches - Parabolic and circular arches - influence lines, rib shortening– Settlement and temperature effects.					
Unit IV	SUSPENSION BRIDGES AND SPACE TRUSSES				9
Analysis of suspension bridges – Unstiffened cables and cables with three hinged stiffening girders – Influence lines for three hinged stiffening girders - Introduction to analysis of space trusses using method of tension coefficients.					
Unit V	APPROXIMATE ANALYSIS OF FRAMES				9
Approximate analysis for gravity loadings - substitute frame method for maximum moments in beams and columns - Approximate analysis for horizontal loads - portal method - assumptions - axial force, shearing force and bending moment diagrams.					
Total periods: 45 Periods					
Text Books:					

1. .Dr. Vaidyanathan & Dr.Perumal Structural Analysis, Vol.1 & 2, Laxmi Publication House Pvt.Ltd.,															
2. Punmia.B.C, Ashok Kumar Jain and Arun Kumar Jain, Theory of structures, Laxmi, Publications,2004.															
References:															
1. Negi.L.S and Jangid R.S., Structural Analysis, Tata McGraw-Hill Publishers, 2004.															
2. Reddy C.S., Basic Structural Analysis, Tata McGraw Hill Publishing Co. Ltd., Third Edition, 2010.															
3. Gambhir.M.L., Fundamentals of Structural Mechanics and Analysis, PHI Learning Pvt. Ltd., 2011.															
4. Vazrani.V.N And Ratwani,M.M, Analysis of Structures, Vol.II, Khanna Publishers,2015.															
Course Outcomes:													Blooms Taxonomy		
CO1 Draw influence lines for statically determinate structures and calculate critical stress resultants.													K3		
CO2 Understand Muller Breslau principle and draw the influence lines for statically indeterminate beams.													K2		
CO3 Analyse three hinged, two hinged and fixed arches.													K4		
CO4 Analyse the suspension bridges with stiffening girders													K4		
CO5 Analysis the rigid frames by approximate methods for gravity and horizontal loads.													K4		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	2				1				3	2	2
CO2	3	3	2	1	2				1				3	2	2
CO3	3	3	2	2	2				1				3	3	2
CO4	3	3	2	2	2				1				3	3	2
CO5	3	3	3	2	2			1	1				3	3	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CET603	ENGINEERING GEOLOGY	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: This course will familiarize the students on the role and importance of geology in civil engineering, apart from learning the techniques of surface and subsurface investigations using geological, geophysical and geomechanical methods.					
Unit I	PHYSICAL GEOLOGY AND GEOMORPHOLOGY				9
Significance of Geology in Civil Engineering; Internal structure of the Earth; Weathering: types, engineering classification of weathered rocks and relevance to Civil Engineering; Fluvial, Marine, Glacial and Aeolian landforms and their importance in Civil Engineering; Plate tectonics and its relevance to earthquakes; Groundwater: types of aquifers, origin, movement and role of groundwater in Civil Engineering constructions.					
Unit II	MINERALOGY AND PETROLOGY				9
Physical and Chemical properties of common rock forming minerals: Quartz family, Feldspar family, Mica (Muscovite, Biotite & Vermiculite), Pyroxene (Augite & Hypersthene), Amphibole (Hornblende), Calcite, Gypsum and Clay minerals and their significance. Formation of Igneous, Metamorphic and Sedimentary rocks; Description of important rocks: Granite, Syenite, Dolerite, Basalt, Quartzite, Slate, Schist, Gneiss, Marble, Sandstone, Limestone, Shale and Conglomerate. Engineering properties of rocks: field and laboratory tests.					
Unit III	STRUCTURAL GEOLOGY AND ROCK MECHANICS				9
Attitudes of beds: Strike and Dip measurements and their relevance to civil engineering; Different types of folds, faults, joints and fractures in rocks and their significance in civil engineering constructions; Geomechanical properties of rocks: Rock Quality Designation (RQD), Rock Mass Rating (RMR) and Geological Strength Index (GSI) and their importance in various civil engineering projects.					
Unit IV	GEOPROSPECTING				9
Geological mapping techniques; Remote Sensing: Fundamentals and its role in geological mapping; Geophysical methods for subsurface investigations: Electrical, Seismic & Ground Penetrating Radar (GPR); Subsurface logging and their importance in civil engineering projects.					
Unit V	GEOLOGICAL CONSIDERATIONS AND GEOHAZARDS				9
Geological conditions necessary for designing and construction of important structures: Dams, Reservoirs, Tunnels, Road cuttings and Coastal protection; Landslides: Causes and mitigation; Earthquakes &					

Tsunamis: Causes and mitigation; Case studies for the above topics.															
Total periods: 45 Periods															
Text Books:															
1. Parbin Singh, "A Textbook of Engineering and General Geology", S. K. Kataria and Sons, 2021.															
2. ChennaKesavulu, N. "Textbook of Engineering Geology", Macmillan India Ltd., 2018															
3. Venkat Reddy, D. "Engineering Geology", Vikas Publishing House Pvt. Lt, 2021.															
4. Gokhale, K.V.G.K, "Principles of Engineering Geology", B.S. Publications, Hyderabad 2019.															
References:															
1. Legget, "Geology and Engineering", McGraw Hill Book company, 1998 Blyth, "Geology for Engineers", ELBS 1995.															
2. Krynine and Judd, "Principals of Engineering Geology and Geotechnics" Tata McGraw Hill, New Delhi, 2018.															
3. Bell, F.G. "Fundamentals of Engineering Geology", B.S. Publications. Hyderabad 2011															
Course Outcomes:													Blooms Taxonomy		
CO1 Knowing the internal structure of earth and its relation to earthquakes. Landforms created by various geological agents and their importance in civil engineering.													K2		
CO2 Getting knowledge on various minerals and rocks that can be used as construction materials and road aggregates. In addition, testing the suitability of rocks for foundation purposes.													K3		
CO3 Studying various geological structures and their impact in engineering constructions. Further, learning the geomechanical properties of rocks and their significance in engineering projects.													K4		
CO4 Gaining knowledge on the role of geological mapping, remote sensing and geophysics for surface and subsurface investigations. In addition, students will also gain knowledge on borehole logging techniques and their applications in civil engineering.													K2		
CO5 Applying geological knowledge for designing and constructing major civil engineering structures, and also mitigating various geological hazards such as earthquakes, landslides and tsunamis													K3		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1	3	2					2					2	3	2	
CO2	3	2	2	2			2					2	3	3	2
CO3	3	3	2	2			2					3	3	3	2
CO4	3	3	3	3	2							3	3	3	3
CO5	3	3	3	3	2	2	3	2			2	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEP601	BUILDING DRAWING AND DETAILING LABORATORY	Category: PCC			
		L	T	P	C
		0	0	4	2
Prerequisites - Design of Reinforced Concrete Elements - Design of Steel Structures					
Course Objectives: To impart knowledge and skill relevant to Building drawing and Detailing lab using computer software					
LIST OF EXPERIMENTS					
1	Principles of planning and orientation				
2	Buildings with load bearing walls and RCC roof (Plan , section , elevation)				
3	Buildings with sloping roof				
4	Buildings with Framed structures.				
5	Building information modeling.				
6	Reinforcement details of RCC structural elements (slab, beam and column)				
7	Reinforcement details of footings (Isolated, stepped, combined footing)				
8	Steel structures (Steel Connections detailing, beam to column connection, beam to beam connection – bolt & Weld, Roof truss & purlin)				
Total periods: 60					
Text Books:					
1. V.B.Sikka, “A course in Civil Engineering Drawing” S.K.Kataria& Sons Publishers, Seventh Edition, 2015.					
2. D.N.Ghose, ”Civil Engineering Drawing and Design” CBS Publishers & Distributors Pvt.Ltd., 2nd Edition, 2010.					

References:															
1. V.B.Sikka, "A course in Civil Engineering Drawing" S.K.Kataria& Sons Publishers, Seventh Edition, 2015.															
2. D.N.Ghose, "Civil Engineering Drawing and Design" CBS Publishers & Distributors Pvt.Ltd., 2nd Edition, 2010.															
3. National Building Code of India 2016 (NBC 2016)															
4. Unnikrishna Pillai and Devdas Menon, Reinforced Concrete Design (Third Edition), Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 3rd Edition, 2017.															
5. Subramanian N, Design of Steel Structures, Oxford University Press, New Delhi, 2016															
Course Outcomes: On completion of the course, the student is expected to be able to													Blooms Taxonomy		
CO1 Draft the plan, elevation and sectional view of the load bearing and framed buildings													K3(Apply)		
CO2 Draw the structural detailing of RCC elements													K3(Apply)		
CO3 Draw the structural detailing of RCC water tanks, footings and retaining walls													K3(Apply)		
CO4 Draw the structural detailing of steel structures													K3(Apply)		
CO5 Draft the structural detailing of Industrial structures													K4(Analysis)		
CO – PO& PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	1	3				1	2		1	3	2	3
CO2	1	3	1	1	3				1	2		1	3	3	3
CO3	1	3	1	1	3				1	2		1	3	3	3
CO4	1	3	1	1	3				1	2		1	3	3	3
CO5	1	3	1	1	3				1	2		1	3	3	3
1 - Low, 2 - Medium, 3 -High , ‘-‘ No correlation															

SEMESTER VII

23CET70 1	Estimation, Costing and Valuation Engineering	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites • Building Materials and Construction • Concrete Technology					
Course Objectives: The students will acquire knowledge in estimation, tender practices, contract procedures, and valuation and will be able to prepare estimates, call for tenders and execute works.					
Unit I	QUANTITY ESTIMATION				9
Philosophy – Purpose – Methods of estimation – Centre line method – Long and short wall method – Types of estimates – Approximate estimates – Detailed estimate – Estimation of quantities for buildings, bituminous and cement concrete roads, septic tank, soak pit, retaining walls – Culverts (additional practice in class room using computer softwares- qE Pro)					
Unit II	RATE ANALYSIS AND COSTING				9
Standard Data – Observed Data – Schedule of rates – Market rates – Materials and Labour – Standard Data for Man Hours and Machineries for common civil works – Rate Analysis for all Building works, canals, and Roads – Cost Estimates (additional practice in class room using Computer softwares) – (Analysis of rates for the item of work asked, the data regarding labour, rates of material and rates of labour to be given in the Examination Question Paper)					
Unit III	SPECIFICATIONS, REPORTS AND TENDERS				9
Specifications – Detailed and general specifications – Constructions – Sources – Types of specifications – Principles for report preparation – report on estimate of residential building – Culvert – Roads – TTT Act 2000 – Tender notices – types – tender procedures – Drafting model tenders , E-tendering- e NOI – e NOT - Digital signature certificates – Encrypting -Decrypting – Reverse auctions.					
Unit IV	CONTRACTS				9
Contract – Types of contracts – BOT – Types - Formation of contract – Contract conditions – Contract for labour, material, design, construction – Drafting of contract documents based on IBRD / MORTH Standard bidding documents – Construction contracts – Contract problems – Arbitration ,litigation and legal requirements.					

Unit V	VALUATION												9		
Definitions – Various types of valuations – Valuation methods - Necessity –Year’s purchase-sinking fund- Capitalised value – Depreciation – Escalation – Valuation of land – Buildings – Calculation of Standard rent – Mortgage – Lease - Types of lease															
Total periods: 60															
Text Books:															
1. B.N Dutta ‘Estimating and Costing in Civil Engineering’, CBS Publishers & Distributors (P) Ltd, Twenty eighth revised edition, 2020.															
2. B.S.Patil, ‘Civil Engineering Contracts and Estimates’, 7th edition, University Press, 2015															
3. D.N. Banerjee, ‘Principles and Practices of Valuation’, V Edition, Eastern Law House, 2015															
References:															
1. Hand Book of Consolidated Data – 8/2000, Vol.1, TNPWD															
2. Tamil Nadu Transparencies in Tenders Act, 1998 and rules 2000															
3. Arbitration and Conciliation Act, 1996															
4. Standard Bid Evaluation Form, Procurement of Good or Works, The World Bank, April 1996															
5. Standard Data Book for Analysis and Rates, IRC, New Delhi, 2019															
Course Outcomes:														Blooms Taxonomy	
CO1: Gain knowledge on types of contracts.														K2	
CO2: Understand types of specifications, principles for report preparation, tender notices types														K2	
CO3: Rate Analysis for all Building works, canals, and Roads and Cost Estimate														K3	
CO4: Estimate the quantities for buildings.														K3	
CO5: Evaluate valuation for building and land														K4	
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS	PSO2	PSO3
CO1	2	1	2	1	1	3	3	2	3	2	3	3	2	1	1
CO2	2	1	2	2	2	3	3	2	3	2	3	3	2	2	1
CO3	3	2	3	3	3	2	2	1	3	2	2	3	3	3	2
CO4	3	2	3	3	3	1	1	1	3	2	2	3	3	3	2
CO5	2	1	3	2	2	3	3	2	3	2	2	3	3	2	2

23CET702	Hydrology and Water Resources Engineering	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To introduce to the students, the concepts of hydrological processes, hydrological extremes and groundwater. - To prepare the students to quantify, regulate and manage water resources.					
Unit I	PRECIPITATION AND ABSTRACTIONS				9
Hydrological cycle - Meteorological measurements – Types and forms of precipitation - Rain gauges - Spatial analysis of rainfall data using Thiessen polygon and Iso-hyetal methods - Interception – Evaporation: Measurement, Evaporation suppression methods – Infiltration: Horton’s equation - Double ring infiltrometer - Infiltration indices.					
Unit II	RUNOFF				9
Catchment: Definition, Morphological characteristics - Factors affecting runoff - Run off estimation using Strange’s table and empirical methods - SCS-CN method – Stage discharge relationship - Flow measurements - Hydrograph – Unit Hydrograph – IUH.					
Unit III	HYDROLOGICAL EXTREMES				9
Natural Disasters - Frequency analysis - Flood estimation - Flood management - Definitions of drought: Meteorological, Hydrological, Agricultural and Integrated - IMD method - NDVI analysis - Drought Prone Area Programme (DPAP).					
Unit IV	RESERVOIRS				9
Classification of reservoirs - Site selection - General principles of design - Spillways -Elevation-Area-Capacity curve - Storage estimation - Sedimentation - Life of reservoirs – Rule curve.					
Unit V	GROUNDWATER AND MANAGEMENT				9
Origin - Classification and types - Properties of aquifers - Governing equations – Steady and unsteady flow - Artificial recharge - RWH in rural and urban areas.					
Total periods: 60					
Text Books:					
1. Subramanya K, "Engineering Hydrology"- Tata McGraw Hill, 2010					
2. Jayarami Reddy P, "Hydrology", Tata McGraw Hill, 2008.					
References:					

1. David Keith Todd. "Groundwater Hydrology", John Wiley & Sons, Inc. 2007															
2. Ven Te Chow, Maidment, D.R. and Mays, L.W. "Applied Hydrology", McGraw Hill International Book Company, 1998.															
3. Raghunath. H.M., "Hydrology", Wiley Eastern Ltd., 1998.															
4. Bhagu R. Chahar, Groundwater Hydrology, McGraw Hill Education (India) Pvt Ltd, New Delhi, 2017															
Course Outcomes:													Blooms Taxonomy		
CO1: Define the hydrological processes and their integrated behaviour in catchments													K2		
CO2: Apply the knowledge of hydrological processes to address basin characteristics, runoff and hydrograph													K3		
CO3: Explain the concept of hydrological extremes and its management strategies													K2		
CO4: Describe the principles of storage reservoirs													K2		
CO5: Understand and apply the concepts of groundwater management													K3		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	2	2	-	2	2	-	2	2	1	1
CO2	2	3	2	2	1	2	2	-	3	2	-	2	2	2	1
CO3	2	2	2	1	-	2	2	-	2	2	2	2	3	3	2
CO4	2	2	3	1	1	3	2	2	2	2	-	3	3	3	2
CO5	2	2	2	2	1	3	2	2	3	2	2	3	3	2	2

23GET701	Human Values and Ethics	Category: HSMC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To create awareness about values and ethics enshrined in the Constitution of India - To sensitize students about the democratic values to be upheld in the modern society. - To inculcate respect for all people irrespective of their religion or other affiliations.					
Unit I	DEMOCRATIC VALUES				9

Understanding Democratic values: Equality, Liberty, Fraternity, Freedom, Justice, Pluralism, Tolerance, Respect for All, Freedom of Expression, Citizen Participation in Governance – World Democracies: French Revolution, American Independence, Indian Freedom Movement. Reading Text: Excerpts from John Stuart Mills' <i>On Liberty</i>		
Unit II	SECULAR VALUES	9
Understanding Secular values – Interpretation of secularism in Indian context - Disassociation of state from religion – Acceptance of all faiths – Encouraging non-discriminatory practices. Reading Text: Excerpt from <i>Secularism in India: Concept and Practice</i> by Ram Puniyani		
Unit III	SCIENTIFIC VALUES	9
Scientific thinking and method: Inductive and Deductive thinking, Proposing and testing Hypothesis, Validating facts using evidence based approach – Skepticism and Empiricism – Rationalism and Scientific Temper. Reading Text: Excerpt from <i>The Scientific Temper</i> by Antony Michaelis R		
Unit IV	SOCIAL ETHICS	9
Application of ethical reasoning to social problems – Gender bias and issues – Gender violence – Social discrimination – Constitutional protection and policies – Inclusive practices. Reading Text: Excerpt from <i>21 Lessons for the 21st Century</i> by Yuval Noah Harari		
Unit V	SCIENTIFIC ETHICS	9
Transparency and Fairness in scientific pursuits – Scientific inventions for the betterment of society - Unfair application of scientific inventions – Role and Responsibility of Scientist in the modern society. Reading Text: Excerpt from <i>American Prometheus: The Triumph and Tragedy of J.Robert Oppenheimer</i> by Kai Bird and Martin J. Sherwin.		
Total periods: 60		
Text Books:		
1. The Nonreligious: Understanding Secular People and Societies, Luke W. Galen Oxford University Press,		
2. Secularism: A Dictionary of Atheism, Bullivant, Stephen; Lee, Lois, Oxford University Press, 2016.		
References:		
1. The Oxford Handbook of Secularism, John R. Shook, Oxford University Press, 2017		
2. The Civic Culture: Political Attitudes and Democracy in Five Nations by Gabriel A. Almond and Sidney Verba, Princeton University Press,		
3. Research Methodology for Natural Sciences by Soumitro Banerjee, IISc Press, January 2022		
Course Outcomes:		Blooms Taxonomy

CO1: Identify the importance of democratic, secular and scientific values in harmonious functioning of social life													K2		
CO2: Practice democratic and scientific values in both their personal and professional													K2		
CO3: Find rational solutions to social problems.													K2		
CO4: Behave in an ethical manner in society													K2		
CO5: Practice critical thinking and the pursuit of truth.													K4		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	2	2	-	2	2	-	2	2	1	1
CO2	2	3	2	2	1	2	2	-	3	2	-	2	2	2	1
CO3	2	2	2	1	-	2	2	-	2	2	2	2	3	3	2
CO4	2	2	3	1	1	3	2	2	2	2	-	3	3	3	2
CO5	2	2	2	2	1	3	2	2	3	2	2	3	3	2	2

23GET702	Total Quality Management	Category: HSMC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: • Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM. • Explain the TQM Principles for application. • Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.					
Unit I	INTRODUCTION				9
Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM - Gurus of TQM (Brief introduction) - TQM Framework- Barriers to TQM –Benefits of TQM.					
Unit II	TQM PRINCIPLES				9

Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning- Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal-- Continuous process improvement –Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.		
Unit III	TQM TOOLS & TECHNIQUES I	9
The seven traditional tools of quality - New management tools - Six-sigma Process Capability- Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent , Documentation, Stages: Design FMEA and Process FMEA.		
Unit IV	TQM TOOLS & TECHNIQUES II	9
Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures- Cost of Quality - BPR.		
Unit V	QUALITY MANAGEMENT SYSTEM	9
Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards - AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation- Internal Audits-Registration-ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS.		
Total periods: 60		
Text Books:		
1. Dale H.Besterfield, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and RashmiUrdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian		
References:		
1. Joel.E. Ross, “Total Quality Management – Text and Cases”, Routledge., 2017.		
2. Kiran.D.R, “Total Quality Management: Key concepts and case studies, Butterworth – Heinemann Ltd, 2016.		
3. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition,2003.		
4. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd.,2006 .		
Course Outcomes:		Blooms Taxonomy
CO1: Ability to apply TQM concepts in a selected enterprise.		K2
CO2: Ability to apply TQM principles in a selected enterprise.		K2

CO3: Ability to understand Six Sigma and apply Traditional tools, New tools,													K2		
CO4: Ability to understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR													K2		
CO5: Ability to apply QMS and EMS in any organization.													K2		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		3										3	2		3
CO2						3						3		2	
CO3					3				3					2	3
CO4		2			3	2	3	2				3	3	2	
CO5			3			3	3	2							

23CEP702	PROJECT WORK I	Category: PCC			
		L	T	P	C
		0	0	8	4
Prerequisites: Estimation and Surveying					
Course Objectives: To use the knowledge acquired in Civil Engineering to do a mini project, which allows the students to come up with designs, fabrication or algorithms and programs expressing their ideas in a novel way. To identify a topic of interest in consultation with Faculty/Supervisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design / fabrication or develop computer code. Demonstrate the novelty of the project through the results and outputs.					
Total periods: 60					
Course Outcomes:					Blooms Taxonomy
CO1: Formulate and analyze problem / create a new product/ process					Understand (K2)
CO2: Design and conduct experiments to find solution					Analyze (K4)
CO3: : Analyze the results and provide solution for the identified problem					Analyze (K4)
CO4: To prepare project report					Analyze (K4)
CO5: To make presentation					Analyze (K4)
CO – PO & PSO Mapping					

Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO Avg.	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

SEMESTER VIII

23CEP801	PROJECT WORK II												Category: PCC			
													L	T	P	C
													0	0	12	6
Prerequisites: Process Dynamics and Control																
Course Objectives: To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reportsand to face reviews and viva voce examination.																
The student works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction. The student will be evaluated based on the report and the viva voce examination by a team of examiners including one external examiner.																
Total periods: 180																
Course Outcomes:													Blooms Taxonomy			
CO1: Identify civil engineering problems reviewing available literature.													Understand (K2)			
CO2: Identify appropriate techniques to analyze complex civil engineering problems.													Analyze (K4)			
CO3: Apply engineering and management principles through efficient handling of Project have a clear idea of his/her area of work and they are in a position to carry out the work in a systematic way.													Analyze (K4)			
CO – PO & PSO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	

CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO Avg.	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

MANDATORY COURSES I

23MCT001	INTRODUCTION TO WOMEN AND GENDER STUDIES	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites • Basic awareness of social issues and human rights. • Interest in understanding gender, culture, and society.					
Course Objectives: • To introduce fundamental concepts related to sex, gender, patriarchy, and gender roles. • To familiarize students with major feminist theories and their evolution. • To understand global, national, and local women’s movements. • To study the relationship between gender and language. • To examine gender representation in media and digital platforms.					
Unit I	CONCEPTS				9
Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour.					
Unit II	FEMINIST THEORY				9
Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.					
Unit III	WOMEN’S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL				9
Rise of Feminism in Europe and America. Women’s Movement in India.					
Unit IV	GENDER AND LANGUAGE				9
Linguistic Forms and Gender. Gender and narratives.					
Unit V	GENDER AND REPRESENTATION				9
Advertising and popular visual media. Gender and Representation in Alternative Media. Gender and social media.					
Total periods:45 PERIODS					
Course Outcomes:					Blooms Taxonomy
CO1: Explain key concepts related to gender, patriarchy, identity, and power.					Understand (K2)
CO2: Compare various feminist theories and their contributions.					Analyze (K4)
CO3: Discuss women’s movements at global, national, and local levels.					Understand (K2)
CO4: Analyze how gender influences language, communication, and narratives.					Analyze (K4)

CO5: Evaluate gender representation in advertising, visual media, alternative media, and social media.													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1				3	2	2	1	2		1	2	1	
CO2	2	2				3	2	2	1	2		1	2	1	
CO3	2	1				3	2	3	2	2		2	2	1	
CO4	2	2	1		1	3	2	3	2	2	1	2	2	1	
CO5	3	2	1		1	3	3	3	2	3	1	2	2	2	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation-															

23MCT002	ELEMENTS OF LITERATURE	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites • Basic understanding of English grammar and vocabulary • Ability to read and interpret simple prose and poetry • Familiarity with basic literary terms such as poet, narrator, plot, and character					
Course Objectives: • To make the students aware about the finer sensibilities of human existence through an art form. The students will learn to appreciate different forms of literature as suitable modes of expressing human experience. • To make the students aware of the finer sensibilities of human existence through literature • To help students appreciate different genres of literature as means of expressing human experiences • To enhance analytical, critical thinking, discussion, and writing skills • To develop the ability to interpret literary texts without bias					
1. COURSE CONTENTS					
Introduction to Elements of Literature					
1. Relevance of literature					
a) Enhances Reading, thinking, discussing and writing skills. b) Develops finer sensibility for better human relationship. c) Increases understanding of the problem of humanity without bias.					

d) Providing space to reconcile and get a cathartic effect.
2. Elements of fiction
a) Fiction, fact and literary truth. b) Fictional modes and patterns. c) Plot character and perspective.
3. Elements of poetry
a) Emotions and imaginations. b) Figurative language. c) (Simile, metaphor, conceit, symbol, pun and irony). d) Personification and animation. e) Rhetoric and trend.
4. Elements of drama
a) Drama as representational art. b) Content mode and elements. c) Theatrical performance. d) Drama as narration, mediation and persuasion. e) Features of tragedy, comedy and satire.
1. READINGS:
1. An Introduction to the Study of English Literature, W.H. Hudson, Atlantic, 2007.
2. An Introduction to Literary Studies, Mario Klarer, Routledge, 2013.
3. The Experience of Poetry, Graham Mode, Open college of Arts with Open Univ Press, 1991.
4. The Elements of Fiction: A Survey, Ulf Wolf (ed), Wolfstuff, 2114.
5. The Elements of Drama, J.L.Styan, Literary Licensing, 2011.
3.1 Textbook:
3.2 *Reference Books: To be decided by the teacher and student, on the basis of individual student so as to enable him or her to write the term paper.
3. OTHER SESSION:
4.1*Tutorials:
4.2*Laboratory:
4.3*Project: The students will write a term paper to show their understanding of a particular piece of literature
4. ASSESSMENT:
5.1HA:

5.2 Quizzes-HA:															
5.3 Periodical Examination: one															
5.4 Project/Lab: one (under the guidance of the teachers the students will take a volume of poetry, fiction or drama and write a term paper to show their understanding of it in a given context; sociological, psychological, historical, autobiographical etc.															
5.5 Final Exam:															
Total periods:45 PERIODS															
Course Outcomes:													Blooms Taxonomy		
CO 1: Students will be able to understand the relevance of literature in human life and appreciate its aspects in developing finer sensibilities.													Understand (K2)		
CO2: Explain the major elements of fiction such as plot, character, theme, and narrative techniques.													Analyze(K4)		
CO3: Interpret poetic devices such as imagery, symbolism, metaphor, and other figurative forms.													Understand (K2)		
CO4: Analyze the features and dramatic techniques used in various forms of drama.													Analyze (K4)		
CO5: Evaluate the role of literature in shaping human emotions, social understanding, and cultural perspectives.													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1						1	1	2		1	2		
CO2	2	2	1					1		2		1	2		
CO3	2	2	2	1				1		2		1	2		
CO4	2	3	2	2				1		3		1	3		
CO5	3	3	3	2	1			1		3		2	3	1	
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation-															

23MCT003	FILM APPRECIATION	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites • Basic understanding of visual media (films, advertisements, or online videos). • Ability to read and interpret narrative content.					

General awareness of cultural, social, and historical contexts.		
Course Objectives: - To introduce students to the core components and processes in filmmaking. - To familiarize students with the evolution of film language and major developments in world cinema. - To enable students to understand and apply major film theories for interpretation. - To provide exposure to global film movements and national cinema traditions. - To help students critically evaluate Indian cinema, regional films, and documentaries.		
Theme - A	The Component of Films	9
A-1: The material and equipment A-2: The story, screenplay and script A-3: The actors, crew members, and the director A-4: The process of film making... structure of a film		
Theme - B	Evolution of Film Language	9
B-1: Film language, form, movement etc. B-2: Early cinema... silent film (Particularly French) B-3: The emergence of feature films: Birth of a Nation B-4: Talkies		
Theme - C	Film Theories and Criticism/Appreciation	9
C-1: Realist theory; Auteurists C-2: Psychoanalytic, Ideological, Feminists C-3: How to read films? C-4: Film Criticism / Appreciation		
Theme - D	Development of Films	9
D-1: Representative Soviet films D-2: Representative Japanese films D-3: Representative Italian films D-4: Representative Hollywood film and the studio system		
Theme - E	Indian Films	9
E-1: The early era E-2: The important films made by the directors E-3: The regional films E-4: The documentaries in India		

READING:															
A Reader containing important articles on films will be prepared and given to the students. The students must read them and present in the class and have discussion on these.															
Course Outcomes:												Blooms Taxonomy			
CO1: Describe the basic components and processes involved in filmmaking.												Understand (K2)			
CO2: Explain the evolution of film language and major developments in world cinema.												Understand (K2)			
CO3: Analyze major film theories and apply them to interpret films.												Analyze (K4)			
CO4: Compare the characteristics of various national cinemas across different eras.												Analyze (K4)			
CO5: Evaluate Indian films, regional cinema, and documentaries through critical appreciation.												Evaluate (K5)			
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1				1	2	1		2		1			
CO2	2	2		1		1	2	1		2		1			
CO3	1	3	1	2		1	2	2	1	2		1			
CO4	1	2	1	2		1	2	2	1	2		1			
CO5	1	3	1	2		2	3	2	1	3		1			
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation-															

23MCT004	DISASTER MANAGEMENT	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites • Basic understanding of geography and environmental science. • Awareness of common natural and human-induced hazards. • Ability to understand social, economic, and cultural systems.					
Course Objectives: • To introduce the fundamental concepts of hazards, vulnerability, disaster risks, and resilience. • To familiarize students with disaster risk reduction strategies and global frameworks. • To understand disaster management phases, policies, and institutional mechanisms in India.					

- To learn tools, technology, and early warning systems used in disaster management. - To analyze real-world disaster case studies and develop practical response skills.		
Unit I	HAZRADS, VULNERABILITY AND DISASTER RISKS	9
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, - -, Inter relations between Disasters and Sustainable development Goals		
Unit II	DISASTER RISK REDUCTION (DRR)	9
Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.		
Unit III	DISASTER MANAGEMENT	9
Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)		
Unit IV	TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT	9
Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster Management		
Unit V	DISASTER MANAGEMENT: CASE STUDIES	9
Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters- Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.-		

Field work-Mock drill -															
Total periods:45 PERIODS															
Text Books:															
1 Taimpo (2016), Disaster Management and Preparedness, CRC Publications															
2 Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications															
3 Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423															
4 Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]															
References:															
1 Taimpo (2016), Disaster Management and Preparedness, CRC Publications															
2 Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications															
3 Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423															
Course Outcomes:													Blooms Taxonomy		
CO 1: To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR)													Understand (K2)		
CO2: To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction													Analyze (K4)		
CO3: To develop disaster response skills by adopting relevant tools and technology													Apply (K3)		
CO4: Enhance awareness of institutional processes for Disaster response in the country and													Understand (K2)		
CO5: Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1		1	1	1	2	2		2		2			
CO2	2	2	1	2	1	1	2	2		2		2			
CO3	2	3	2	2	2	1	2	2	1	2		2			
CO4	2	2	1	1	1	1	2	2		2		2			

CO5	1	3	2	2	1	2	3	3	1	3		2			
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation-															

MANDATORY COURSES II

23MCT006	WELL-BEING WITH TRADITIONAL PRACTICES- YOGA, AYURVEDA AND SIDDHA	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites • Basic awareness of health and hygiene • Willingness to participate in physical and mindfulness activities • Openness to learning traditional wellness practices					
Course Objectives: • To enjoy life happily with fun filled new style activities that help to maintain health also • To adapt a few lifestyle changes that will prevent many health disorders • To be cool and handbill every emotion very smoothly in every walk of life • To learn to eat cost effective but healthy foods that are rich in essential nutrients • To develop immunity naturally that will improve resistance against many health disorders					
Unit I	HEALTH AND ITS IMPORTANCE				2+4
Health: Definition - Importance of maintaining health - More importance on prevention than treatment Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational/Professional heath. Present health status - The life expectancy-present status - mortality rate - dreadful diseases - Non-communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities. Types of diseases and disorders - Lifestyle disorders – Obesity – Diabetes - Cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues. Causes of the above diseases / disorders - Importance of prevention of illness - Takes care of health -					

Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time		
Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) - Maintaining BMI-Importance and actions to be taken		
Unit II	DIET	4+6
Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong.		
Balanced Diet and its 7 Components - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water.		
Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions		
Definition of BMI and maintaining it with diet Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM		
Common cooking mistakes Different cooking methods, merits and demerits of each method		
Unit III	ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH	4+4
AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy.		
Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.		
Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Panchcheekarana Theory / (Five Element Theory) 96 fundamental Principles - UyirThathukkal (TriDosha Theory) - Udal Thathukkal		
Prevention of illness with our traditional system of medicine Primary Prevention - To decrease the number		

of new cases of a disorder or illness - Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention - To decrease the amount of disability associated with an existing disorder.		
Unit IV	MENTAL WELLNESS	3+4
Emotional health - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioural response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances - Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions. Stress management - Stress definition - Stress in daily life - How stress affects one's life - Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement. Sleep - Sleep and its importance for mental wellness - Sleep and digestion. Immunity - Types and importance - Ways to develop immunity		
Unit V	YOGA	2+12
Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life.		
Total periods:60		
Text Books:		
1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA		
2. Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California		
References:		
1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England		
2. The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York,		

NY 10001.															
Course Outcomes:													Blooms Taxonomy		
CO1: Learn the importance of different components of health													Understand (K2)		
CO2: Gain confidence to lead a healthy life													Apply (K3)		
CO3: Learn new techniques to prevent lifestyle health disorders													Apply (K3)		
CO4: Understand the importance of diet and workouts in maintaining health.													Analyze (K4)		
CO5: Calculate the various performance parameters of IC engines													Apply (K3)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2					2	3	1							
CO2						2	3	3	2						
CO3			1			3	3	3							
CO4	1			1		2	2								
CO5						3	3	2							
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MCT007	HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites • Basic understanding of social sciences at the school level • Interest in science, technology, and historical evolution • Ability to read and interpret historical sources					
Course Objectives: • Introduce the concepts and perspectives involved in understanding the history of science and technology. • Familiarize students with major historiographical works on Indian science and technology. • Explore the development of science and technology in ancient, medieval, and colonial India. • Analyze post-independence science and technology policies and advancements. • Understand the relationship between science, technology, and society in the Indian context.					
Unit I	CONCEPTS AND PERSPECTIVES				

Meaning of History Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism. Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.		
Unit II	HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA	
Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.		
Unit III	SCIENCE AND TECHNOLOGY IN ANCIENT INDIA	
Technology in pre-historic period Beginning of agriculture and its impact on technology Science and Technology during Vedic and Later Vedic times Science and technology from 1st century AD to C-1200		
Unit IV	SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA	
Science and the Empire Indian response to Western Science Growth of techno-scientific institutions		
Unit V	SCIENCE AND TECHNOLOGY IN COLONIAL INDIA	
Performance and Emission Testing, Performance parameters and calculations. Morse and Heat Balance tests. Multipoint Fuel Injection system and Common rail direct injection systems. Ignition systems – Magneto, Battery and Electronic. Lubrication and Cooling systems. Concepts of Supercharging and Turbocharging – Emission Norms		
Unit VI	SCIENCE AND TECHNOLOGY IN A POST-INDEPENDENT INDIA	
Science, Technology and Development discourse Shaping of the Science and Technology Policy Developments in the field of Science and Technology Science and technology in globalizing India Social implications of new technologies like the Information Technology and Biotechnology		
Total periods:45		
Course Outcomes:		Blooms Taxonomy
CO1: Explain key concepts, perspectives, and methods used in the history of science and technology		Understand (K2)
CO2: Summarize major historiographical contributions to the study of science and technology in India		Understand (K2)
CO3: Describe the evolution of science and technology in ancient, medieval, and colonial India		Understand (K2)
CO4: Analyze the development of science and technology in post-independent India and its socio-economic implications		Analyze (K4)
CO5: Evaluate the interaction between science, technology, and society using		Evaluate (K5)

historical evidence															
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1				1	1			1					
CO2	1									1					
CO3	2					1	1			1					
CO4	1	1		2		2	2	1		1					
CO5	1	2		2		3	2	2		1					
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MCT008	POLITICAL ECONOMIC THOUGHT FOR A HUMAN SOCIETY	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites None.(Desirable: Universal Human Values 1, Universal Human Values 2)					
Course Objectives: This course will begin with a short overview of human needs and desires and how different political-economic systems try to fullfill them. In the process, we will end with a critique of different systems and their implementations in the past, with possible future directions.					
Unit I					9
Considerations for humane society, holistic thought, human being’s desires, harmony in self, harmony in relationships, society, and nature, societal systems					
Unit II					5
Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism. Liberal democracy.					
Unit III	STEAM AND GAS TURBINES				2
Fascism and totalitarianism. World war I and II. Cold war.					
Unit IV					5
Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models.					
Unit V					3
Welfare state. Relation with human desires. Empowered human beings, satisfaction.					
Unit VI					6

Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one’s lives. Relationship with nature.															
Unit VII														3	
Essential elements of Indian civilization.															
Unit VIII														4	
Technology as driver of society, Role of education in shaping of society. Future directions															
														2	
Conclusion															
Total periods:39															
References:															
1. Ballaney. P, “Thermal Engineering”, 25th Edition, Khanna Publishers, 2017.															
Course Outcomes:													Blooms Taxonomy		
CO1: Explain fundamental concepts relating to humane society, human needs, and socio-political harmony													Understand(K2)		
CO2:Compare and contrast major political and economic systems such as capitalism, fascism, communism, welfare state, and Gandhian thought													Analyze(K4)		
CO3:Evaluate the historical impact of political ideologies on human welfare, conflicts, and global developments													Evaluate(K5)		
CO4:Assess the relevance of Indian civilization, decentralization, and community-centered living for present society													Analyze(K4)		
CO5:Formulate informed views on how technology, education, and governance contribute to building a humane and sustainable society													Create(K6)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1				2	2	2		2		2			
CO2	1	2				3	2	2		2		2			
CO3	1	2				3	2	3		2		3			
CO4		1				3	3	2		2		2			
CO5		2				3	3	3	1	3	2	3			
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23MCT009	STATE, NATION BUILDING AND POLITICS IN INDIA	Category: MC

		L	T	P	C
		3	0	0	0
Prerequisites					
None.(Desirable: Prior exposure to civics, political science, or UHV courses)					
Course Objectives:					
The objective of the course is to provide an understanding of the state, how it works through its main organs, primacy of politics and political process, the concept of sovereignty and its changing contours in a globalized world. In the light of this, an attempt will be made to acquaint the students with the main development and legacies of national movement and constitutional development in India, reasons for adopting a Parliamentary-federal system, the broad philosophy of the Constitution of India and the changing nature of Indian Political System. Challenges/ problems and issues concerning national integration and nation-building will also be discussed in the contemporary context with the aim of developing a future vision for a better India.					
Unit I					
Understanding the need and role of State and politics.					
Unit II					
Development of Nation-State, sovereignty, sovereignty in a globalized world.					
Unit III					
.Organs of State – Executive, Legislature, Judiciary. Separation of powers, forms of governmentunitary-federal, Presidential-Parliamentary, The idea of India.					
Unit IV					
.1857 and the national awakening.					
Unit V					
1885 Indian National Congress and development of national movement – its legacies. Constitution making and the Constitution of India					
Unit VI					
Goals, objective and philosophy. Why a federal system? National integration and nation-building.					
Unit VII					
Challenges of nation-building – State against democracy (Kothari) New social movements. The changing nature of Indian Political System, the future scenario. What can we do?					
Total periods:45					
References:					
1.Sunil Khilnani, The Idea of India. Penguin India Ltd., New Delhi.					

2.Madhav Khosla, The Indian Constitution, Oxford University Press. New Delhi, 2012.															
3.Brij Kishore Sharma, Introduction to the Indian Constitution, PHI, New Delhi, latest edition.															
Course Outcomes:													Blooms Taxonomy		
CO1: Explain the need, role, and functions of the State and politics in society													Understand (K2)		
CO2: Analyze the concept of nation-state, sovereignty, and their evolution in a globalized world													Analyze (K4)		
CO3: Describe the structure and functioning of the major organs of the State and forms of government													Understand (K2)		
CO4: Examine the evolution of the Indian national movement and constitutional development													Analyze (K4)		
CO5: Evaluate India's challenges in nation-building and propose informed perspectives for a better political future													Evaluate/Create (K5/K6)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1					3	2	2		2		2			
CO2	1	2				3	2	2		2		3			
CO3	1	1				2	1	2		2		2			
CO4	1	2				3	2	2		2		3			
CO5		2				3	3	3	1	3		3			
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23MCT010	INDUSTRIAL SAFETY	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites None. (Desirable: Basic knowledge of physics, chemistry, and workplace operations.)					
Course Objectives: - To Understand the Introduction and basic Terminologies safety. - To enable the students to learn about the Important Statutory Regulations and standards. - To enable students to Conduct and participate the various Safety activities in the Industry. - To have knowledge about Workplace Exposures and Hazards.					

To assess the various Hazards and consequences through various Risk Assessment Techniques.		
Unit I	SAFETY TERMINOLOGIES	9
Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators- Flammability- Toxicity Time-weighted Average (TWA) - Threshold Limit Value (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS		
Unit II	STANDARDS AND REGULATIONS	9
Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006		
Unit III	SAFETY ACTIVITIES	9
Types, Impulse and reaction principles, Velocity diagrams, Work done and efficiency – optimal operating conditions. Multi-staging, compounding and governing. Gas turbine cycle analysis – open and closed cycle. Performance and its improvement - Regenerative, Intercooled, Reheated cycles and their combination.		
Unit IV	INTERNAL COMBUSTION ENGINES – FEATURES AND COMBUSTION	9
Noise hazard- Particulate matter- musculoskeletal disorder improper sitting posture and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety Toxic gas Release		
Unit V	HAZARD IDENTIFICATION TECHNIQUES	9
Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment		
Total periods:45		
Text Books:		
1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER		
2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education		
References:		
1. Frank Lees (2012) ‘Lees’ Loss Prevention in Process Industries.Butterworth-Heinemann		

publications, UK, 4th Edition.															
2. John Ridley & John Channing (2008) Safety at Work: Routledge, 7th Edition.															
3. Dan Petersen (2003) Techniques of Safety Management: A System Approach.															
4. Alan Waring.(1996). Safety management system: Chapman & Hall, England															
5. Society of Safety Engineers, USA															
Course Outcomes:													Blooms Taxonomy		
CO1: Understand the basic concept of safety.													Understand (K2)		
CO2: Obtain knowledge of Statutory Regulations and standards.													Understand (K2)		
CO3: Know about the safety Activities of the Working Place.													Apply (K3)		
CO4: Analyze on the impact of Occupational Exposures and their Remedies													Analyze (K4)		
CO5: Obtain knowledge of Risk Assessment Techniques.													Apply (K3)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1				2	2	2		1		2	2	1	
CO2	2	2	1			3	2	3		1		2	2	1	
CO3	1	2	2	1		3	2	2	1	2		2	3	2	
CO4	2	3	2	2		3	3	3		2	1	3	3	3	
CO5	2	3	3	2		3	3	3		2	1	3	3	3	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

VERTICAL I: STRUCTURES

23CEE001	CONCRETE STRUCTURES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Strength of Materials • Concrete Technology • Engineering Mechanics • Structural Analysis					
Course Objectives: • To acquire hands on experience in design and preparation of structural drawings for concrete / steel structures normally encountered in Civil Engineering practice using Computer Software Staad Pro,					
Unit I	INTRODUCTION AND CODES				9
Geometric Parameters, Grade of concrete and steel for different elements, Exposure and cover requirements, Fire rating, Load Combinations, Serviceability Requirements, Analysis tools. Indian &					
Unit II	LOADS ACTING ON STRUCTURES				9
Introduction, Dead, Live loads, Wind loading and Calculations of - force coefficients, Wind pressure, storey forces and base shears. Earthquake loading and Calculations of - acceleration coefficient, Time period, Base shear. Scheme Design, Concrete floor systems, Sizing and design of various slab systems, Beams, Reinforced Concrete Columns - Location and Shape, Design Axial Load, sizing, Lateral Load Systems, IS 1893- Requirements.					
Unit III	MODELLING OF BASIC STRUCTURAL ELEMENTS				9
Introduction to Analysis & Modelling, Modelling of Cantilever, Portal Frame, three bay Portal Frame, 3D structural models - Geometry, gravity loads, defining earthquake loads, defining wind loads, Modelling Shear walls, Practical Structural Model of building, Structural models of Floor System, Estimation of deflections					
Unit IV	DESIGN OF STRUCTURAL ELEMENTS				9
Design of Beams- flexural reinforcement, shear reinforcement, Design of flat slabs- Flexural Reinforcement, shear reinforcement, Design of 2-way continuous slabs. Design of Reinforcements in Columns, Post processing, Design and arrangement of vertical reinforcement, horizontal reinforcement in the design of buildings. Design of shear walls - Sizing of elements based on Constructability aspects like formwork, concrete placement and compaction, rebar arrangement to satisfy economy and optimum					

utilisation.																
Unit V		DETAILING OF STRUCTURAL ELEMENTS												9		
Development of Reinforcement, Typical details of- flat slabs, two-way continuous slabs, beams, columns and shear wall, detailing and documentation. Case Studies : Structural analysis and design of a multi-storey building with load calculation (dead, live, wind and seismic) as per Indian standard codes using any Structural design and analysis Software.																
Total Periods: 45																
Text Books:																
Gambhir.M.L., "Fundamentals of Reinforced Concrete Design", Prentice Hall of India Private Limited, New Delhi, 2006																
. Krishnaraju.N “Design of Reinforced Concrete Structures “, CBS Publishers & Distributors Pvt. Ltd., New Delhi.																
References:																
1.Unnikrishna Pillai, S., Devdas Menon, “Reinforced Concrete Design”, Tata McGraw Hill Publishing Company Ltd., 2009.																
2. Gambhir.M.L., "Fundamentals of Reinforced Concrete Design", Prentice Hall of India Private Limited, New Delhi, 2006																
3. Krishnaraju.N “Design of Reinforced Concrete Structures “, CBS Publishers & Distributors Pvt. Ltd., New Delhi.																
4. Sinha, S.N., “Reinforced Concrete Design”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2002.																
5. Punmia.B.C., Ashok Kumar Jain, Arun Kumar Jain, “Limit State Design of Reinforced Concrete”,Laxmi Publication Pvt. Ltd., New Delhi, 2007.																
Course Outcomes:													Blooms Taxonomy			
CO 1: Plan a layout of a structure													K2			
CO2: Calculate loads using IS codes and various computational tools													K4			
CO3: Analyse the structure for various loads and load combination according to the relevant IS codes													K4			
CO4: Design and Analysis of structures using computer software/tools													K4			
CO5: Prepare the complete structural drawings using computer software													K4			
CO - PO & PSO Mapping																
Particular	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO	

	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	0	3	0	2	1	0	3	1	0	1	3	3	1	2
CO2	3	0	0	2	1	0	0	0	1	0	1	0	3	1	2
CO3	3	2	0	3	3	0	0	3	1	2	1	0	3	2	3
CO4	3	3	2	3	3	0	0	1	1	0	1	2	2	3	3
CO5	3	3	2	3	3	0	2	1	1	0	1	2	2	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEE002	STEEL STRUCTURES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Strength of Materials • Structural Analysis • Engineering Mechanics • Structural Steel Design Basics					
Course Objectives: • To acquire hands on experience in design and preparation of structural drawings for steel structures like industrial buildings, steel framed buildings using structural design software and detailed drawing softwares • To introduce the students to design of light gauge steel structures					
Unit I	DESIGN ASPECTS AND LOADS ON A STEEL BUILDING				9
Inputs for the design of a steel building - Design basis report, covering Site Data, geometrical, functional and structural requirements for its end usage - material specifications - Methods of designing a steel building. Calculating the various loads acting on a steel building - Vertical & Lateral loads - Effects of each loads separately and in combination – Dead, superimposed dead, live, temperature, MEP service loads - Lateral loads due to Wind and Seismic effects					
Unit II	SELECTION OF LOAD RESISTING SYSTEM AND MODELLING OF STRUCTURE				9
Studying the layout plans of the structure - Selection of load resisting systems - Load flow in each system - Satisfying Stability and strength of the structure - Vertical and Lateral load resisting systems. Analysis and					

design of Sway and non-sway frames - Manual and Computer aided modelling, analysis and design - Geometric and structural parameters of the structure - Loading the structure - Interpretation of the results of the software – Analysis and Design of a multi-storeyed building		
Unit III	DESIGN OF VARIOUS ELEMENTS OF A STEEL BUILDING	9
Manual and Software aided design – Beams, columns, floors, bracings, purlins/girts and facades, base plates and anchor bolts – Various loads, different conditions of supports, exposure, and purpose of use - Design of Connections between the members – bolted and welded, moment and shear connections.		
Unit IV	DESIGN OF AN INDUSTRIAL BUILDING	9
Functional requirements - Serviceability Requirements - Structural Configurations - Selection of sections as per requirements - Configuration of the elements, connectivity - Analysis and design of different types of trusses — Design of Gantry Girders – Design of gable frames – Design of steel columns for combined loading - Analysis and design of industrial buildings - Study of General assembly drawings - Fabrication processes - Fabrication, logistics & erection – Sequence of erection Inspection of a completed structure		
Unit V	DESIGN OF LIGHT GAUGE STEEL STRUCTURES	9
Philosophy of design of light gauge steel members, Direct Strength Method (DSM) ,Effective width method (EWM) – Concept of buckling, local buckling and post-buckling strength - Analysis and design of Compression members– Analysis and design of flexural members, Lateral buckling of beams, Shear Lag, Flange Curling – Design of wall panels		
Total Periods: 45		
Text Books:		
1. Subramanian N, Design of Steel Structures, Oxford University Press, New Delhi, 2016		
2. Negi L.S. “Design of steel structures” McGraw Hill Co., New Delhi, 2014		
3. Duggal S.K., Design of Steel Structures, Tata McGraw Hill, Publishing Co. Ltd., New Delhi,2010		
References:		
1. Gambhir M L, Fundamentals of Structural Steel Design, McGraw Hill Education India Pvt Limited, 2013.		
2. Jack C. McCormac and Stephen F Csernak, Structural Steel Design, Pearson Education Limited, 2013.		
3. Sarwar Alam Raz, Structural Design in Steel, New Age International Publishers, 2014		
4. Gaylord E H, Gaylord N C and Stallmeyer J E, “Design of Steel Structures”, 3 rd edition, McGraw Hill Publications, 1992		
5. Salmon, Johnson & Malhas,” Steel Structures: Design and Behavior, 4th Edition, Harper Collins College Publisher, 1996.		
6. Bhavikatti S.S, Design of Steel Structures, Ik International Publishing House, New Delhi,2017		

Course Outcomes:													Blooms Taxonomy		
CO 1: Plan the layout of the structure and calculate the loads of the steel structure.													K2		
CO2: Select a load resisting system, model the structure and interpret the results													K2		
CO3: Design the various elements of a steel building													K4		
CO4: Design a typical industrial building													K4		
CO5: Design the various elements of a cold –formed steel buildings													K4		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	0	2	0	0	1	0	2	1	2	3	2	3
CO2	3	2	1	0	2	0	1	1	1	1	0	1	3	2	3
CO3	3	3	2	2	2	0	1	2	1	1	0	1	3	3	3
CO4	3	2	2	1	2	1	2	2	2	1	1	2	3	3	3
CO5	3	3	2	1	2	1	2	2	1	1	1	2	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEE003	PREFABRICATED STRUCTURES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Concrete Technology - Building Materials and Construction - Structural Analysis - Reinforced Concrete Design					
Course Objectives: - To introduce the basic concepts of prefabrication - To acquire the knowledge of prefabrication components and systems - To understand the design principles in prefabrication - To perceive the types of joints and connections in structural members - To impart knowledge about the structural stability.					
Unit I	INTRODUCTION				9

Need for prefabrication -Advantages and limitations – Principles of prefabrication – Modular coordination – Standarization– Loads and load combinations– Materials – Production – Transportation – Erection.		
Unit II	PREFABRICATED COMPONENTS AND SYSTEMS	9
Behaviour and types of structural components– roof and floor slabs – Walls panels - Shear walls - Beams - Columns – skeletal system- portal frame system-Large panel systems- block system.		
Unit III	DESIGN PRINCIPLES	9
Design philosophy- Design of cross section based on efficiency of material used – Problems in design because of joint flexibility – Allowance for joint deformation - Demountable precast concrete systems- Design for stripping , stacking ,transportation and erection of elements.		
Unit IV	JOINTS AND CONNECTIONS IN STRUCTURAL MEMBERS	9
Types of Joints – based on action of forces - compression joints - shear joints - tension joints - based on function - construction joints , contraction joints, expansion joints. Design of expansion joints - Dimensions and detailing - Types of sealants - Types of structural connections - Beam to Column - Column to Column - Beam to Beam - Column to foundation.		
Unit V	DESIGN FOR ABNORMAL LOADS	9
Progressive collapse – Codal provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc., - Importance of avoidance of progressive collapse -case study.		
Total Periods: 45		
Text Books:		
1. Bruggeling A.S. G and Huyghe G.F. "Prefabrication with Concrete", A.A. Balkema Publishers, USA,1991.		
2.Lewitt,M. " Precast Concrete- Materials, Manufacture, Properties And Usage ,CRC Press, 2019		
3. <u>Alfred Steinle</u> , <u>Hubert Bachmann</u> , <u>Mathias Tillmann</u> , <u>Philip Thrift</u> . "Precast Concrete Structures", Ernst & Sohn, Berlin, 2019.		
References:		
1. Koncz T., "Manual of precast concrete construction", Vol. I, II and III, Bauverlag, GMBH, 1976..		
2. "Handbook on Precast Concrete Buildings", Indian Concrete Institute, 2016.		
3. " Precast concrete connection details", Structural Design manual, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 2009.		
Course Outcomes:		Blooms Taxonomy
CO 1: Understand concepts about principles of prefabrication, production, transportation, erection.		K2
CO2: Acquire knowledge about panel systems, slabs, beams, shear walls and		K2

columns used in precast construction															
CO3: Acquire knowledge about design of cross section, joint flexibility													K4		
CO4: Acquire knowledge about joints and connection in precast construction													K2		
CO5: Acquire knowledge about structural stability.													K2		
CO - PO & PSO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	1	3	3	2	1	2	3	2	2
CO2	3	1	2	1	1	3	1	3	1	2	1	2	3	2	2
CO3	3	3	3	3	3	3	1	3	2	2	1	2	3	2	2
CO4	3	2	2	2	1	3	1	3	1	2	1	2	3	2	2
CO5	3	2	3	3	1	3	1	3	1	2	1	2	3	2	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEE004	PRESTRESSED CONCRETE STRUCTURES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Strength of Materials • Concrete Technology • Structural Analysis • Reinforced Concrete Design					
Course Objectives: • To understand the methods and types of prestressing and to enable the students to design prestressed concrete structural elements and systems					
Unit I	INTRODUCTION – THEORY AND BEHAVIOUR				9
Basic principles of prestressing – Classification and types – Advantages over ordinary reinforced concrete – Materials – High strength concrete and high tensile steel – Methods of prestressing – Freyssinet, Magnel, Lee-McCall and Gifford Udall anchorage systems – Analysis of sections of stresses by stress concept, strength concept and load balancing concept – Losses of prestress in post -tensioned and pre-tensioned members.					

Unit II	DESIGN FOR FLEXURE AND SHEAR	9
Basic assumptions of flexural design – Permissible stresses in steel and concrete as per I.S.1343 Code – Different Types of sections - Design of sections of Type I and Type II post-tensioned and pre-tensioned beams – Check for flexural capacity based on I.S. 1343 Code – Influence of Layout of cables in post-tensioned beams – Location of wires in pre-tensioned beams – Design for shear based on I.S. 1343 Code.		
Unit III	DEFLECTION AND DESIGN OF ANCHORAGE ZONE	9
Factors influencing deflections – Short-term deflections of uncracked members – Prediction of long- term deflections due to creep and shrinkage – Check for serviceability limit states. Determination of anchorage zone stresses in post-tensioned beams by Magnel’s method, Guyon’s method and I.S. 1343 code – design of anchorage zone reinforcement – Check for transfer bond length in pre- tensioned beams– design of anchorage zone reinforcement – Check for transfer bond length in pre- tensioned beams.		
Unit IV	COMPOSITE BEAMS AND CONTINUOUS BEAMS	9
Analysis and design of composite beams – Shrinkage strain and its importance – Differential shrinkage - Methods of achieving continuity in continuous beams – Analysis for secondary moments Concordant cable and linear transformation – Calculation of stresses – Principles of design.		
Unit V	MISCELANEOUS STRUCTURES	9
Role of prestressing in members subjected to Tensile forces and compressive forces – Design of Tension members and Compression members - Design of Tanks, Pipes, Sleepers and Poles – Partial prestressing – methods of achieving partial prestressing, merits and demerits of partial prestressing.		
Total Periods: 45		
Text Books:		
1. Krishna Raju N., "Prestressed concrete", 5th Edition, Tata McGraw Hill Company, New Delhi, 2012.		
2. Pandit.G.S. and Gupta. S.P., "Prestressed Concrete", CBS Publishers and Distributors Pvt. Ltd, 2014.		
References:		
1. Lin T.Y. and Ned.H.Burns, "Design of prestressed Concrete Structures", Third Edition, Wiley India Pvt. Ltd., New Delhi, 2013.		
2. Rajagopalan.N, "Prestressed Concrete", Narosa Publishing House, 2017.		
3. Dayaratnam.P., "Prestressed Concrete Structures", Oxford and IBH, 2017		
Course Outcomes:		Blooms Taxonomy
CO 1: Design a prestressed concrete beam accounting for losses.		K3
CO2: Design for flexure and shear		K3
CO3: Design the anchorage zone for post-tensioned members and estimate the deflection in beams		K3

CO4: Design composite members and continuous beams													K3		
CO5: Design water tanks, pipes, poles and sleepers													K3		
CO - PO & PSO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	1	1	1	1	2	1	1	1	2	3	1	1
CO2	3	2	3	1	1	1	1	2	1	1	1	2	3	3	2
CO3	3	2	3	1	1	1	1	2	1	1	1	2	3	3	2
CO4	2	2	3	1	1	1	1	2	1	1	1	2	3	2	2
CO5	2	2	3	1	1	1	1	2	1	1	1	2	3	3	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEE005	MAINTAINANCE, REPAIR AND REHABILITATION OF STRUCTURES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Concrete Technology - Structural Analysis - Reinforced Concrete Design					
Course Objectives: To understand the importance of maintaining, repairing, and rehabilitating structures by learning the causes of deterioration, methods of inspection, special concretes, modern testing and protection techniques, and various strengthening and restoration practices for damaged structures.					
Unit I	MAINTENANCE AND REPAIR STRATIGES				9
Maintenance, Repair and Rehabilitation - Facets of Maintenance, Classification of Maintenance - Importance of Maintenance – Inspection of Concrete Structures - Assessment procedure for evaluating a damaged structure - Causes of deterioration.					
Unit II	SERVICEABILITY AND DURABILITY OF CONCRETE				9
Quality assurance for concrete — Strength and Durability of concrete - Cracks, different types, causes-Effects due to climate, temperature, Sustained elevated Temperature.					
Unit III	SPECIAL CONCRETES				9

Polymer concrete - Sulphur infiltrated concrete - Fibre reinforced concrete - High strength concrete- High performance concrete - Self compacting concrete - Geopolymer concrete - Concrete made with industrial wastes.		
Unit IV	TESTING TECHNIQUES AND PROTECTION METHODS	9
Non-destructive Testing Techniques, Epoxy injection, Shoring, Underpinning, Corrosion protection techniques – Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection.		
Unit V	STRENGTHENING, REPAIR AND REHABILITATION OF STRUCTURES	9
Need for strengthening of structures - Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, leakage and earthquake.		
Total Periods: 45 PERIODS		
Text Books:		
1. Dr.G.Nandini Devi, Maintenance, Repair, Rehabilitation and Retrofitting of Structures, Published by I.K. International, Pvt. Ltd, Edition 2020		
2. Shetty.M.S. Jain A K., Concrete Technology - Theory and Practice, S.Chand and Company, Eighth Edition, 2019.		
3. B.Vidivelli, Rehabilitation of Concrete Structures Standard Publishes Distribution.1 st edition 2009.		
References:		
1. Hand book on Seismic Retrofit of Buildings, CPWD and Indian Buildings Congress, Narosa Publishers, 2008.		
2. Hand Book on “Repair and Rehabilitation of RCC Buildings” – Director General works CPWD ,Govt of India , New Delhi – 2002		
3. P.C.Varghese, Maintenance Repair and Rehabilitation & Minor works of building, Prentice Hall India Pvt Ltd 2014		
4. Dodge Woodson, Concrete Structures, Protection, Repair and Rehabilitation, Butterworth-Heinemann, Elsevier, New Delhi 2012		
Course Outcomes:		Blooms Taxonomy
CO1 Understand the need for maintenance, repair, and rehabilitation and identify the causes of structural deterioration.		K2
CO2 Explain the factors affecting the strength and durability of concrete and the causes of different types of cracks.		K2
CO3 Describe the types, properties, and applications of special concretes used in		K2

repair and rehabilitation works.															
CO4 Explain various non-destructive testing methods and corrosion protection techniques for concrete structures.													K2		
CO5 Understand the methods of strengthening, repair, rehabilitation of damaged structures													K2		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	2	2	-	-	-	-	2	2	2	-
CO2	3	2	-	2	-	2	3	-	-	-	-	2	2	3	-
CO3	3	2	2	2	2	-	2	-	-	-	-	2	3	3	2
CO4	3	3	-	3	3	-	2	-	-	-	-	2	3	2	3
CO5	3	3	2	3	2	-	2	2	-	-	2	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEE006	DYNAMICS AND EARTHQUAKE RESISTANT STRUCTURES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Engineering Mechanics • Strength of Materials • Structural Analysis • Basic Structural Engineering					
Course Objectives: • To understand the behaviour of structures under dynamic, earthquake loading and design the structures as earthquake resistant as per codal provisions.					
Unit I	INTRODUCTION TO DYNAMICS				9
Dynamics - Degree of freedom – Free and forced vibration - Idealization of structure as Single Degree of Freedom (SDOF) and Multi degree of freedom (MDOF) system – D’Alemberts Principles- Formulation of equation of motion for SDOF system and MDOF system — Evaluation of natural frequencies and modes -					

Effect of damping.		
Unit II	SEISMOLOGY	9
Elements of Engineering Seismology – Seismic hazard - Earthquake phenomenon – Seismotectonics – Seismic Instrumentation – Characteristics of Strong Earthquake motion – Estimation of Earthquake Parameters – Soil Structure Interaction – Liquefaction of soil - Seismic zone map – Response spectra.		
Unit III	EARTHQUAKE EFFECTS ON STRUCTURES	9
Inertia force on structures – load transfer path – Effect of architectural features on behavior of structures – Hysteretic Behaviour of RCC, steel and prestressed concrete - Pinching Effect – Bouchinger Effects - Energy dissipation - P-delta effect - storey drift - Behavior of brick masonry, stone masonry and reinforced concrete structures under past earthquakes – typical failures - Causes of damage – Lessons learnt from past earthquakes.		
Unit IV	EARTHQUAKE LOAD ANALYSIS	9
Design spectra – Codal provision – Different methods of earthquake analysis – Analysis of structure by Equivalent static method – Analysis of structure by Response spectrum method – Introduction to time-history method of analysis		
Unit V	EARTHQUAKE RESISTANT DESIGN	9
Philosophy of earthquake resistant design - Planning considerations and Architectural concepts - Design and detailing as per codal provisions - Design and detailing of typical flexural member and column member, Ductile detailing of beam-column joints and footing – Concept and principle of shear wall - Introduction to performance based seismic design - Seismic isolation principles and methods.		
Total Periods: 45		
Text Books:		
1. Mario Paz, Structural Dynamics – Theory and Computations, Fifth Edition 2nd printing, CBS publishers, 2006.		
2. Agarwal.P and Shrikhande.M. Earthquake Resistant Design of Structures, Prentice Hall of India Pvt. Ltd. 2011.		
References:		
1. Clough.R.W, and Penzien.J, Dynamics of Structures, Second Edition, McGraw Hill International Edition, 1995.		
2. Minoru Wakabayashi, Design of Earthquake Resistant Buildings, Mc Graw – Hill Book Company, 1986.		
3. Anil K Chopra, Dynamics of structures – Theory and applications to Earthquake Engineering, Prentice Hall Inc., 2007		

4. Moorthy.C.V.R., Earthquake Tips, NICEE, IIT Kanpur,2002.															
Course Outcomes:												Blooms Taxonomy			
CO 1: Develop the equations of motion for SDOF and MDOF system and to evaluate the natural frequencies and mode shapes.												K2			
CO2: Explain the elements of engineering seismology, characteristics of earthquake and seismic instrumentation.												K2			
CO3: Explain the behaviour of various types of structures under earthquake												K2			
CO4: Determine the forces in a structure due to earthquake												K2			
CO5: Design earthquake resistant building structures												K2			
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	1	1	1	1	1	1	2	3	3	3
CO2	3	2	2	2	1	1	1	1	1	1	1	2	3	3	2
CO3	3	3	3	3	1	1	1	3	1	2	1	2	3	3	3
CO4	3	3	3	2	2	1	1	2	1	3	1	3	3	3	3
CO5	3	3	3	3	2	1	1	3	1	3	1	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEE007	INTRODUCTION TO FINITE ELEMENT METHOD	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Engineering Mathematics • Strength of Materials • Structural Analysis • Engineering Mechanics					
Course Objectives: • To develop a thorough understanding of the finite element analysis techniques with an ability to					
Unit I	INTRODUCTION				9
Historical Background – Mathematical Modeling of field problems in Engineering –Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual					

Unit II	STIFFNESS MATRIX FORMULATION	9
Introduction to Discrete and Continua elements – Discrete Elements - Direct stiffness method - Special characteristics of stiffness matrix - Assemblage of elements – Boundary condition & reaction - 2D – truss element - 2D - beam element - Analysis of framed Structures -Basic steps in finiteelement analysis -		
Unit III	ONE DIMENSIONAL PROBLEMS	9
One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Continua Elements - Displacement models - convergence requirements. Natural coordinate systems - Shape function. Interpolation function. Linear and quadratic elements - Lagrange & Serendipity elements. Strain displacement matrix - element stiffness matrix and nodal load vector. Natural frequencies of longitudinal vibration and mode shapes.		
Unit IV	TWO DIMENSIONAL PROBLEMS	9
Two dimensional isoparametric elements - Four noded quadrilateral elements - triangular elements. Computation of stiffness matrix for isoparametric elements - numerical integration (Gauss quadrature) Convergence criteria for isoparametric elements.		
Unit V	ANALYSIS OF PLATES	9
Introduction to Plate Bending Problems - displacement functions – Analysis of Thin Plate - Analysis of Thick Plate - Analysis of Skew Plate, Finite Element Analysis of Shell, plane stress and plane strain analysis, Example problem using any general-purpose finite element software.		
Total Periods: 45		
Text Books:		
1. Rao, S.S., “The Finite Element Method in Engineering”, 6th Edition, ButterworthHeinemann,2018.		
2. Reddy,J.N. “Introduction to the Finite Element Method”, 4thEdition, Tata McGrawHill,2018.		
References:		
1. Krishnamoorthy, C. S, Finite Element Analysis - Theory and Programming, McGraw - Hill, 1995.		
2. David Hutton, Fundamentals of Finite Element Analysis, Tata McGraw Hill Publishing Company Limited, New Delhi, 2005.		
3. G.R. Liu and S.S.Quek, Finite Element Method: A Practical Course, Butterworth-Heinemann; 1st edition (21 February 2003)		
4. Chennakesava R. Alavala Finite Element Methods: Basic Concepts and Applications, Prentice Hall Inc., 2010.		
5. R. T. Chandrupatla and A. D. Belegundu, Introduction to Finite Elements in Engineering, PHI Learning Pvt Ltd, New Delhi, 1997.		
6. S. S. Bhavikatti, Finite Element Analysis, New Age Publishers, 2007		

Course Outcomes:													Blooms Taxonomy		
CO 1: Understand the basics of finite element formulation.													K2		
CO2: Formulate the stiffness matrix for beam, truss and framed structures													K2		
CO3: Apply finite element formulations to solve one-dimensional problems													K3		
CO4: Apply finite element method to solve two dimensional problems.													K3		
CO5: Apply finite element method to analyze plate bending problems.													K3		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	1	-	-	3	-	1	1	3	2	2
CO2	3	3	2	1	1	1	-	-	3	-	1	1	3	2	2
CO3	3	3	1	2	2	1	-	-	3	-	2	1	3	2	2
CO4	2	3	1	1	2	1	-	-	3	-	1	2	3	2	2
CO5	3	3	2	1	3	2	-	-	3	-	1	2	3	2	2
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

VERTICAL – II CONSTRUCTION TECHNIQUES AND PRACTICES

23CEE008	FORM WORK ENGINEERING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Building materials and construction • Concrete technology					
Course Objectives: • On completion of this course the students will be able to know the detailed planning of formwork, design of forms and erection of form work.					
Unit I	INTRODUCTION TO FORM WORK				9
Introduction to Formwork and false work, Temporary work systems, Requirements, Construction planning and site constraints, Selection, and Classification (Types) of Formwork, General objectives of formwork building - Planning for safety - Development of a Basic System - Key Areas of cost reduction - Planning examples - Overall Planning - Detailed planning - Overall programme - Detailed programme - Costing -					

Planning crane arrangements - Site layout plan - Transporting plant - Formwork beams - Scaffold frames - Framed panel formwork.		
Unit II	FORMWORK MATERIALS ASSESORIES & PRESSURES	9
Formwork Materials, Accessories and consumables – Application of tools, Reconstituted wood – Steel Aluminum Plywood - Types and grades Standard units - Corner units – Pass units, Calculation of labour constants - Formwork hours - Labour Requirement. Hardware and fasteners - Nails in Plywood - Allowable withdrawal load and lateral load. Pressures on formwork - Examples - Finish - Sheathing boards working stresses - Repetitive member stress Vertical loads for design of slab forms - Uplift on shores - Laterals loads on slabs and walls		
Unit III	FORMWORK DESIGN	9
Concepts, Formwork Systems – components, assembly, De-shuttering, safety of work and Design for Tall Structures, Foundation Wall, Column, Slab and Beam formworks. Design of Decks and False works. Effects of various loads. Loading and moment of formwork, IS Code provisions.		
Unit IV	FORMWORK FOR SPECIAL STRUCTURES	9
Formwork for Bridge Structures, Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Nuclear Reactor, Tunnel, Lift Shaft, stairs and Formwork for Precast Concrete. Various climbing system, Table lifting system.		
Unit V	CASE STUDIES	9
Formwork failures: Causes of failures – Inadequate shoring inadequate bracing of members – improper vibration – Premature stripping Errors in design – Case studies – Finish of exposed concrete design deficiencies – Safety factors – Prevention of rotation – Stripping sequence – failure formwork issues in multi - story building construction – vertical and horizontal elements used in the industry.		
Total Periods: 45		
Text Books:		
1. Peurify R.L and Oberlender G.D , Formwork for Concrete Structures, , McGraw Hill Education India ,2015		
2. Jha K N, Formwork for Concrete Structures, Tata McGraw Hill Education, 2012.		
References:		
1. Austin, C.K., Formwork for Concrete, Cleaver -Hume Press Ltd., London, 1996.		
2. Hurd, M.K., Formwork for Concrete, Special Publication No.4, American Concrete Institute, Detroit, 1996		
3. Michael P. Hurst, Construction Press, London and New York, 2003.		
Course Outcomes:		Blooms Taxonomy

CO 1: Design a prestressed concrete beam accounting for losses.													K3		
CO2: Design for flexure and shear													K3		
CO3: Design the anchorage zone for post-tensioned members and estimate the deflection in beams													K3		
CO4: Design composite members and continuous beams													K3		
CO5: Design water tanks, pipes, poles and sleepers													K3		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	0	0	0	0	2	2	0	3	0	3	2	3	0	0
CO2	3	3	3	2	0	0	2	0	3	0	2	2	3	3	2
CO3	3	3	3	2	2	0	0	0	3	0	2	2	3	3	3
CO4	2	3	0	0	0	0	0	0	2	0	2	2	3	0	0
CO5	2	1	2	3	0	0	0	0	2	0	3	2	3	0	0
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEE009	CONSTRUCTION EQUIPMENT AND MACHINERY	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Building materials and construction • Concrete technology					
Course Objectives: • To expose the students in the field of construction equipment and machineries so as to gain knowledge in carrying out engineering tasks.					
Unit I	CONSTRUCTION EQUIPMENTS				9
Identification - Planning of equipment - Selection of equipment - Equipment management in projects - Maintenance management - Equipment cost - Operating cost - Cost control of equipment - Depreciation analysis - Replacement analysis - Safety management.					
Unit II	EQUIPMENT FOR EARTHWORK				9
Fundamentals of earthwork operations - Earth moving operations - Types of earthwork equipment - Tractors, motor graders, scrapers, front end waders - Dozer, excavators, rippers, loaders, trucks and hauling					

equipment, compacting equipment, finishing equipment - Case studies on earthwork equipment.		
Unit III	OTHER CONSTRUCTION EQUIPMENT	9
Equipment for dredging, trenching, drag line and clamshells, tunneling - Jacking equipment - Equipment for drilling and blasting - Pile driving equipment - Erection equipment - Crane, mobile crane - Types of pumps used in construction - Equipment for dewatering, grouting and demolition.		
Unit IV	ASPHALT AND CONCRETE PLANTS	9
Aggregate production - Different crushers - Feeders - Screening equipment - Handling equipment - Batching and mixing equipment - Ready mix concrete equipment, concrete pumping equipment - Asphalt plant - Asphalt pavers - Asphalt compacting equipment.		
Unit V	MATERIALS HANDLING EQUIPMENT	9
Forklifts and related equipment - Portable material bins - Material handling conveyors - Material handling cranes - Industrial trucks - Aerial transporting equipment		
Total Periods: 45		
TEXTBOOKS:		
1. Peurifoy, R.L., Schexnayder, C., Schmitt, R.L. and Aviad Shapira., Construction Planning, Equipment and Methods, 9 th Edn. McGraw Hill, Singapore, 2018.		
2. Granberg G., Popescu M Construction Equipment and Management for Engineers Estimators and Owners, Taylor and Francis Publishers, New York, 2006.		
REFERENCES:		
1. Deodhar, S.V. Construction Equipment and Job Planning, 4 th Edn. Khanna Publishers, New Delhi, 2020.		
2. Arora S.P. and Bindra S.P., Building Construction, Planning Techniques and Method of Construction, Dhanpat Rai and Sons, 2018		
3. Sharma S.C. Construction Equipment and Management, Khanna Publishers, New Delhi, 2008.		
4. Dr. Mahesh Varma., Construction Equipment and its Planning and Application, Metro-politan Book Company, New Delhi., 2003		
Course Outcomes:		Blooms Taxonomy
CO1 Develop knowledge on planning of equipment and selection of equipment		K2
CO2 Explain the knowledge on fundamentals of earth work operations, earth moving operations and types of earth work equipment		K2
CO3 Develop the knowledge on special construction equipment		K2
CO4 Apply the knowledge on asphalt and concrete plants		K2
CO5 Apply the knowledge and select the proper materials handling equipment		K2

CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	3	2	2	3	2	2	2	3	2	3
CO2	3	3	2	2	3	2	2	2	2	2	3	3	2	2	3
CO3	2	3	2	2	2	3	2	2	3	2	2	2	2	3	2
CO4	2	2	3	3	2	3	3	2	3	2	2	2	3	2	3
CO5	3	2	3	2	3	2	3	3	3	2	2	2	2	2	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CEE010	SUSTAINABLE CONSTRUCTION AND LEAN CONSTRUCTION	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Building materials and construction • Concrete technology					
Course Objectives: • To impart knowledge about sustainable construction and to understand the concepts of sustainable materials, energy calculations, green buildings and environmental effects.					
Unit I	INTRODUCTION & MATERIALS USED IN SUSTAINABLE CONSTRUCTION				9
Introduction and definition of Sustainability - Carbon cycle - role of construction material: concrete and steel, etc. - CO2 contribution from cement and other construction materials - Recycled and manufactured aggregate - Role of QC and durability - Life cycle and sustainability.					
Unit II	ENERGY CALCULATIONS				9
Components of embodied energy - calculation of embodied energy for construction materials - Energy concept and primary energy - Embodied energy via-a-vis operational energy in conditioned building - Life Cycle energy use					
Unit III	GREEN BUILDINGS				9
Control of energy use in building – National Building Code (NBC), ECBC code, codes in neighboring tropical countries - OTTV concepts and calculations – Features of LEED and TERI – Griha ratings - Role					

of insulation and thermal properties of construction materials - influence of moisture content and modeling -Performance ratings of green buildings - Zero energy building’															
Unit IV		CORE CONCEPTS IN LEAN												9	
Introduction to the Course; Lean Overview; Need for Productivity Measurement and improvement; Productivity Measurement System (PMS)															
Unit V		LEAN CONSTRUCTION TOOLS AND TECHNIQUES												9	
Sampling/ Work Sampling; Survey/ Foreman delay survey; Value Stream/ Process Mapping– 5S , Collaborative Planning System (CPS)/ Last Planner™ System (LPS) – Big Room Approach, IT/BIM and Lean, How to Start Practicing Lean Tools in Project Site.															
Total Periods: 45															
Text Books:															
1. Krishna Raju N., "Prestressed concrete", 5th Edition, Tata McGraw Hill Company, New Delhi, 2012.															
2. Pandit.G.S. and Gupta. S.P., "Prestressed Concrete", CBS Publishers and Distributers Pvt. Ltd, 2014.															
References:															
1. Charles J Kibert, Sustainable Construction: Green Building Design & Delivery, 4 th Edition, Wiley Publishers 2016.															
2. Steve Goodhew, Sustainable Construction Process, Wiley Blackwell,UK, 2016.															
3. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.															
Course Outcomes:														Blooms Taxonomy	
CO1: Describe the various sustainable materials used in construction.														K2	
CO2: Explain the method of estimating the amount of energy required for building.														K2	
CO3: Describe the features of LEED, TERI and GRIHA ratings of buildings														K2	
CO4: Explain the core concepts of lean construction tools and techniques and their importance in achieving better productivity														K2	
CO5: Apply lean tools & techniques to achieve sustainability in construction projects.														K2	
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	0	1	1	0	2	3	1	1	0	2	1	3	2	3
CO2	3	1	3	2	1	2	2	0	1	1	1	2	3	2	3
CO3	2	2	3	1	1	1	1	0	0	0	3	1	3	3	3

CO4	3	1	3	2	2	1	3	1	1	1	3	2	3	3	3
CO5	3	1	2	2	2	2	3	1	0	1	3	2	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEE011	DIGITALIZED CONSTRUCTION LAB	Category: PEC			
		L	T	P	C
		0	0	6	3
Prerequisites • Engineering graphics • Building materials and construction					
Course Objectives: • To train the students in field of digitalization of construction. Students can be trained in the latest software’s relevant to construction industry					
LIST OF EXPERIMENTS					
1	Introduction and understanding of Primavera project planner for construction				
2	Using Primavera project planner, update the schedule of the project of a construction project.				
3	Introduction and understanding of MS Project for a construction project				
4	Using MS project, schedule the construction project planning				
5	Introduction to BIM in construction projects -				
6	Development of BIM for small construction project				
7	Progress the work flows in construction project using BIM				
Total Periods:90					
Course Outcomes: At the end of the course, learners will be able					Blooms Taxonomy
CO1 To understand the importance of latest softwares in a construction industry.					K2
CO2 To plan a construction project using Primervera					K2
CO3 To plan a construction project using MS project					K4
CO4 To develope a BIM information model					K4
CO5 To analyse the bid management and its effectiveness using bid management software					K4
CO - PO & PSO Mapping					

Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	3	3	2	2	3	2	2	2	3	2	3
CO2	3	3	2	2	3	2	2	2	2	2	3	3	2	2	3
CO3	2	3	2	2	3	3	2	2	3	2	2	2	2	3	2
CO4	2	2	3	3	3	3	3	2	3	2	3	3	3	2	3
CO5	3	2	3	2	3	2	3	3	3	2	3	3	2	2	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEE012	CONSTRUCTION MANAGEMENT AND SAFETY	Category: PEC			
		L	T	P	C
		2	0	2	3
Prerequisites • Building materials and construction • Concrete technology					
Course Objectives: • To study and understand the formulation, costing of construction projects, scheduling and various safety concepts and its requirements applied to construction projects.					
Unit I	GENERAL OVERVIEW AND PROJECT ORGANIZATION				9
Introduction - Interdisciplinary nature of modern construction projects – execution of project – evaluation of bids – resource management					
Unit II	ESTIMATION OF PROJECT COST & ECONOMICS				9
Estimating quantities – description of items – estimation of project cost – running account bills – decision making in construction projects – depreciation of construction equipment – case study.					
Unit III	PLANNING AND SCHEDULING				9
Introduction – project scheduling – uncertainties in duration of activities using PERT – Project monitoring and control system – resource levelling and allocation – crashing of network.					
Unit IV	SAFETY DURING CONSTRUCTION				9
Basic terminology in safety - types of injuries - safety pyramid - Accident patterns - Planning for safety budget, safety culture - Introduction to OSHA regulations - Site safety programs - Job hazard analysis, accident investigation & accident indices-violation, penalty.					

Unit V	SAFE OPERATING PROCEDURES												9		
Role of prestressing in members subjected to Tensile forces and compressive forces – Design of Tension members and Compression members - Design of Tanks, Pipes, Sleepers and Poles – Partial prestressing – methods of achieving partial prestressing, merits and demerits of partial prestressing.															
Total Periods: 45															
LAB															
Ex 1 Introduction to various construction management software															
Ex 2 Planning and creating new project															
Ex 3 Scheduling and constraints using PRIMAVERA															
Ex 4 Project cost management using PRIMAVERA															
Ex 5 Construction project safety management using BIM															
Text Books:															
1.Krishna Raju N., "Prestressed concrete", 5th Edition, Tata McGraw Hill Company, New Delhi, 2012.															
2.Pandit.G.S. and Gupta. S.P., "Prestressed Concrete", CBS Publishers and Distributors Pvt. Ltd, 2014.															
References:															
1.Barcus, S.W. and Wilkinson.J.W., Hand Book of Management Consulting Services, McGraw Hill, New York, 1986.															
2.Joy P.K., Total Project Management - The Indian Context, New Delhi, Macmillan India Ltd., 1992															
3.Albert Lester, Project Management, Planning and Control, 7th Edition, Butterworth- Heinemann, USA , 2017.															
4.Patrick X.W. Zou ,Riza YosiaSunindijo, Strategic Safety Management in Construction and Engineering John Wiley & Sons, Ltd 2015.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Perform formulations of projects													K3		
CO2: Analyze project costing.													K3		
CO3: Identify and estimate the activity in the construction													K3		
CO4: Develop the knowledge on accidents and their causes													K3		
CO5: Plan, assess, analyze and manage the construction project sites.													K3		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	0	0	3	2	0	2	2	3	3	1	2	2	3
CO2	2	3	0	0	3	2	0	2	2	3	3	1	2	2	3

CO3	0	3	3	0	3	0	1	0	0	0	3	0	3	3	2
CO4	2	3	0	2	3	0	2	0	0	0	3	2	0	0	0
CO5	2	2	2	0	0	0	0	0	2	0	2	0	2	2	2
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CEE013	ADVANCED CONSTRUCTION TECHNIQUES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Concrete technology					
Course Objectives: To study and understand the latest construction techniques applied to engineering construction for sub structure, super structure, special structures, rehabilitation and strengthening techniques and demolition techniques.					
Unit I	SUB STRUCTURE CONSTRUCTION				9
Construction Methodology - Box jacking - Pipe jacking - Under water construction of diaphragm walls and basement - Tunneling techniques - Piling techniques - Driving well and caisson - sinking cofferdam - cable anchoring and grouting - Driving diaphragm walls, Sheet piles - Laying operations for built up offshore system - Shoring for deep cutting - Large reservoir construction - well points - Dewatering for underground open excavation.					
Unit II	SUPER STRUCTURE CONSTRUCTION FOR BUILDINGS				9
Vacuum dewatering of concrete flooring – Concrete paving technology – Techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections – Erection techniques of tall structures, Large span structures – launching techniques for heavy decks – in-situ prestressing in high rise structures, Post tensioning of slab- aerial transporting – Handling and erecting lightweight components on tall structures.					
Unit III	CONSTRUCTION OF SPECIAL STRUCTURES				9
Erection of lattice towers - Rigging of transmission line structures – Construction sequence in cooling towers, Silos, chimney, sky scrapers - Bow string bridges, Cable stayed bridges – Launching and pushing of box decks – Construction of jetties and break water structures – Construction sequence and methods in domes – Support structure for heavy equipment and machinery in heavy industries Erection of articulated structures and space decks.					

Unit IV	REHABILITATION AND STRENGTHENING TECHNIQUES												9		
Seismic retrofitting - Strengthening of beams - Strengthening of columns - Strengthening of slab - Strengthening of masonry wall, Protection methods of structures, Mud jacking and grouting for foundation – Micro piling and underpinning for strengthening floor and shallow profile - Sub grade water proofing, Soil Stabilization techniques															
Unit V	DEMOLITION												9		
Demolition Techniques, Demolition by Machines, Demolition by Explosives, Advanced techniques using Robotic Machines, Demolition Sequence, Dismantling Techniques, Safety precaution in Demolition and Dismantling.															
Total Periods: 45															
Text Books:															
1. Krishna Raju N., "Prestressed concrete", 5th Edition, Tata McGraw Hill Company, New Delhi, 2012.															
2. Pandit.G.S. and Gupta. S.P., "Prestressed Concrete", CBS Publishers and Distributers Pvt. Ltd, 2014.															
References:															
1.Jerry Irvine, Advanced Construction Techniques, CA Rocket, 1984															
2.Patrick Powers. J., Construction Dewatering: New Methods and Applications, John Wiley & Sons, 1992.															
3.Peter H.Emmons, “Concrete repair and maintenance illustrated”, Galgotia Publications Pvt. Ltd., 2001.Press, 2008.															
4.Robertwade Brown, Practical foundation engineering hand book, McGraw Hill Publications, 1995.															
5.Sankar, S.K. and Saraswati, S., Construction Technology, Oxford University, New Delhi, 2008.															
Course Outcomes:													Blooms Taxonomy		
CO1 Understand the modern construction techniques used in the sub structure construction.													K2		
CO2 Demonstrate knowledge and understanding of the principles and concepts relevant to super structure construction for buildings													K2		
CO3 Understand the concepts used in the construction of special structures													K2		
CO4 Knowledge on Various strengthening and repair methods for different cases.													K2		
CO5 Identify the suitable demolition technique for demolishing a building.													K2		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	3	3	2	2	0	1	1	2	1	3	2	3
CO2	1	0	0	2	2	2	3	0	1	1	2	1	2	3	2

CO3	2	3	3	2	3	3	2	1	2	2	3	2	3	3	3
CO4	2	3	3	3	2	1	2	1	1	1	2	1	3	3	3
CO5	1	3	3	3	2	2	1	1	2	2	3	2	2	3	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEE014	ENERGY EFFICIENT BUILDINGS	Category: BSC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: To provide an understanding of the concept of energy consumption in buildings and design anenergy efficient building					
Unit I	INTRODUCTION				9
Climate adapted and climate rejecting buildings – Heat Transfer – Measuring Conduction – Thermal Storage – Measurement of Radiation – The Greenhouse Effect – Convection – Measuring latent and sensible heat – Psychrometry Chart – Thermal Comfort – Microclimate, Site Planning and Development – Temperature – Humidity – Wind – Optimum Site Locations – Sun Path Diagrams – Sun Protection – Types of Shading Devices – Design responses to energy conservation strategies.					
Unit II	PASSIVE SOLAR HEATING AND COOLING				9
General Principles of passive Solar Heating – Key Design Elements – Sunspace – Direct gain – Trombe Walls, Water Walls – Convective Air loops – Concepts – Case Studies – General Principles of Passive Cooling – Ventilation – Principles – Case studies – Courtyards – Roof Ponds– Cool Pools Predicting ventilation in buildings – Window Ventilation Calculations – Room Organization Strategies for Cross and Stack Ventilation – Radiation – Evaporation and dehumidification – Wind Catchers – Mass Effect – Zoning – Load Control – Air Filtration and odor removal.					
Unit III	DAYLIGHTING AND ELECTRICAL LIGHTING				9
Materials, components and details – Insulation – Optical materials – Radiant Barriers – Glazing materials – Glazing Spectral Response – Day lighting – Sources and concepts –Building Design Strategies – Case Studies – Daylight apertures – Light Shelves – Codal requirements – Day lighting design – Electric Lighting – Light Distribution – Electric Lighting control for day lighted buildings –Switching controls – Coefficient of utilization – Electric Task Lighting – Electric Light Zones – Power Adjustment Factors.					
Unit IV	HEAT CONTROL AND VENTILATION				9

Hourly Solar radiation – Heat insulation – Terminology – Requirements – Heat transmission through building sections – Thermal performance of Building sections – Orientation of buildings – Building characteristics for various climates – Thermal Design of buildings – Influence of Design Parameters – Mechanical controls – Examples. Ventilation – Requirements – Minimum standards for ventilation – Ventilation Design – Energy Conservation in Ventilating systems – Design for Natural Ventilation – Calculation of probable indoor wind speed.		
Unit V	DESIGN FOR CLIMATIC ZONES	9
Energy efficiency – An Overview of Design Concepts and Architectural Interventions – Embodied Energy – Low Embodied Energy Materials – Passive Downdraft Evaporative Cooling – Design of Energy Efficient Buildings for Various Zones – Cold and cloudy – Cold and sunny – Composite – Hot and dry – Moderate – Warm and humid – Case studies of residences, office buildings and other buildings in each zones – Commonly used software packages in energy efficient building analysis and design - Energy Audit – Certification.		
Total Periods: 45		
References:		
1. Energy Conservation Building Code, cau of Energy Efficiency, New Delhi, 2018.		
2. Handbook on Functional Requirements of Buildings Part 1 to 4 SP : 41 (S and T) 1995		
3. Residential Energy: Cost Savings and Comfort for Existing Buildings by John Krigger and Chris Dorsi, Published by Saturn Resource Management, 2013.		
4. Brown, G.Z. and DeKay, M., Sun, Wind and Light - Architectural Design Strategies, John Wileyand Sons Inc,3rd Edition, 2014		
5. Majumdar, M (Ed), Energy - Efficient Buildings in India, Tata Energy Research Institute, Ministryof Non-Conventional Energy Sources, 2009.		
Course Outcomes:		Blooms Taxonomy
CO1 Understand the modern construction techniques used in the sub structure construction.		K2
CO2 Demonstrate knowledge and understanding of the principles and concepts relevant to super structure construction for buildings		K2
CO3 Understand the concepts used in the construction of special structures		K2
CO4 Knowledge on Various strengthening and repair methods for different cases.		K2
CO5 Identify the suitable demolition technique for demolishing a building.		K2
CO - PO & PSO Mapping		

Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	3	3	2	2	0	1	1	2	1	3	2	3
CO2	1	0	0	2	2	2	3	0	1	1	2	1	2	3	2
CO3	2	3	3	2	3	3	2	1	2	2	3	2	3	3	3
CO4	2	3	3	3	2	1	2	1	1	1	2	1	3	3	3
CO5	1	3	3	3	2	2	1	1	2	2	3	2	2	3	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

VERTICAL III: GEOTECHNICAL

23CEE015	GEOENVIRONMENTAL ENGINEERING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Soil Mechanics					
Course Objectives: • The student acquires the knowledge on the Geotechnical engineering problems associated with soil contamination, safe disposal of waste and remediate the contaminated soils by different techniques hereby protecting environment.					
Unit I	SOIL – WASTE INTERACTION				9
Role of Geo-environmental Engineering – sources, generation and classification of wastes – causes and consequences of soil pollution – case studies in soil failure -factors influencing soilpollutant interaction – modification of index, chemical and engineering properties – physical and physio- chemical mechanisms.					
Unit II	CONTAMINANT TRANSPORT AND SITE CHARACTERISATION				9
Transport of contaminant in subsurface – advection, diffusion, dispersion – chemical process – biological process, sorption, desorption, precipitation, dissolution, oxidation, complexation, ion exchange, Volatization, biodegradation – characterization of contaminated sites – soil and rock data hydrological and chemical data – analysis and evaluation.					
Unit III	WASTE CONTAINMENT AND REMEDIATION OF CONTAMINATED SITES				9

In-situ containment – vertical and horizontal barrier – surface cover – ground water pumping system on subsurface drain – soil remediation – Soil Vapour extraction, soil waste stabilization, solidification of soils, electrokinetic remediation, soil heating, vitrification, bio remediation, Phyto-remediation – ground water remediation – pump and treat , In-situ flushing, permeable reacting barrier, In-situ air sparging.		
Unit IV	LANDFILLS AND SURFACE IMPOUNDMENTS	9
System – Source and characteristics of waste - site selection for landfills – components of landfills – liner soil, geomembrane, geosynthetic clay, geo-composite liner system – leachate collection – final cover design – monitoring landfill - Environmental laws and regulations.		
Unit V	STABILISATION OF WASTE	9
Evaluation of waste materials – flyash, municipal sludge, plastics, scrap tire, blast furnace slag, construction waste, wood waste and their physical, chemical and biological characteristics – potential reuse – utilization of waste and soil stabilization.		
Total periods: 45		
Text Books:		
1. Hari D. Sharma and Krishna R.Reddy, Geo-Environmental Engineering – John Wiley and Sons, INC, USA, 2004.		
References:		
1. Daniel B.E, Geotechnical Practice for waste disposal, Chapman & Hall, London, 1993.		
2. Westlake, K., Landfill Waste pollution and Control, Albion Publishing Ltd., England, 1995.		
3. Wentz, C.A., Hazardous Waste Management, McGraw Hill, Singapore, 1989.		
4. Proceedings of the International symposium of Environmental Geotechnology (Vol.I and II), Environmental Publishing Company, 1986 and 1989.		
5. Ott, W.R., Environmental Indices, Theory and Practice, Ann Arbor, 1978.		
6. Fried, J.J., Ground Water Pollution, Elsevier, 1975.		
7. ASTM Special Tech. Publication 874, Hydraulic Barrier in Soil and Rock, 1985.		
8. Lagrega, M.d., Buckingham, P.L., and Evans, J.C., Hazardous Waste Management, McGraw Hill, Inc. Singapore, 1994.		
Course Outcomes:		Blooms Taxonomy
On completion of the course, the student is expected to be able to		
CO1 Understand the various causes and consequences of waste interaction with soil and their modification.		K2 (Understanding)
CO2 Understand the various mechanism of transport of contaminants into the subsurface and characterization of contaminated sites and their risk analysis.		K2 (Understanding)

CO3 Understand on how to decontaminate the site so as to reuse the site for human settlement													K2 (Understanding)		
CO4 Understand how to safely dispose the waste through different containment process.													K2 (Understanding)		
CO5 Expose on how to convert the waste into a resource material through soil waste stabilization techniques with or without chemical stabilization.													K3 (Applying)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	2	2	3	0	0	0	1	3	2	2	3
CO2	3	1	0	0	2	2	3	0	2	0	0	3	2	2	3
CO3	2	1	2	2	1	3	3	2	0	0	0	3	2	2	2
CO4	1	3	3	2	0	2	3	2	2	2	0	3	3	2	3
CO5	2	2	3	3	0	2	3	2	3	2	1	3	1	2	2
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CEE016	GROUND IMPROVEMENT TECHNIQUES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Soil Mechanics					
Course Objectives: • Students will be exposed to various problems associated with soil deposits and methods to evaluate them. The different techniques will be taught to them to improve the characteristics of difficult soils as well as design techniques required to implement various ground improvement methods.					
Unit I	HYDRAULIC MODIFICATIONS				9
Scope and necessity of ground improvement in Geotechnical engineering basic concepts. Drainage - Ground Water lowering by well points, deep wells, vacuum and electro-osmotic methods. Stabilization by thermal and freezing techniques - Applications.					
Unit II	MECHANICAL MODIFICATIONS				9
Insitu compaction of granular and cohesive soils, Shallow and Deep compaction methods – Sand piles – Concept, design, factors influencing compaction. Blasting and dynamic consolidation design and relative merits of various methods – Soil liquefaction mitigation methods.					

Unit III	PHYSICAL MODIFICATION	9
Preloading with sand drains, fabric drains, wick drains – theories of sand drain - Stone column with and without encased, lime stone – functions – methods of installation – design, estimation of load carrying capacity and settlement. Root piles and soil nailing – methods of installation – Design and Applications.		
Unit IV	MODIFICATION BY INCLUSIONS	9
Reinforcement – Principles and basic mechanism of reinforced earth, simple design: Synthetic and natural fiber based Geotextiles and their applications. Filtration, drainage, separation, erosion control.		
Unit V	CHEMICAL MODIFICATION	9
Grouting – Types of grout – Suspension and solution grouts – Basic requirements of grout. Grouting equipment – injection methods – jet grouting – grout monitoring – Electro – Chemical stabilization – Stabilization with cement, lime - Stabilization of expansive clays.		
Total periods: 45		
Text Books:		
1. Pappala, A.J.,Huang,J., Han, J., and Hoyos, L.R., Ground Improvement and Geosynthetics; Geotechnical special publication No.207, Geo Institute, ASCE, 2010		
References:		
1. Cox, B.R., and Griffiths S.C., Practical Recommendation for Evaluation and mitigation of Soil Liquefaction in Arkansas, (Project Report), 2010.		
2. Day, R.W., Foundation Engineering Handbook, McGraw – Hill Companies, Inc. 2006.		
3. Rowe, R.K., Geotechnical and Geo-environmental Engineering Handbook, Kluwer Academic Publishers, 2001.		
4. Das, B.M., Principles of Foundation Engineering, Fourth Edition, PWS Publishing, 1999.		
Course Outcomes:	Blooms Taxonomy	
On completion of the course, the student is expected to be able to		
CO1 Identify and evaluate the deficiencies in the deposits of the given project area and improve its characteristics by hydraulic modifications	K5 (Evaluating)	
CO2 Know the improvement of the ground characteristics by mechanical modifications using various method and design the system	K2 (Understanding)	
CO3 Understand the improvement of the ground characteristics by physical modifications using various method and design the system	K2 (Understanding)	
CO4 Know the improvement of the characteristics of soils by various reinforcement techniques and design	K2 (Understanding)	
CO5 Analyse the ground and decide the suitable chemical method for improving	K4 (Analysing)	

its characteristics.															
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	1	3	3	3	3	3	2	3	3	3	2
CO2	2	3	3	2	3	2	2	1	2	2	1	3	3	3	3
CO3	2	3	3	2	3	3	2	1	2	1	1	3	3	3	3
CO4	2	3	3	1	3	2	2	1	2	1	1	3	3	3	3
CO5	2	3	2	2	1	2	2	1	2	1	1	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEE017	SOIL DYNAMICS AND MACHINE FOUNDATIONS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Soil Mechanics					
Course Objectives: • To design different types of machine foundations based on the dynamic properties of soils and to get an exposure on vibration isolation techniques.					
Unit I	THEORY OF VIBRATION				9
Introduction – Nature of dynamic loads – Basic definitions – Simple harmonic motion – Fundamentals of vibration – Single degree and multi degree of freedom systems – Free vibrations of spring – Mass systems – Forced vibrations – Resonance – Viscous damping – Principles of vibrations measuring systems – Effect of transient and pulsating loads.					
Unit II	DYNAMIC SOIL PROPERTIES				9
Dynamic stress-strain characteristics – Principles of measuring dynamic properties – Laboratory techniques – Field tests – Block vibration test – Factors affecting dynamic properties – Typical values. Mechanism of liquefaction – Influencing factors – Evaluation of liquefaction potential – Analysis from SPT test – Dynamic bearing capacity – Dynamic earth pressure.					
Unit III	MACHINE FOUNDATIONS				9
Introduction – Types of machine foundations – General requirements for design of machine foundations – Design approach for machine foundation – Vibration analysis – Elastic Half-Space theory – Mass-spring-dashpot model – Permissible amplitudes – Permissible bearing pressures.					

Unit IV	DESIGN OF MACHINE FOUNDATION												9		
Evaluation of design parameters – Types of Machines and foundations – General requirements – their importance – Analysis and design of block type and framed type machine foundations – Modes of vibration of a rigid foundation – Foundations for reciprocating machines, impact machines, Two – Cylinder vertical compressor, Double-acting steam hammer –Codal recommendations - Emprical approach – Barken’s method – Bulb of pressure concept – Pauw’s analogy – Vibration table studies.															
Unit V	VIBRATION ISOLATION												9		
Vibration isolation – Types of isolation – Transmissibility – Passive and active isolation – Methods of isolation – Use of springs and damping materials – Properties of isolating materials – Vibration control of existing machine foundation.															
Total periods: 45															
Text Books:															
1. KameswaraRao, N.S.V., Dynamics soil tests and applications, Wheeler Publishing, New Delhi, 2000.															
References:															
1. Prakash, S and Puri, V.K., Foundations for machines, McGraw Hill, 1987.															
2. Moore, P.J.,Analysis and Design of Foundations for Vibrations, Oxford and IBH, 1985.															
3. Vaidyanathan, C.V., and Srinivasalu, P., Handbook of Machine Foundations, McGraw Hill, 1995.															
4. Arya, S., O’Nelt; S., Design of Structures and Foundations for Vibrating Machines, Prentice Hall, 1981.															
Course Outcomes:												Blooms Taxonomy			
On completion of the course, the student is expected to be able to															
CO1 Identify and evaluate the deficiencies in the deposits of the given project area and improve its characteristics by hydraulic modifications												K5 (Evaluating)			
CO2 Know the improvement of the ground characteristics by mechanical modifications using various method anddesign the system												K2 (Understanding)			
CO3 Understand the improvement of the ground characteristics by physical modifications using various method and designthe system												K2 (Understanding)			
CO4 Know the improvement of the characteristics of soils by various reinforcement techniques and design												K2 (Understanding)			
CO5 Analyse the ground and decide the suitable chemical method for improving its characteristics.												K4 (Analysing)			
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1	3	2	1	1	1	2	2	1	1	1	1	3	2	2	2
CO2	2	2	2	3	2	2	1	2	2	1	1	3	2	2	2
CO3	2	3	3	3	2	3	2	3	2	0	0	3	3	3	3
CO4	2	3	3	3	0	3	3	3	2	1	1	3	3	3	3
CO5	2	3	3	3	2	3	2	3	2	1	1	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEE018	ROCK MECHANICS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Engineering Geology • Building Materials					
Course Objectives: • Students are expected to classify, understand stress-strain characteristics, failure criteria, and influence of in-situ stress in the stability of various structures and various technique to improve the in-situ strength of rocks.					
Unit I	STRENGTH CRITERIA OF ROCKS				9
Types of Rocks - Index properties and classification of rock masses, competent and incompetent rock - value of RMR and ratings in field estimations.					
Unit II	INSITU STRESSES IN ROCKS				9
Behaviour of rock under hydrostatic compression and deviatric loading - Modes of rock failure planes of weakness and joint characteristics - joint testing, Mohr - Coulomb failure criterion and tension cut-off. Hoek and Brown Strength criteria for rocks with discontinuity setsbetween Highway and airport pavements- Introduction to various design methods- Airport drainage.					
Unit III	AIRPORT DESIGN				9
In-situ stresses and their measurements, Hydraulic fracturing, flat jack, over coring and under coring methods - stress around underground excavations – Design aspects of openings in rocks.					
Unit IV	SLOPE STABILITY AND BEARING CAPACITY OF ROCKS				9
Rock slopes - role of discontinuities in slop failure, slope analysis and factor of safety - remedial measures for critical slopes – Bearing capacity of foundations on rocks.					
Unit V	ROCK STABILIZATION				9

Stabilization of rocks-rock support and rock reinforcement-active and passive supports-ground response curve-support reaction curve-reinforcement of fractured and joined rocks-Shotcreting- bolting-anchoring-installation methods	
Total periods: 45	
Text Books:	
1.Goodman, R.E., Introduction to rock mechanics, John Willey and Sons, 1989.	
2 Hudson, A. and Harrison, P., Engineering Rock mechanics – An introduction to the principles, Pergamon publications, 1997.	
3. Hoek, E and Bray, J., Rock slope Engineering, Institute of Mining and Metallurgy, U.K. 1981.	
References:	
1.Bazant, Z.P., Mechanics of Geomaterials Rocks, Concrete and Soil, John Wiley and Sons, Chichester, 1985.Wittke, W., Rock Mechanics. Theory and Applications with case Histories, Springer-Verlag, Berlin, 1990.	
2. Waltham, T, Foundations of Engineering Geology, Second Edition, Spon Press, Taylor & Francis Group, London and New York, 2002.	
Course Outcomes:	Blooms Taxonomy
CO1 Classify the Rock mass and rate the quality of rock for tunnelling and foundations works and suggest the safer length of tunnelling and stand-up time.	K2 (Understanding)
CO2 Apply the knowledge of engineering and understand the stress — strain characteristics and failure criteria of rock and apply them to arrive at the shear strength parameters of rocks to be used for the design of structures resting on rock and also for the design of underground excavation in rocks	K2 (Understanding)
CO3 Apply the knowledge of engineering and assess the influence of in-situ stress in the stability of various underground excavations and also acquire the knowledge of design of opening in rocks.	K4 (Analyzing)
CO4 Apply the knowledge on rock mechanics and analyze the stability of rock slopes and arrive at the bearing capacity of shallow and deep foundations resting on rocks considering the presence of joints. design the foundations resting on rocks. Able to carry-out suitable foundation for the structure resting on rock.	K2 (Understanding)
CO5 Improve the in-situ strength of rocks by various methods such as rock reinforcement and rock support. Able to select suitable support system	K2 (Understanding)

considering the interaction between rock and support. Also capable of executing the same in the field.															
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	3	1	2	1	3	2	1	2	3	3	2	2
CO2	3	3	3	2	3	2	2	1	2	1	2	3	3	2	2
CO3	3	3	3	3	2	3	2	1	2	2	3	3	3	2	3
CO4	3	3	3	2	3	3	3	1	3	2	3	3	3	3	3
CO5	2	2	3	1	3	3	3	3	3	1	3	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															
23CEE019	EARTH AND EARTH RETAINING STRUCTURES											Category: PEC			
												L	T	P	C
												3	0	0	3
Prerequisites • Soil mechanics • Foundation Engineering															
Course Objectives: • At the end of this course, students are expected to analyse and design rigid, flexible earth retaining structures, slurry supported trenches and deep cuts.															
Unit I	EARTH PRESSURE THEORIES													9	
Introduction – State of stress in retained soil mass – Earth pressure theories – Classical and graphical techniques (Culmann’s method) – Active and passive cases – Earth pressure due to external loads.															
Unit II	COMPACTION, DRAINAGE AND STABILITY OF RETAINING STRUCTURES													9	
Retaining structure — Selection of soil parameters - Lateral pressure due to compaction, strain softening, wall flexibility, drainage arrangements and its influence. – Stability analysis of retaining structure both for regular and earthquake forces.															
Unit III	SHEET PILE WALLS													9	
Types of sheet piles - Analysis and design of cantilever and anchored sheet pile walls – free earth support method – fixed earth support method. Design of anchor systems - isolated and continuous.															
Unit IV	SLURRY SUPPORTED EXACAVATION													9	

Lateral pressure on sheeting in braced excavation, stability against piping and bottom heaving. Earth pressure around tunnel lining, shaft and silos – Soil anchors – Soil pinning –Basic design concepts.		
Unit V	SLURRY SUPPORTED EXCAVATION	9
Slurry supported trenches-basic principles-slurry characteristics-specifications-diaphragm walls-bored pile walls-contiguous pile wall-secant piles-stability analysis		
Total periods: 45		
Text Books:		
1.Clayton, C.R.I., Militisky, J. and Woods, R.I., Earth pressure and Earth-Retaining structures,Second Edition, Survey University Press, 1993.		
2.Das, B.M., Principles of Geotechnical Engineering, Fourth Edition, The PWS series in Civil Engineering, 1998.		
3.Militisky, J. and Woods, R., Earth and Earth retaining structures, Routledge,1992.		
References:		
1.Winterkorn, H.F. and Fang, H.Y., Foundation Engineering Handbook, GalgotiaBooksource,2000.		
2. Rowe, R.K., Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers, 2001.		
3. Koerner, R.M. Designing with Geosynthetics, Third Edition, Prentice Hall, 1997		
Course Outcomes:		Blooms Taxonomy
On completion of the course, the student is expected to be able to		
CO1 Analyse the earth pressure acting on retaining structures by applying classical theories considering all influencing parameters and suggest the earth pressure to be considered for the design of retaining structures.		K2 (Understanding)
CO2 Apply the knowledge of engineering and earth pressure to analyse and design rigid retaining structures considering effect of compaction, wall flexibility, pore water pressure and earth quake forces		K2 (Understanding)
CO3 Apply the knowledge of engineering and earth pressure to analyse and design flexible earth retaining walls and also acquire the knowledge of design of anchors		K3 (Applying)
CO4 Apply the knowledge on lateral earth pressure behind and around excavation to analyse and design braced excavations, slurry supported excavations and underground utilities		K2 (Understanding)
CO5 To understand the role of slurry in supporting excavations and to perform stability analysis by considering the actual shape of slurry support		K2 (Understanding)

CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3
CO2	2	2	3	3	3	2	1	1	2	1	3	3	2	2	2
CO3	2	2	3	3	3	2	1	1	2	2	3	3	2	2	2
CO4	3	3	3	1	3	3	1	1	1	2	3	3	3	3	3
CO5	3	1	2	2	3	2	2	3	1	0	3	3	2	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															
23CEE020	PILE FOUNDATION											Category: PEC			
												L	T	P	C
												3	0	0	3
Prerequisites • Soil mechanics • Foundation engineering • Engineering Geology															
Course Objectives: • The student will be exposed to the design of piles, pile groups and caissons with respect to vertical and lateral loads for various field conditions.															
Unit I	PILE CLASSIFICATIONS AND LOAD TRANSFER PRINCIPLE													9	
Necessity of pile foundation – classification of piles – Factors governing choice of type of pile – Load transfer mechanism – piling equipments and methods – effect of pile installation on soil condition –pile raft system – basic interactive analysis - criteria for pile socketing.															
Unit II	AXIAL LOAD CAPACITY OF PILES AND PILE GROUPS													9	
Allowable load of piles and pile groups — Static and dynamic methods — for cohesive and cohesionless soil – negative skin friction – group efficiency – pile driving formulae - limitation – Wave equation application – evaluation of axial load capacity from field test results - Settlement of piles and pile group.															
Unit III	LATERAL AND UPLIFT LOAD CAPACITIES OF PILES													9	
Piles under Lateral loads – Broms method, elastic, p-y curve analyses – Batter piles – response to moment – piles under uplift loads – under reamed piles – Drilled shaft – Lateral and pull out capacity from load test.															
Unit IV	STRUCTURAL DESIGN OF PILE AND PILE GROUPS													9	

Structural design of pile – structural capacity – pile and pile cap connection – pile cap design – shape, depth, assessment and amount of steel – truss and bending theory- Reinforcement details of pile and pile caps — pile subjected to vibration.		
Unit V	CAISSONS	9
Necessity of caisson – type and shape - Stability of caissons – principles of analysis and design – tilting of caisson – construction - seismic influences.		
Total periods: 45		
Text Books:		
1.Das, B.M., Principles of Foundation Engineering, Design and Construction, Fourth Edition, PWS Publishing, 1999.		
2.Poulos, H.G., Davis, E.H., Pile foundation analysis and design, John Wiley and Sons, New York, 1980.		
References:		
1.Tomlinson, M.J. Foundation engineering, ELBS, Longman Group, U.K. Ltd., England 1995.		
2.Michael Tomlinson and John Woodward, Pile design and construction practice, Taylor & Francis Group, London & New York, 2008.		
3.Cernica, J.N. Geotechnical Engineering Foundation Design, John Wiley and Sons, Inc. 1995.		
Course Outcomes:		Blooms Taxonomy
On completion of the course, the student is expected to be able to		
CO1 Explain the importance of pile foundation and various functions and responsibilities of geotechnical engineer and contractor, in addition to the piling equipments.		K2 (Understanding)
CO2 Determine the vertical load carrying capacity of pile and pile group-keeping the settlement of pile as an important criteria based on field practices and codal provisions.		K2 (Understanding)
CO3 Apart from vertically loaded piles, the structures are exposed to the peculiar pile subjected to lateral and uplift load with reference to codal provision and case studies.		K3 (Applying)
CO4 Understand the design of pile and pile caps, considering the wind and seismic loads.		K2 (Understanding)
CO5 Explain the importance of caisson foundation and checking the stability of caissons based on codal provisions.		K2 (Understanding)
CO - PO & PSO Mapping		

Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	3	2	1	1	1	2	2	1	3	3	2	2
CO2	2	3	3	1	1	0	1	1	1	1	1	3	2	1	3
CO3	2	3	3	2	2	1	1	1	1	1	0	3	3	2	3
CO4	1	3	3	2	2	0	1	1	1	1	1	0	3	2	3
CO5	2	3	2	2	2	1	1	1	1	1	1	3	3	2	3

1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation

23CEE021	TUNNELING ENGINEERING	Category: PEC			
		L	T	P	C
		3	0	0	3

Prerequisites

- Soil mechanics
- Engineering Geology
- Surveying and leveling

Course Objectives:

- Students mainly focused in visualizing and critically analyzing the behavior of underground structures with reference to various supporting systems under different loading conditions due to induced earth pressure on the underground structures.
- To give idea about the equipment used in underground excavations

Unit I	TUNNELS AND UNDERGROUND SPACE APPLICATION	9
History-caves-tunnels for transport-water,power supply-storage of LPG –nuclear waste disposal-defence facilities-submerged tunnels-underground library,museums.		
Unit II	EXCAVATION TECHNIQUES	9
Types and purpose of tunnels-choice of excavation methods-soft ground tunneling-hardrock tunneling-tunnel drilling-blasting-impact hammers-problems encountered and remedial measures.		
Unit III	PLANNING AND GEOMETRIC DESIGN OF TUNNELS	9
Topographical –geological survey-rock sampling-testing-determination of location size shape and alignment-subsidence problem on soft ground –tunneling design in hard rock.		
Unit IV	CONSTRUCTION OF TUNNEL	9
Advanced drilling techniques –TBM-cuttability assessment-shield tunneling-advantages-types of shield tunneling-factors affecting selection of shield-twin tunnel-NATM.		
Unit V	DESIGN OF TUNNEL SUPPORTING SYSTEMS AND VENTILATION	9

Classification of supports-active –passive-permanent-temporary-excavation support-steel supports-lining-grouting-ground freezing-environment in underground-various methods of ventilation.															
Total periods: 45															
Text Books:															
1.“ Infrastructure planning design construction”-R.K.Goel, Bhavani singh, Jian Zhao, Butterworth heinemunn publishers.															
2.“Practical tunnel construction”, Hemphill G.B 2012 Johnwileyand Son.															
References:															
1.“Introduction to tunnel construction”, David chapran, Nicole metse and Alfred stark,Spor press															
2.“Practical tunnel construction”, Hemphill G.B 2012 Johnwileyand Son.															
Course Outcomes:													Blooms Taxonomy		
On completion of the course, the student is expected to be able to															
CO1 To Understand need of utilization of underground space for various applications													K2 (Understanding)		
CO2 To study various methods of excavations and tunneling methods													K2 (Understanding)		
CO3 Planning and design process of tunnels..													K3 (Applying)		
CO4 To identify the suitable method of tunneling.													K2 (Understanding)		
CO5 To study various types of support system and its merit and demerits.													K2 (Understanding)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	2	0	1	1	0	0	3	2	3	2
CO2	2	3	1	0	1	0	0	0	0	0	0	3	2	3	3
CO3	2	2	3	0	1	0	0	0	0	0	0	3	2	3	2
CO4	2	2	3	1	1	0	0	0	0	0	0	3	2	3	2
CO5	2	2	2	1	0	1	1	0	0	1	1	3	2	3	2
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

VERTICAL IV: GEO-INFORMATICS

23CEE022	TOTAL STATION AND GPS SURVEYING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Surveying and leveling					
Course Objectives: To understand the working of Total Station and GPS and solve the surveying problems.					
Unit I	FUNDAMENTALS OF TOTAL STATION AND ELECTROMAGNETIC WAVES				9
Methods of Measuring Distance, Basic Principles of Total Station, Historical Development, Classifications, applications and comparison with conventional surveying - Applications of Electromagnetic waves, Propagation properties, wave propagation at lower and higher frequencies – Refractive index (RI) – factors affecting RI -Computation of group for light and near infrared waves at standard and ambient conditions – Computation of RI for microwaves at ambient condition – Reference refractive index -Real-time application of first velocity correction. Measurement of atmospheric parameters - Mean refractive index – Second velocity correction -Total atmospheric correction - Use of temperature -pressure, transducers					
Unit II	ELECTRO-OPTICAL AND MICROWAVE				9
Electro - optical system: Measuring principle, Working principle, Sources of Error, Infrared and Laser Total Station instruments. Microwave system: Measuring principle, working principle, Sources of Error, Microwave Total Station instruments. Comparison between Electro-optical and Microwave system. Care and maintenance of Total Station instruments. COGO functions: Area, Inverse / MLM, REM, Resection, offsets and stakeout - Land survey applications.					
Unit III	SATELLITE SYSTEM				9
Basic concepts of GPS – Historical perspective and development – applications -Geoid and Ellipsoid – satellite orbital motion – Keplerian motion – Kepler’s Law – Perturbing forces -Geodetic satellite – Doppler effect – Positioning concept – GNSS and IRNSS – SBAS: GAGAN and WAAS Different segments - space, control and user segments – satellite configuration – GPS signal structure – Orbit determination and representation – Anti Spoofing and Selective Availability -Task of control segment GPS receivers					
Unit IV	GPS DATA PROCESSING				9

GPS observables – code and carrier phase observation – linear combination and derived observables concept of parameter estimation – downloading the data – RINEX Format–Differential data processing – software modules - solutions of cycle slips, ambiguities - Multi path and other observational errors – satellite geometry and accuracy measures – Continuously Operating Reference System (CORS)– long base line processing - use of different processing software’s:Open Source, Scientific and Commercial.		
Unit V	SURVEYING METHODS AND APPLICATIONS	9
Total Station: Traversing and Trilateration measurement and adjustment –Planimetric map and Contour map and Topography Mapping. GNSS: Concepts of rapid, static, semi-Kinematic, pure Kinematic and RTK methods. Observation by Radiation, Lee frog and Trilateration measurement and processing -Topography mapping using PPK and RTK methods Total Station and GNSS application		
Total periods: 45		
Text Books:		
1.Rueger, J.M. Electronic Distance Measurement, Springer-Verlag, Berlin, 4th Edition, 1996.		
2.Gunter Seeber , Satellite Geodesy, Walter De Gruyter, Berlin, 2 nd Edition, 2003		
3.SatheeshGopi, rasathishkumar, N.madhu, — Advanced Surveying , Total Station GPS and Remote Sensing — Pearson education , 2nd Edition,2017. isbn: 978-81317 00679		
References:		
1.R.Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.		
2.Laurila, S.H. Electronic Surveying in Practice, John Wiley and Sons Inc, 1983		
3.Guocheng Xu, GPS Theory, Algorithms and Applications, Springer - Verlag, Berlin, 3 rd Edition, 2016.		
Course Outcomes:	Blooms Taxonomy	
On completion of the course, the student is expected to be able to		
CO1 Learn about the fundamental concept of Total station.	K2 (Understanding)	
CO2 Provide knowledge about electromagnetic waves and its usage in Total station and GNSS.	K2 (Understanding)	
CO3 Gain Knowledge on basic concepts of GNSS	K2 (Understanding)	
CO4 Understand the measuring and working principle of electro optical and Microwave Total station and GPS	K2 (Understanding)	
CO5 Gain knowledge about Total station and GNSS data processing and Mapping.	K3 (Applying)	

CO - PO & PSO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	3	2	0	0	1	0	0	2	3	3	2
CO2	3	2	3	2	3	3	0	0	1	0	0	2	3	3	2
CO3	3	2	2	2	3	2	0	0	1	0	0	2	3	3	2
CO4	3	2	3	3	3	3	0	0	1	0	0	2	3	3	3
CO5	3	3	2	3	3	3	0	0	2	0	0	2	3	3	3
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23CEE023	REMOTE SENSING CONCEPTS	Category: PEC			
		L	T	P	C
		3	0	0	3
Course Objectives: ○ To introduce the concepts of remote sensing processes and its components. ○ To expose the various remote sensing platforms and sensors and to introduce the elements of data interpretation.					
Unit I	REMOTE SENSING AND ELECTROMAGNETIC RADIATION				9
Definition – components of RS – History of Remote Sensing – Merits and demerits of data collation between conventional and remote sensing methods - Electromagnetic Spectrum – Radiation principles - Wave theory, Planck’s law, Wien’s Displacement Law, Stefan’s Boltzmann law, Kirchoff’s law – Radiation sources: active & passive - Radiation Quantities					
Unit II	EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL				9
Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows - Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance – Spectroradiometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water – solid surface scattering in microwave region					
Unit III	ORBITS AND PLATFORMS				9
Motions of planets and satellites – Newton’s law of gravitation - Gravitational field and potential - Escape velocity - Kepler’s law of planetary motion - Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms - Ground based, Airborne platforms and Space borne					

platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Lefrange Orbit.		
Unit IV	SENSING TECHNIQUES	9
Classification of remote sensors – Resolution concept : spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors - High Resolution Sensors - LIDAR , UAV Orbital and sensor characteristics of live Indian earth observation satellites		
Unit V	DATA PRODUCTS AND INTERPRETATION	9
Photographic and digital products – Types, levels and open source satellite data products -- selection and procurement of data– Visual interpretation: basic elements and interpretation keys -Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification		
Total periods: 45		
Text Books:		
1.Thomas M.Lillesand, Ralph W. Kiefer and Jonathan W. Chipman, Remote Sensing and Image interpretation, John Wiley and Sons, Inc, New York,2015.		
2.George Joseph and C Jeganathan, Fundamentals of Remote Sensing,Third Edition Universities Press (India) Private limited, Hyderabad, 2018		
References:		
1.Janza, F.Z., Blue H.M. and Johnson,J.E. Manual of Remote Sensing. Vol.I, AmericanSociety of Photogrametry, Virginia, USA, 2002.		
2.Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press, 1995		
3.Paul Curran P.J. Principles of Remote Sensing. Longman, RLBS, 1988.		
Course Outcomes:		Blooms Taxonomy
On completion of the course, the student is expected to be able to		
CO1 understand the concepts and laws related to remote sensing		K5 (Evaluating)
CO2 understand the interaction of electromagnetic radiation with atmosphere and earth material		K2 (Understanding)
CO3 acquire knowledge about satellite orbits and different types of satellites		K2 (Understanding)
CO4 understand the different types of remote sensors		K2 (Understanding)
CO5 gain knowledge about the concepts of interpretation of satellite imagery		K4 (Analysing)
CO - PO & PSO Mapping		

Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	0	0	0	0	0	0	0	0	0	0	0	3	0	2
CO2	3	0	0	0	0	0	0	0	0	0	0	0	3	0	2
CO3	2	0	0	0	0	0	0	0	3	3	0	0	3	0	3
CO4	2	3	2	3	3	0	3	3	0	0	1	2	3	3	3
CO5	2	3	2	3	3	3	3	0	3	3	1	2	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CEE024	SATELLITE IMAGE PROCESSING	Category: PEC			
		L	T	P	C
		3	0	0	3
Course Objectives: To make the undergraduate Engineering Students understand the concepts, principles, processing of Satellite data in order to extract useful information from them					
Unit I	FUNDAMENTALS OF IMAGE PROCESSING				9
Information Systems - Encoding and decoding - acquisition, storage and retrieval –data products - satellite data formats - Digital Image Processing Systems - Hardware and software design consideration Scanner, digitizer - photo write systems					
Unit II	SENSORS MODEL AND PRE PROCESSING				9
Image Fundamentals – Sensor models – spectral response – Spatial response – IFOV,GIFOV& GSI – Simplified Sensor Models – Sampling & quantization concepts – Image Representation& geometry and Radiometry – Colour concepts – Sources of Image degradation and Correction procedures- Atmospheric, Radiometric, Geometric Corrections- Image Geometry Restoration- Interpolation methods and resampling techniques.					
Unit III	IMAGE ENHANCEMENT				9
Image Characteristics - Histograms - Scattergrams – Univariate and multi variate statistics- enhancement in spatial domain – global, local & colour Transformations – PC analysis, edge detections, merging - filters - convolution – LPF, HPF , HBF, directional box, cascade – Morphological and adaptive filters – Zero crossing filters – scale space transforms – power spectrum – texture analysis – frequency transformations - Fourier, wavelet and curvelet transformations.					
Unit IV	IMAGE CLASSIFICATION				9

Spectral discrimination - pattern recognition concepts - Baye’s approach - Signature and training sets – Separability test –Supervised Classification – Minimum distance to mean, Parallelepiped, MLC – Unsupervised classifiers – ISODATA,K-means-Support Vector Machine – Segmentation (Spatial, Spectral) – Tree classifiers - Accuracy assessment – Error matrix – Kappa statistics – ERGAS, RMS															
Unit V		ADVANCED CLASSIFIERS												9	
Fuzzy set classification – sub- pixel classifier – hybrid classifiers, Texture based classification –Object based classifiers – Artificial Neural nets – Hebbian leaning – Expert system, types and examples – Knowledge systems.															
Total periods: 45															
Text Books:															
1.John, R. Jensen, Introductory Digital Image Processing, Prentice Hall, New Jersey, 4 th Edition, 2015.															
2.Robert, A. Schowengergt, Techniques for Image Processing and classification in Remote Sensing, Academic Press, 2012.															
References:															
1.Robert, G. Reeves,- Manual of Remote Sensing Vol. I & II - American Society of Photogrammetry, Falls, Church, USA, 1983.															
2.Richards, Remote sensing digital Image Analysis - An Introduction 5 th Edition, 2012,Springer -Verlag 1993.															
Course Outcomes:													Blooms Taxonomy		
On completion of the course, the student is expected to be able to															
CO1 Understand about Remote sensing and Image processing systems													K5 (Evaluating)		
CO2 Acquire knowledge about the source of error in satellite image and also to remove the error from satellite image.													K2 (Understanding)		
CO3 Select appropriate image Enhancement techniques based on image characteristics													K2 (Understanding)		
CO4 Classify the satellite image using various method and also evaluate the accuracy of classification.													K2 (Understanding)		
CO5 Apply the advanced image classification methods and conduct lifelong research in the field of image processing													K4 (Analysing)		
CO - PO & PSO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	0	0	0	3	0	0	0	0	0	0	2	3	3	3

CO2	3	3	0	0	3	0	0	0	0	0	0	2	3	3	3
CO3	3	3	3	3	3	0	2	2	2	0	3	2	3	3	3
CO4	3	3	3	3	3	3	2	2	0	2	3	2	3	3	3
CO5	3	3	3	3	3	3	2	2	2	2	3	2	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEE025	CARTOGRAPHY AND GIS	Category: PEC			
		L	T	P	C
		3	0	0	3
Course Objectives: To introduce concepts of Cartography and GIS To expose the process of map making and production To introduce GIS data structures, data input and data presentation					
Unit I	ELEMENTS OF CARTOGRAPHY				9
Definition of Cartography – Maps – Functions – Uses and Types of Maps – Map Scales and Contents Map Projections – Shape, Distance, Area and Direction Properties – Perspective and mathematical Projections – Indian Maps and Projections – Map Co-ordinate System – UTM and UPS references					
Unit II	MAP DESIGN AND PRODUCTION				9
Elements of a Map – Map Layout Principles – Map Design Fundamentals – Symbols and Conventional Signs – Graded and Ungraded Symbols – Color Theory – Colours and Patterns in Symbolization – Map Lettering – Map Production – Map Printing – Colours and Visualization – Map Reproduction – Map Generalization – Geometric Transformations – Bilinear and Affine Transformations.					
Unit III	FUNDAMENTALS OF GIS				9
Introduction to GIS – Definitions – History of GIS – Components of a GIS – Hardware, Software, Data, People, Methods – Introduction to data quality – Types of data – Spatial, Attribute data – types of attributes – scales/levels of measurements – spatial data models – Raster Data Structures – Raster Data Compression – Vector Data Structures – Raster Vs Vector Models – TIN and GRID data models					
UNIT IV	DATA INPUT AND TOPOLOGY				9
Scanner – Raster Data Input – Raster Data File Formats – Georeferencing– Vector Data Input – Digitizer– Datum Projection and Reprojection – Coordinate Transformation – Topology - Adjacency, Connectivity and containment – Topological Consistency – Non topological file formats – Attribute Data Linking – Linking External Databases – GPS Data Integration – Raster to Vector and Vector to Raster Conversion.					
UNIT V	DATA QUALITY AND OUTPUT				9

Assessment of Data Quality - Basic Aspects - Completeness, Logical Consistency, Positional Accuracy, Temporal Accuracy, Thematic Accuracy and Lineage – Metadata – GIS Standards – Interoperability – OGC - Spatial Data Infrastructure – Data Output – Map Compilation – Chart / Graphs.															
Total periods: 45															
Text Books:															
1.Arthur H. Robinson et al, “Elements of Cartography”, 7 th Edition, Wiley, 2002.															
2.Kang – Tsung Chang, "Introduction to Geographic Information Systems", McGraw Hill Publishing, Fourth Edition, 2017.															
3.Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, “An Introduction to Geographical Information Systems, Pearson Education, Fourth Edition, 2011															
References:															
1. John Campbell, "Introductory Cartography", Wm. C.BrownPublishers,3 rd Edition,2004															
2. Chor Pang LO, Albert K. W. Yeung, “Concepts and Techniques of Geographic Information Systems”, Pearson Education, 2nd Edition, November 2016. ISBN: 9789332581883															
Course Outcomes:													Blooms Taxonomy		
CO1 Be familiar with appropriate map projection and co-ordinate system for production of Maps and shall able to compile and design maps for their required purpose.													K2 (Understanding)		
CO2 Be familiar with co-ordinate and Datum transformations													K2 (Understanding)		
CO3 Understand the basic concepts and components of GIS, the techniques used for storage of spatial data and data compression													K4 (Analyzing)		
CO4 Understand the concepts of spatial data quality and data standard													K2 (Understanding)		
CO5 Understand the concept of spatial data inputs													K2 (Understanding)		
CO - PO & PSO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	2	1	1	1	0	0	0	0	0	0	3	2	2
CO2	3	2	1	1	1	1	0	0	0	0	0	0	3	2	3
CO3	2	1	1	1	3	1	0	0	0	0	0	0	3	2	2
CO4	2	1	2	1	2	1	0	0	0	0	0	0	3	2	2

CO5	2	2	2	1	2	2	0	0	0	0	0	0	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															
23CEE026	PHOTOGRAMMETRY											Category: PEC			
												L	T	P	C
												3	0	0	3
Course Objectives: To introduce basics and concepts of optics, aerial photography acquisition and mapping from aerial photographs															
UNIT I	PRINCIPLES AND PROPERTIES OF PHOTOGRAPHY													9	
History - Definition, Applications – Types of Photographs, Classification – Photographic overlaps – Camera: metric vs. non-metric, Digital Aerial cameras – Multiple frame and Line cameras – Linear array scanner – Flight Planning – Crab & Drift– Computation of flight plan - Photogrammetry project Planning.															
UNIT II	GEOMETRIC PROPERTIES OF AERIAL PHOTOGRAPHS													9	
Photo coordinate measurement – Vertical photographs -geometry, scale, Coordinate system, Relief displacement – Stereoscopes – Stereoscopic parallax – parallax equations -Geometry, Scale, Coordinate system – Relief displacement – Photo Interpretation.															
UNIT III	STEREOPLOTTERS & ORIENTATION													9	
Projection system, Viewing, Measuring and Tracing system Stereo plotters–Classification: Analog, semi analytical, Analytical and Digital systems – Interior orientation - Relative orientation – Absolute orientation - Collinearity condition and Coplanarity condition - Orientation: Two-dimensional coordinate transformations –Three-dimensional conformal coordinate transformation															
UNIT IV	AEROTRIANGULATION, TERRAIN MODELING, ORTHOPHOTO													9	
model – Strip and blocks of photographs – Aerotriangulation: strip adjustment, independent model triangulation, Bundle block Adjustment and GPS Aerotriangulation (INS and GNSS integration) - feature collection – DTM generation and Contour mapping – ortho rectification - mono plotting – stereo plotting															
UNIT V	DIGITAL PHOTOGRAMMETRY													9	
Photogrammetric Scanner – Digital Photogrammetry WorkStation – Work Station Basic system function – Storage System – Stereoscopic Viewing and Measuring System – Image properties - Image matching: template matching, feature based matching - DEM and DSM - Satellite photogrammetry principles															
Total periods: 45															
Text Books:															

1. Paul. R Wolf., Bon A. De Witt, Elements of Photogrammetry with Application in GIS McGraw Hill International Book Co., 4th Edition, 2014.
2. E. M. Mikhail, J. S. Bethel, J. C. McGlone, Introduction to Modern Photogrammetry, Wiley Publisher, 2001

References:

1. Gollfried Konecny, Geoinformation: Remote Sensing, Photogrammetry and Geographical Information Systems, CRC Press, 2nd Edition, 2014.

2. Karl Kraus, Photogrammetry: Geometry from Images and Laser Scans, Walter de Gruyter GmbH & Co. 2nd Edition, 2007

Course Outcomes:**Blooms Taxonomy**

On completion of the course, the student is expected to be able to

CO1 Understand and appreciate the importance of photography as means of mapping, functional and physical elements of photography.

K2
(Understanding)

CO2 Understand the need of the photogrammetric mapping and the relevance of accuracy standards and means to achieve them for precise large-scale maps with scientific methods.

K2
(Understanding)

CO3 Evaluate the standards of map based on the state-of-the-art tool and techniques and assess the production standards for photogrammetric map making.

K3 (Applying)

CO4 Acquire knowledge on the current development, issues methods and solutions in map making and evaluate methods of production.

K2
(Understanding)

CO5 Analyze critically and evaluate methods by applying the knowledge gained and to be a part of innovation and integration of mapping technology

K2
(Understanding)

CO - PO & PSO Mapping

Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	2	2	2	2	1	2	1	3	2	2	3	3	3
CO2	2	3	3	3	2	3	1	3	3	2	3	3	3	3	2
CO3	3	2	3	2	2	2	2	2	3	2	3	1	2	2	2
CO4	3	3	2	3	3	3	3	3	3	3	2	3	3	2	3
CO5	3	3	3	3	3	3	3	2	2	2	3	2	3	3	3

1 - Low, 2 - Medium, 3 - High, '-' - No correlation

23CEE027	AIRBORNE AND TERRESTRIAL LASER MAPPING	Category: PEC			
		L	T	P	C
		3	0	0	3
Course Objectives: To introduce the concepts of Space Borne, Air Borne, Terrestrial and Bathymetric LASER Scanners for Topographic and Bathymetric Mapping					
Unit I	SPACE BORNE RADAR AND LIDAR ALTIMETER				9
Principle and Properties of LASER- Production of Laser – Components of LASER – LiDAR – Types of LiDAR:Range Finder, DIAL and Doppler LiDAR - Platforms: Terrestrial, Airborne and Space borne LiDAR – Space Borne LiDAR Missions – Space Borne Radar Altimeter for mapping Sea Surface Topography , Moon Topography - Merits of ALS in comparison to Levelling, echo sounding, GPS leveling, Photogrammetry and Interferometry					
Unit II	AIRBORNE LASER SCANNERS				9
Airborne Topographic Laser Scanner – Ranging Principle – Pulse Laser and Continuous Wave Laser –First Return and Last Return – Ellipsoidal and Geoidal Height - Typical parameters of Airborne Laser Scanner (ALS) – Specifications of Commercial ALS – Components of ALS - GPS, IMU, LASER Scanner, Imaging Device, Hardware and Software - Various Scanning Mechanisms: Oscillating Mirror, Rotating Polygon, Nutating Mirror, Fibre Optic					
Unit III	DATA ACQUISITION AND PRE-PROCESSING				9
Laser Classification – Class I to Class IV Laser – Eye Safety - Synchronization of GPS, IMU and ALS Data -Reflectivity of terrain objects – Flight Planning – Determination of various data acquisition parameters – Swath Width, Point Density, No. of Strips, Area Covered, Point Spacing - Data Processing – Determination of optimal flight trajectory- Quality Assurance					
Unit IV	POST PROCESSING of LiDAR Data				9
Post Processing – Geo location of Laser Foot Prints – Various Co-ordinate Transformations involved Filtering - Ground Point filtering – Digital Surface Model and Digital Elevation Model - LIDAR data file formats – LAS File format and other proprietary file formats – Post Processing Software: Open Source and COTS Software – Quality Control Measures – Error Budget - Overview of LIDAR Applications in various domains - 3D city models – Corridor Mapping Applications – Forestry Applications.					
Unit V	TERRESTRIAL LASER SCANNERS				9

Terrestrial Laser Scanners (TLS) – Working Principle – Static TLS – Dynamic TLS – Commercial TLS Specifications – Mobile Mapping Lasers :Vehicle Mounted TLS, Back Pack Wearable Laser Scanners – Asset Management Studies – Highways and Railway Asset Management – Indoor Mapping : Laser Scanning of interior of buildings/monuments – Immersive Applications - BIM Model Applications in Tunnel Surveying, Forest Inventory, Open Cast Mine Surveying															
Total periods: 45															
Text Books:															
1. Jie Shan, Charles K. Toth, “Topographic Laser Ranging and Scanning – Principles and Processing”, 2 nd Edition, CRC Press Publication, March 2018. ISBN: 9781498772273															
References:															
1.George Vosselman and Hans-Gerd Maas, Airborne and Terrestrial Laser Scanning, WhittlesPublishing, 2010															
2.Matti Maltamo, Erik Næsset, JariVauhkonen, Forestry Applications of Airborne Laser Scanning-Concepts and Case Studies, Springer, Dordrecht , 2016,Reprint Edition. ISBN 978-94- 017-8662-1															
Course Outcomes:													Blooms Taxonomy		
On completion of the course, the student is expected to be able to															
CO1 Understand the components of laser and various platforms of laser scanning													K2 (Understanding)		
CO2 Summarize the components of Airborne Laser Scanner and concept of ranging principles													K2 (Understanding)		
CO3 Analyse the flight planning parameters and pre-processing of acquired data													K3 (Applying)		
CO4 Post process the data to derive DSM and DEM and its applications													K2 (Understanding)		
CO5 Understand the components of TLS and its applications													K2 (Understanding)		
CO - PO & PSO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	0	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	0	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	0	-	-	-	-	-	-	-	-	-	-	-	-	-

1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation					
23CEE028	HYDROGRAPHIC SURVEYING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Surveying and leveling					
Course Objectives: To provide the necessary knowledge and practical instrument operational and data processing skills needed for them to confidently accomplish a bathymetric survey in the real world To develop students’ critical and creative thinking, as well as cooperative attitudes & behaviour of working with others					
Unit I	INTRODUCTION, TIDES AND DATUMS				
9					
Overview of hydrographic surveying concepts- bathymetric and nautical charts- Basic tidal theory- tidal observations and predictions - common types of recording tide gauges - different vertical datums					
Indian tides					
Unit II	SOUNDINGS				
9					
Overview of depth data types- Working principle of echo sounders - characteristics and nature of underwater acoustic signals – transducers - error sources and calibrations- Advanced instrumentation					
Unit III	NAVIGATION AND POSITION FIXING				
9					
Horizontal positioning methods and requirements - concept of line and surface of position - positioning and navigation using satellite positioning systems - differential GPS and Real-time kinematic (RTK)					
Unit IV	PLANNING AND DATA PROCESSING				
9					
General considerations for planning of an inshore hydrographic survey - ground and track control - practical soundings in inshore and coastal surveys - data processing and chart compilation - hydrographic software packages for data collection - processing and plotting					
Unit V	MARINE ENVIRONMENTAL MEASUREMENTS				
9					
Methods of measuring and recording of currents - composition of the sea bed - and solids in suspension - Case Studies (The role of the hydrographic surveyor on different marine projects)					
Total periods: 45					
Text Books:					
1.U.S. Army Corps of Engineers, (2002), Hydrographic Surveying, Document No. EM 1110-2-1003.					

References:															
1. de Jong, C. D., Lachapelle, G., Skone, S. & Elema, I. A. (2002), Hydrography, Delft University Press, The Netherlands.															
2. Ingham, A. E. (1992), Hydrography for the Surveyor and Engineer, 3rd Edition revised by Abbott															
Course Outcomes:													Blooms Taxonomy		
On completion of the course, the student is expected to be able to															
CO1 Learn the fundamentals of hydrographic surveying													K2 (Understanding)		
CO2 Identify the appropriate techniques for different types of survey													K2 (Understanding)		
CO3 Understand the various options available during the Navigation													K3 (Applying)		
CO4 Analyze the data collected from a survey and assess its quality against the project requirements													K2 (Understanding)		
CO5 Discuss the different roles for a hydrographic surveyor on marine projects													K2 (Understanding)		
CO - PO & PSO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	1	3	3	2	1	2	3	2	2
CO2	3	1	2	1	1	3	1	3	1	2	1	2	3	2	2
CO3	3	3	3	3	3	3	1	3	2	2	1	2	3	2	2
CO4	3	2	2	2	1	3	1	3	1	2	1	2	3	2	2
CO5	3	2	3	3	1	3	1	3	1	2	1	2	3	2	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

VERTICAL V TRANSPORTATION INFRASTRUCTURE

23CEE029	AIRPORTS AND HARBOURS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: To introduce the students about airport planning, design, construction and planning design principles of seaport.					

Unit I	AIRPORT PLANNING	9
Air transport characteristics - airport classification – ICAO - airport planning: Site selection typical Airport Layouts, Case Studies, parking and Circulation Area.		
Unit II	AIRPORT COMPONENTS	9
Airport Classification, Planning of Airfield Components – Runway, Taxiway, Apron, Hangar- Passenger Terminals- Geometric design of runway and taxiways-Runway pavement Design- Difference between Highway and airport pavements- Introduction to various design methods- Airport drainage.		
Unit III	AIRPORT DESIGN	9
Runway Design: Orientation, Wind Rose Diagram, Problems on basic and Actual Length, Geometric Design – Elements of Runway Design – Airport Zones – Passenger Facilities and Services – Runway and Taxiway Markings- Air Traffic Control Tower- Instrumental Landing.		
Unit IV	SEAPORTS COMPONENTS AND CONSTRUCTION	9
Definition of Basic Terms: Harbor, Port, Satellite Port, Docks- Dry and Floating Dock, Waves and Tides – Planning and Design of Harbors: Harbour Layout and Terminal Facilities – Coastal Structures: Piers, Break waters, Wharves, Jetties, Quays, Spring Fenders, Dolphins Floating Landing Stage – Navigational Aids- Inland Water Transport.		
Unit V	SEAPORT REGULATIONS AND EIA	9
Wave action on Coastal Structures and Shore Protection and Reclamation – Coastal Regulation Zone, 2011-EIA – methods of impact analysis and its process		
Total periods: 45		
Text Books:		
1. Khanna.S.K. Arora.M.G and Jain.S.S, Airport Planning and Design, Nemachand and Bros, Roorkee,1994		
2. Robert Honjeff and Francis X.Mckelvey, "Planning and Design of Airports", McGraw Hill, New York,1996		
3. Subramanian K.P., Highways, Railways, Airport and Harbour Engineering,Scitech Publications (India), Chennai, 2010		
References:		
1. Venkatramaiah. C., Transportation Engineering-Vol.2 Railways, Airports, Docks and Harbours, Bridges and Tunnels.,Universities Press (India) Private Limited, Hyderabad, 2015.		
2. Mundrey J S, Railway Track Engineering, McGraw Hill Education (India) Private Ltd, New Delhi, 2013.		
Course Outcomes:		Blooms Taxonomy

CO1 Gain an insight on the planning and site selection of Airport Planning and design.													K2		
CO2 Knowledge on Design of various Airport components													K2		
CO3 Analyze and design the elements for orientation of runways and passenger facility systems.													K4		
CO4 Understand the various features in Harbours and Ports, their construction, coastal protection works													K2		
CO5 Knowledge on various Environmental Regulations and Acts.													K2		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	3	2	3	-	2	3	-	-	1	2	3	2	2
CO2	3	3	-	2	2	3	2	1	2	-	-	2	3	3	3
CO3	-	3	3	2	3	-	2	3	-	-	1	2	3	3	2
CO4	3	3	-	2	2	3	2	1	2	-	-	2	3	2	3
CO5	3	2	3	3	-	-	2	-	-	-	1	-	2	2	3
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23CEE030	TRAFFIC ENGINEERING AND MANAGEMENT	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: To give an overview of Traffic engineering, various surveys to be conducted, traffic Regulation, management and traffic safety					
UNIT I	TRAFFIC SURVEYS AND ANALYSES				8
Traffic characteristics: Human, vehicular, and Pavement Characteristics, Problems- presentation of traffic volume data, Annual Average Daily Traffic, Average Daily Traffic, Design hourly traffic volume; Speed-spot speed, presentation of spot speed data, speed and delay studies, methods of conducting spot-speed studies and Speed and Delay studies; Problems Origin and Destination – methods of conducting the survey and presentation of data; parking surveys, presentation of data and analyses, determination of parking demand; Accident studies and analyses; Different problems.					

UNIT II	TRAFFIC FLOW AND ROADWAY CAPACITY	8
Traffic Flow Characteristics – Basic traffic manoeuvres, Traffic stream flow characteristics, Speed- Flow-Density Relations; Passenger Car Units – Mixed traffic flow and related issues – Concept of PCU value-Factors affecting PCU values- Recommended PCU values for different conditions; Capacity and Level of Service – Factors affecting practical capacity – Design Service Volumes		
UNIT III	COST – EFFECTIVE TRAFFIC MANAGEMENT TECHNIQUES	10
Traffic System Management: Regulatory Techniques- one way street, Reversible Street, Reversible lane, Turning moment restrictions, closing streets; Traffic Control Devices – Traffic Signs – Road Markings, Traffic Signals, Miscellaneous traffic control devices; Traffic Segregation – Vehicle segregation, Pedestrian segregation, Traffic signals design; Bus Priority Techniques – Priority manoeuvres – With-flow bus lane and contra-flow bus lane; Self- Enforcing Techniques- Demand Management Techniques (TDM) Road pricing, parking control, Tolls, Staggering of office/educational institution hours.		
UNIT IV	DESIGN OF ROAD INTERSECTIONS	10
Definition of Basic Terms: Harbor, Port, Satellite Port, Docks- Dry and Floating Dock, Waves and Tides – Planning and Design of Harbors: Harbour Layout and Terminal Facilities – Coastal Structures: Piers, Break waters, Wharves, Jetties, Quays, Spring Fenders, Dolphins Floating Landing Stage – Navigational Aids- Inland Water Transport.		
UNIT V	DESIGN OF PARKING AND PEDESTRIAN FACILITIES AND CYCLE TRACKS	9
Parking: Need for parking studies and its ill effects- Parking Standards for different land uses, different types of parking - Conceptual plans for different types of parking; Pedestrians: Importance, Barriers, Behaviour, Pedestrian facilities – Principles of planning, Level of Service (LoS), Design standards.; Cycle Tracks: Principles of design, Design criteria, Design standards for Rural Expressways		
Total periods: 45		
Text Books:		
1. Kadiyali. L.R. Traffic Engineering and Transport Planning, Khanna Publishers, Delhi, 2019.		
2. Khanna .K and Justo C.E.G. and Veeraragavan, A Highway Engineering, Nem Chand Bros., Roorkee, Revised 10th Edition, 2014		
3. Srinivasa Kumar, “Introduction to Traffic Engineering”, Universities Press, 2018.		
4. Partha Chakroborty and Animesh Das Principles of Transportation Engineering, PHI Learning Pvt. Ltd., 2011		
5. Papacosta.P.S and Prevedouros.P.D, “ Transportation Engineering and Planning, third edition, 2015.		

References:															
1. Indian Roads Congress (IRC) Specifications: Guidelines and special publications on Traffic Planning and Management															
2. Khanna S. K, and others, Highway Engineering, Nam Chand & Bros, Roorkee, 2014, Pages 177 – 308.															
3. C. JotinKhisty, Kent Lall, Transportation Engineering: An Introduction, Prentice Hall, 1998															
4. Taylor MAP and Young W, Traffic Analysis – New Technology and New Solutions, Hargreen Publishing Company , 1998.															
5. Salter. R.I and Hounsell N.B, Highway Traffic Analysis and design, Macmillan Press Ltd.1996															
6. Roger P.Roess, William R.Mcshane and Elena S.Prassas, Traffic Engineering-Second Edition, Prentice Hall Publishers,, Upper Saddle River, New Jersey 1998.															
Course Outcomes:													Blooms Taxonomy		
On completion of the course, the student is expected to be able to															
CO1 Apply the knowledge of science and engineering fundamentals in conducting traffic surveys, analyze the problems and relating it with standards													K2		
CO2 Understand the principles of traffic flow characteristics and their relationships													K2		
CO3 Understand various traffic management measures in addressing the demand Pricing and ITS applications													K2		
CO4 Designing various types of control and regulatory measures to meet an efficient traffic network													K3		
CO5 Understand various type of facilities and plan for Non Motorised Transport													K2		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	1	1	1	2	2	3	1	3	3	3
CO2	3	3	3	3	3	2	1	2	3	-	3	1	3	2	3
CO3	3	2	3	2	1	1	1	2	2	3	2	1	2	2	2
CO4	2	3	3	3	3	2	2	2	2	3	3	1	2	3	3
CO5	2	2	1	1	1	2	3	3	1	1	2	1	2	2	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEE031	URBAN PLANNING AND DEVELOPMENT	Category: PEC

		L	T	P	C
		3	0	0	3
Prerequisites:					
Course Objectives: To enable students to have the knowledge on planning process and to introduce to the students about the regulations and laws related to Urban Planning.					
UNIT I	INTRODUCTION				7
Definition of Human settlement, Urban area, Town, City, Metropolitan City, Megalopolis, Urbanisation, Urbanism, Suburbanisation, Urban sprawl, Peri-urban areas, Central Business District (CBD), Urban Agglomeration, Census definition of urban settlements, Classification of urban areas –Positive and negative impacts of urbanisation, - Atal Mission for Rejuvenation and Urban Transformation (AMRUT).					
UNIT II	PLANNING PROCESS AND THEORIES				10
Principles of Planning –Stages in Planning Process – Goals, Objectives, Delineation of Planning Areas, Draft Plans, Evaluation, Final Plan. Planning Theories - Garden City Concept, Geddesian Triad by Patrick Geddes, Modernism Concept by Le-Corbusier, Radbun Concept, Neighbourhoods, Theories of Ekistics, Bid-rent Theory by William Alonso, Green Belt Concept.					
UNIT III	DEVELOPMENT PLANS, PLAN FORMULATION AND EVALUATION				10
Types of plans – Regional Plan, Master Plan, Structure Plan, Detailed Development Plan, New Town/ Satellite town- Development Plan, urban nodes, Smart City Plan -Scope and Content of Regional Plan (RP), Master Plan (MP), and the Detailed Development Plan (DDP), Methodologies for the preparation of the RP, MP, and the DDP – Case Studies.					
UNIT IV	PLAN IMPLEMENTATION				10
Planning Standards, Project Formulation and evaluation; Project Report preparation and presentation; Legal, Financial and Institutional constraints – Problems due to multiple laws, rules and institutions; Financing of Urban Development Projects; Urban planning agencies and their functions in the plan formulation and implementation.					
UNIT V	URBAN AND REGIONAL PLANNING LEGISLATIONS, REGULATIONS AND DESIGNS				8
Town and Country Planning, Local Bodies and Land Acquisition Acts, Development and Building Rules, Site analyses, Layouts and Buildings Design					
Total periods: 45					
Text Books:					
1. Goel, S.L Urban Development and Management, Deep and Deep publications, New Delhi 2002					

2. George Chadwick, A Systems view of planning, Pergamon press, Oxford 1978
3. Singh V.B, Revitalised Urban Administration in India, Kalpaz publication, Delhi, 2001
4. Edwin S.Mills and Charles M.Becker, Studies in Urban development, A World Bank publication, 1986

References:

1. Tamil Nadu Town and Country Planning Act 1971, and Rules made thereunder, Government of Tamil Nadu, Chennai
2. Thooyavan, K.R., Human Settlements – A Planning Guide to Beginners, M.A Publications, Chennai, 2005
3. Chennai City Municipal Corporation Act, 1919 and Tamil Nadu District Municipalities Act, 1920
4. The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013.
5. The Tamil Nadu Combined Development and Building Rules, 2019
6. Urban & Regional Development Plans Formulation & Implementation (URDPFI) Guidelines, Vol I & II, Jan 2015, Govt of India, Ministry of Urban Development
7. http://moud.gov.in

Course Outcomes:													Blooms Taxonomy		
On completion of the course, the student is expected to be able to															
CO1 Understand the basic issues and meaning of terminologies in urban planning													K2		
CO2 Understand the different types of theories of urban planning and city development.													K2		
CO3 Understand the different types of plan, their strategies and their preparation process.													K2		
CO4 Comprehend the planning standards, evaluate the constraints and the financial mechanism													K3		
CO5 Knowledge on various town and country planning acts and their functions													K2		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	3	3	-	3	-	3	-	3	2	3
CO2	2	-	3	2	-	3	2	2	2	-	3	2	3	3	3
CO3	3	-	3	-	-	2	3	-	2	2	2	1	2	2	3
CO4	-	-	2	2	2	-	2	2	3	-	3	2	2	1	2
CO5	3	2	1	2	-	3	2	2	2	2	3	2	1	1	2

1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation

23CEE032	SMART CITIES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: To help the leaners to understand the concepts of smart city and to introduce the students about application of technologies in smart cities					
UNIT I	INTRODUCTION				6
Urbanisation, need of focused development, role of Authorities, Smart city, Opportunity and Challenges- Smart infrastructures for city- Smart Cities Mission					
UNIT II	SMART PHYSICAL INFRASTRUCTURE				12
Infrastructure development in Smart Cities - Physical Infrastructure, Land Use - Compact/mixed-use development, Transit oriented development (TOD); Smart City Management-Transportation Unified governance structure (UMTA). Smart public transportation, Smart parking, Intelligent traffic management, Detour management; Low emission vehicles, Electric Mobility - Environmental projects etc					
UNIT III	SUSTAINABILITY AND SMART PLANNING				10
Relationship Between Sustainability and Smart planning - Place making project guidelines- Surveillance, Smart Street Lighting, Intelligent Emergency Services, Intelligent Disaster Forecasting and Management, GIS-based Spatial Decision Support Systems, Smart Communication Services					
UNIT IV	APPLICATION OF TECHNOLOGIES IN SMART CITIES				8
Role of Technologies in Smart Cities - Integrated Command and Control Center (ICCC), Data Analytics, Data driven strategies implementation in smart cities.					
UNIT V	SMART CITIES PROJECT MANAGEMENT				9
Need for project management, Philosophy and concepts; Project phasing and stages; Project organizational structuring: Planning and Scheduling: Project cost analysis; Procurement and Contracting: PPP: Project Monitoring and Evaluation: Risk Management; Case studies					
Total periods: 45					
References:					
1. P Sharma , “Sustainable Smart cities in India, Challenges and Future Perspectives”, Springer					

Link, 2017															
2. Sameer Sharma, "Smart Cities Unbounded- Ideas and Practice of Smart Cities in India", Bloomsbury India, 2018.															
3. <u>Binti Singh</u> , <u>Manoj Parmar</u> , "Smart City in India Urban Laboratory, Paradigm or Trajectory?" Routledge India, 2019															
4. https://smartcities.gov.in/guidelines#block-habikon-content															
5. https://smartnet.niua.org/learn/library															
Course Outcomes:												Blooms Taxonomy			
On completion of the course, the student is expected to be able to															
CO1 Understand the basics of Urbanisation and the role of smart cities.												K2			
CO2 Gain knowledge on implementation of smart physical infrastructure												K2			
CO3 Understand the role of smart planning for sustainable development.												K2			
CO4 Comprehend the knowledge of Technologies in Smart City planning												K3			
CO5 Reviewing the case studies of smart city projects.												K2			
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	3	2	3	1	1	2	2	1	3	3	2
CO2	3	3	3	2	1	3	3	2	3	1	3	1	3	3	3
CO3	3	1	3	2	1	1	3	3	2	2	3	2	3	2	3
CO4	3	2	2	2	3	2	2	2	3	3	3	1	3	2	2
CO5	2	2	3	3	2	2	2	2	3	3	2	2	2	3	3
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23CEE033	INTELLIGENT TRANSPORTATION SYSTEMS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To learn the fundamentals of ITS. - To study the ITS functional areas					

To have an overview of ITS implementation in developing countries.		
UNIT I	INTRODUCTION TO ITS	7
Fundamentals of ITS: Definition of ITS, Challenges in ITS Development-Purpose of ITS Deployment-Benefits of ITS- Overview of application of ITS in Transportation Planning.		
UNIT II	DATA COLLECTION THROUGH ITS	9
Sensors & its application in traffic data collection - Elements of Vehicle Location and Route Navigation and Guidance concepts; ITS Data collection techniques – vehicle Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), GIS, RFID, video data collection, Internet of Things (IOT)		
UNIT III	ITS IN TRAFFIC MANAGEMENT	10
ITS User Needs and Services and Functional areas –Introduction, Advanced Traffic Management systems (ATMS), Advanced Traveler Information systems (ATIS), Advanced Vehicle Control systems (AVCS), Advanced Public Transportation systems (APTS), Advanced Rural Transportation systems (ARTS)- Autonomous Vehicles- Autonomous Intersections		
UNIT IV	ITS IN TRANSPORTATION PLANNING	10
ITS and safety, ITS and security- Traffic and incident management systems; ITS and sustainable mobility, travel demand management, electronic toll collection, ITS and road-pricing.; Transportation network operations – public transportation applications- Weight –in Motion		
UNIT V	ITS APPLICATION IN LOGISTICS	9
Commercial vehicle operations and intermodal freight-Fleet Management- IT application in freight logistics-E commerce		
Total periods: 45		
Text Books:		
1. R. Srinivasa Kumar,"Intelligent Transportation Systems", Universities Press P Ltd, Telangana, 2022		
References:		
1. Intelligent Transport Systems, Intelligent Transportation Primer, Washington, US,2001.		
2. Henry F.Korth, and Abraham Siberschatz, Data Base System Concepts, McGraw Hill,1992.		
3. TurbanE., "Decision Support and Export Systems Management Support Systems", Maxwell Macmillan,1998		
4. Sitausu S. Mittra, "Decision Support Systems–Tools and Techniques", John Wiley, New York,1986		

5. Cycle W.Halsapple and Andrew B.Winston, "Decision Support Systems–Theory and Application", Springer Verlog, New York, 198

6. ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.

Course Outcomes:													Blooms Taxonomy		
On completion of the course, the student is expected to be able to															
CO1 Understand the fundamentals of ITS and its benefit													K2		
CO2 Gain knowledge on data collection using sensors and its applications													K2		
CO3 Acquainted with the knowledge of ITS in Traffic Management													K2		
CO4 Application of ITS in Transportation Planning													K3		
CO5 Able to gain knowledge on application of ITS in Logistics													K2		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	2	3	2	2	1	3	1	2	2	2	2	2
CO2	2	2	1	3	3	2	2	2	3	2	3	2	2	2	2
CO3	2	1	2	2	3	2	1	1	3	2	1	1	3	2	3
CO4	2	2	1	3	3	2	1	1	3	1	3	2	3	3	2
CO5	3	2	1	3	3	2	1	2	3	2	3	2	3	2	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEE034	PAVEMENT ENGINEERING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: Student gains knowledge on various IRC guidelines for designing rigid and flexible pavements. Further, the student will be in a position to assess quality and serviceability conditions of roads					
UNIT I	PAVEMENT MATERIALS AND SUBGRADE ANALYSIS				8
Introduction – Pavement as layered structure – Pavement types -rigid and flexible-Subgrade analysis- Stress and deflections in pavements- Pavement Materials and Testing- Modified Binders					
UNIT II	DESIGN OF FLEXIBLE PAVEMENTS				10
Flexible pavement design – Advantages and disadvantages -Factors influencing design of flexible pavement, Empirical – Mechanistic empirical and theoretical methods – Design procedure as per IRC					

guidelines – Design and specification of rural roads.		
UNIT III	DESIGN OF RIGID PAVEMENTS	9
Cement concrete pavements Factors influencing CC pavements – Modified Westergaard approach Design procedure as per IRC guidelines – Concrete roads and their scope in India		
UNIT IV	PAVEMENT CONSTRUCTION, EVALUATION AND MAINTENANCE	10
Construction Techniques practice of flexible and concrete pavement Pavement Evaluation - Causes of distress in rigid and flexible pavements – Evaluation based on Surface Appearance, Cracks, Patches and Pot Holes, Undulations, Raveling, Roughness, Skid Resistance. Structural Evaluation by Deflection Measurements - Pavement Serviceability index, - Pavement maintenance (IRC Recommendations only).		
UNIT V	STABILIZATION OF PAVEMENTS	8
Stabilization with special reference to highway pavements – Choice of stabilizers – Testing and field control - Stabilization for rural roads in India – Use of Geosynthetics in roads.		
Total periods: 45		
Text Books:		
1. Khanna, S.K. and Justo C.E.G. and Veeraragavan, A, “Highway Engineering”, New Chand and Brothers, Revised 10th Edition, 2014		
2. Kadiyali, L.R., “Principles and Practice of Highway Engineering”, Khannatech. Publications, New Delhi, 2015.		
References:		
1. Yoder, R.J. and Witchak M.W. “Principles of Pavement Design”, John Wiley 2000.		
2. Guidelines for the Design of Flexible Pavements, IRC-37–2012, The Indian roads Congress, New Delhi		
3. Guideline for the Design of Rigid Pavements for Highways, IRC 58-2018, The Indian Road Congress, New Delhi		
Course Outcomes:		Blooms Taxonomy
On completion of the course, the student is expected to be able to		
CO1 Get knowledge about types of rigid and flexible pavements		K2
CO2 Able to design of rigid pavements		K4
CO3 Able to design of flexible pavements.		K4
CO4 Determine the causes of distress in rigid and flexible pavements		K4
CO5 Understand stabilization of pavements, testing and field control.		K2
CO - PO & PSO Mapping		

Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	3	1	-	2	-	-	-	3	2	-
CO2	1	-	3	-	2	-	1	-	2	-	-	2	3	3	1
CO3	3	3	3	2	3	-	2	3	-	-	2	3	3	3	1
CO4	2	3	2	2	2	3	3	3	2	-	3	3	3	3	2
CO5	3	2	1	1	2	3	1	3	-	1	3	2	2	1	2
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23CEE035	TRANSPORTATION PLANNING PROCESS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites:					
Course Objectives: To impart knowledge in the rudiments and stages in Transportation Planning Process.					
UNIT I	TRANSPORTATION PLANNING PROCESS				8
Importance of transportation planning, Integration of Land Use and Transport; Systems Approach to Transport Planning; Four Steps in the Transport Planning Process; Travel Demand Modelling Approach; Traffic Analyses Zones – internal and external; Various Transportation Surveys for the collection of data – methodology, analyses of data and presentation of results					
UNIT II	TRIP GENERATION STAGE				9
Definition and importance; Trip Production and Attraction, Types of trips; Factors governing trip generation: population related data, land and building use, socio-economic, Trip generation models: Types, Assumptions made, Multiple Linear Regression, category analysis- merits and de-merits of the model, verification, calibration and validation of the model.					
UNIT III	TRIP DISTRIBUTION STAGE				10
Definition and objective; Data collection, analyses and presentation of trip matrix table, Desire Line Diagram, Development of Gravity, growth factor methods for Trip Distribution, Calibration of gravity model and its validation.					
UNIT IV	MODAL SPLIT STAGE				9
Factors influencing mode choice - Household characteristics; Zonal Characteristics; Network characteristics - Modal split: pre distribution or post distribution - Mode wise trip matrix and modal split					

analyses- Overview of Probit and Logit model.															
UNIT V		TRAFFIC ASSIGNMENT STAGE												9	
Meaning and objective; General principles; Assignment Techniques- all-or-nothing assignments, multiple route assignment, capacity restraint, diversion curves, Trip assignment route selection; Mode-wise trip matrices; element of transportation network, nodes and links, speed flow curves, minimum path trees															
Total periods: 45															
Text Books:															
1. Kadiyali. L.R., Traffic Engineering and Transport Planning, Khanna Publishers, Delhi, 2019															
2. C.S. Papacostas and P.D. Prevedouros, Transportation Engineering and Planning, Prentice Hall of India Pvt. Ltd., 2009															
3. Michael J.Bruton, Introduction to Transportation Planning, Hutchinson, London, 1995.															
References:															
1. J D Ortuzar and L G Willumnsen. Modeling Transport. John Wiley and Sons, New York, 2011															
2. John W. Dickey, Metropolitan Transportation Planning, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1990.															
3. C. JotinKhisty, Kent Lall, Transportation Engineering: An Introduction, Prentice Hall,															
4. Juan de Dios Ort zar and Luis G. Willumsen, Modelling Transport, John Wiley & Sons 20															
5. Chennai Comprehensive Traffic Study, Chennai Metropolitan Development Autho															
Course Outcomes:														Blooms Taxonomy	
On completion of the course, the student is expected to be able to															
CO1 Understand the principles of the transportation planning process and methods of data collection														K2	
CO2 Acquainted with the trip production, trip attraction models and calibration.														K2	
CO3 Acquainted with the trip production, trip attraction models and calibration.														K2	
CO4 Able to understand trip distribution models and its application.														K2	
CO5 Gain knowledge on the mode choice behaviour and mode split models.														K2	
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	3	2	2	3	2	3	1	3	1	3	2	3
CO2	2	3	3	3	2	1	2	1	1	1	2	1	2	1	1
CO3	2	3	3	3	2	1	2	2	2	1	3	1	-	1	2
CO4	2	2	3	2	2	2	2	2	2	2	3	1	1	-	-

CO5	0	0	2	0	2	3	2	2	0	0	2	1	-	2	2
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

VERTICAL VI: ENVIRONMENT

23CEE036	CLIMATE CHANGE ADAPTATION AND MITIGATION	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites:					
Course Objectives: To impart knowledge on the global warming, the impact of climate change on society and the adaptation and mitigation measures to the students					
UNIT I	INTRODUCTION				9
Atmosphere – weather and Climate - climate parameters – Temperature, Rainfall, Humidity, Wind Global Ocean circulation – El Nino and its effect - Carbon cycle					
UNIT II	ELEMENTS RELATED TO CLIMATE CHANGE				7
Greenhouse gases - Total carbon dioxide emissions by energy sector – industrial, commercial, transportation, residential – Impacts – air quality, hydrology, green space - Causes of global and regional climate change – Changes in patterns of temperature, precipitation and sea level rise – Greenhouse effect.					
Unit III	IMPACTS OF CLIMATE CHANGE				10
Effects of Climate Changes on living things — health effects, malnutrition, human migration, socioeconomic impacts- tourism, industry and business, vulnerability assessment- infrastructure, population and sector – Agriculture, forestry, human health, coastal areas					
Unit IV	MITIGATING CLIMATE CHANGE				9
IPCC Technical Guidelines for Assessing Climate Change Impact and Adaptation -Identifying adaption options – designing and implementing adaption measures – surface albedo environment-reflective roofing and reflective paving – enhancement of evapotranspiration - tree planting programme – green roofing strategies – energy conservation in buildings – energy efficiencies – carbon sequestration.					
UNIT V	ALTERNATE FUELS AND RENEWABLE ENERGY				10
Energy source – coal, natural gas – wind energy, hydropower, solar energy, nuclear energy, geothermal energy – biofuels – Energy policies for a cool future - Energy Audit.					

Total Periods: 45															
Text Books:															
1. Ruddiman W.F, freeman W.H. and Company, “Earth’s Climate Past and Future”, 2001															
2. Velma. I. Grover “Global Warming and Climate” Change. Vol I an II. Science Publishers, 2005.															
3. Dash Sushil Kumar, “Climate Change — An Indian Perspective”, Cambridge University Press India Pvt. Ltd, 2007															
References:															
1. IPCC Fourth Assessment Report, Cambridge University Press, Cambridge, UK, 2007															
2. Thomas E, Lovejoy and Lee Hannah “Climate Change and Biodiversity”, TERI Publishers, 2005															
3. Jan C. van Dam, Impacts of “Climate Change and Climate Variability on Hydrological Regimes”, Cambridge University Press, 2003.															
Course Outcomes:													Blooms Taxonomy		
CO1 An insight into carbon cycle, physical basis of the natural greenhouse effect, including the meaning of the term radiative forcing, climate change, global warming and measures to adapt and to mitigate the impacts of climate change													K2		
CO2 Understanding on the growing scientific consensus established through the IPCC as well as the complexities and uncertainties													K2		
CO3 Ability to plan climate change mitigation and adaptation projects including the use of alternate fuels and renewable energy													K3		
CO4 Gain in-depth knowledge on climate models													K2		
CO5 Post process the model outputs for climate impact assessment, know about adaptation strategies													K2		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	-	-	-	-	-	-	-	1	-	2	-	-	-
CO2	-	3	-	-	-	3	3	-	-	-	-	-	2	-	3
CO3	2	3	-	2	3	-	-	-	-	-	-	3	-	-	-
CO4	2	-	2	2	3	-	-	-	3	-	-	-	-	-	-
CO5	-	3	-	-	3	2	-	-	3	2	3	2	-	2	-
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CEE037	AIR AND NOISE POLLUTION CONTROL ENGINEERING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites: Environmental science and engineering.					
Course Objectives: To impart knowledge on the sources, effects and control techniques of air pollutants and noise pollution.					
Unit I	GENERAL				9
Atmosphere as a place of disposal of pollutants – Air Pollution – Definition - Air Pollution and Global Climate - Units of measurements of pollutants - Air quality criteria - emission standards - National ambient air quality standards - Air pollution indices - Air quality management in India.					
Unit II	SOURCES, CLASSIFICATION AND EFFECTS				9
Sources and classification of air pollutants - Man made - Natural sources - Type of air pollutants Pollution due to automobiles - Analysis of air pollutants - Chemical, Instrumental and biological methods.Air pollution and its effects on human beings, plants and animals - Economic effects of air pollution - Effect of air pollution on meteorological conditions - Changes on the Meso scale, Micro scale and Macro scale.					
Unit III	SAMPLING, METEOROLOGY AND AIR QUALITY MODELLING				9
Sampling and measurement of particulate and gaseous pollutants - Ambient air sampling - Stack sampling. Environmental factors - Meteorology - temperature lapse rate and stability – Adiabatic lapse rate - Wind Rose - Inversion – Wind velocity and turbulence - Plume behavior - Dispersion of air pollutants- Air Quality Modeling.					
Unit IV	AIR POLLUTION CONTROL MEASURES				9
Control - Source correction methods - Control equipments - Particulate control methods – Bag house filter - Settling chamber - cyclone separators - inertial devices - Electrostatic precipitator – scrubbers - Control of gaseous emissions - Absorption - Absorption equipments - adsorption and combustion devices (Theory and working of equipments only).					
Unit V	NOISE POLLUTION AND ITS CONTROL				9
Sources of noise – Units and Measurements of Noise - Characterization of Noise from Construction, Mining, Transportation and Industrial Activities, Airport Noise – General Control Measures – Effects of noise pollution – auditory effects, non-auditory effects. Noise Menace– Prevention and Control of Noise Pollution – Control of noise at source, control of transmission, protection of exposed person - Control of					

other types of Noise Sound Absorbent.															
Total Periods: 45															
Text Books:															
1. C. S. Rao, “Environmental Pollution Control Engineering”, Wiley Eastern Limited, 2006.															
2. M. N. Rao, H. V. N. Rao, Air pollution, Tata McGraw Hill Pvt Ltd, New Delhi, 2017.															
3. Dr. Y. Anjaneyulu, “Air Pollution and Control Technologies”, Allied publishers Pvt. Ltd., 2019.															
References:															
1. Noel De Nevers, "Air pollution control Engineering", McGraw Hill International Edition, McGraw Hill Inc, New Delhi, 2000.															
2. Air Pollution act, India, 1987															
3. Peterson and E.Gross Jr., “Hand Book of Noise Measurement”, 7th Edition, 1974															
4. Mukherjee, "Environmental Pollution and Health Hazards", causes and effects, 1986															
5. Antony Milne, “Noise Pollution: Impact and Counter Measures”, David & Charles PLC, 1979.															
6. Kenneth wark, Cecil F.Warner, “Air Pollution its Origin and Control”, Harper and Row Publishers, New York, 1998.															
Course Outcomes:													Blooms Taxonomy		
CO1 Understand various types and sources of air pollution and its effects.													K2		
CO2 Know the dispersion of air pollutants and their modelling.													K2		
CO3 Know about the principles and design of control of particulate pollutants.													K3		
CO4 Understand the principles and design of control of gaseous pollutant.													K2		
CO5 Know the sources, effects and control of vehicular, indoor air and noise pollution.													K2		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	3	-	-	2	1	2	-	-	2	-	-
CO2	2	-	-	3	-	2	-	-	-	-	-	2	1	2	2
CO3	2	-	3	-	3	0	1	-	-	-	2	-	2	2	2
CO4	2	-	3	-	3	0	1	-	-	-	2	-	2	2	2
CO5	3	3	2	3	3	2	-	-	-	-	2	-	-	2	-
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CEE038	ENVIRONMENTAL IMPACT ASSESSMENT	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites: Environmental Engineering					
Course Objectives: - To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment and to develop the skill to prepare environmental management plan. - To participate in the performance of an environmental assessment process (EIA or SEA), given the disciplinary knowledge and skills in natural sciences and engineering the student have achieved in other courses.					
UNIT I	INTRODUCTION				9
Historical development of Environmental Impact Assessment (EIA). Environmental Clearance- EIA in project cycle. legal and regulatory aspects in India – types and limitations of EIA –EIA process screening – scoping - terms of reference in EIA- setting – analysis – mitigation. Cross sectoral issues –public hearing in EIA- EIA consultant accreditation.					
UNIT II	IMPACT IDENTIFICATION AND PREDICTION				10
Matrices – networks – checklists – cost benefit analysis – analysis of alternatives – expert systems in EIA. prediction tools for EIA – mathematical modelling for impact prediction – assessment of impacts – air – water – soil – noise – biological — cumulative impact assessment					
UNIT III	SOCIO-ECONOMIC IMPACT ASSESSMENT				8
Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. Factors and methodologies- individual and family level impacts. Communities in transition-rehabilitation.					
UNIT IV	EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN				9
Environmental management plan - preparation, implementation and review – mitigation and rehabilitation plans – policy and guidelines for planning and monitoring programmes – post project audit – documentation of EIA findings – ethical and quality aspects of environmental impact assessment.					
UNIT V	CASE STUDIES				9
Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects.					

Total Periods: 45															
Text Books:															
1. Canter, L.W., "Environmental Impact Assessment", McGraw Hill, New York. 1996															
2. Lawrence, D.P., "Environmental Impact Assessment – Practical solutions to recurrent problems", Wiley-Interscience, New Jersey. 2003															
References:															
1. Cutter, S.L., "Environmental Risk and Hazards", Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.															
2. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff “Risk Assessment and Management															
Course Outcomes:													Blooms Taxonomy		
CO1 Carry out scoping and screening of developmental projects for environmental and social assessments													K2		
CO2 Explain different methodologies for environmental impact prediction and assessment													K2		
CO3 Asses socio-economic investigation of the environment in a project													K3		
CO4 Plan environmental impact assessments and environmental management plans													K2		
CO5 Knowledge to prepare environmental impact assessment reports for various projects													K2		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	2	3	3	-	-	-	-	2	-	-
CO2	3	2	3	2	2	-	-	3	2	-	-	1	-	2	2
CO3	-	2	3	2	2	-	-	3	2	-	-	1	-	2	-
CO4	-	-	3	-	3	2	2	2	2	1	1	-	-	2	2
CO5	3	-	-	2	-	-	-	2	-	-	-	-	-	-	-
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEE039	INDUSTRIAL WASTEWATER MANAGEMENT	Category: PEC			
		L	T	P	C
		3	0	0	3

Prerequisites		
• Environmental Engineering • Waste Water Engineering		
Course Objectives:		
• To impart knowledge on the concept and application of Industrial pollution prevention, cleaner technologies, industrial wastewater treatment and residue management. • Understand principles of various processes applicable to industrial wastewater treatment • Identify the best applicable technologies for wastewater treatment from the perspective of yield production.		
Unit I	INTRODUCTION	8
Industrial scenario in India– Industrial activity and Environment - Uses of Water by industry – Sources and types of industrial wastewater – Nature and Origin of Pollutants - Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial wastewater – Industrial waste survey – Industrial wastewater monitoring and sampling – generation rates, characterization and variables –Toxicity of industrial effluents and Bioassay tests – Major issues on water quality management.		
Unit II	INDUSTRIAL POLLUTION PREVENTION & WASTE MINIMISATION	8
Prevention vis a vis Control of Industrial Pollution – Benefits and Barriers – Waste management Hierarchy - Source reduction techniques – Periodic Waste Minimisation Assessments – Evaluation of Pollution Prevention Options – Cost benefit analysis – Pay-back period – Implementing & Promoting Pollution Prevention Programs in Industries.		
Unit III	INDUSTRIAL WASTEWATER TREATMENT	10
Flow and Load Equalisation – Solids Separation – Removal of Fats, Oil & Grease- Neutralisation- Removal of Inorganic Constituents — Precipitation, Heavy metal removal, Nitrogen & Phosphorousremoval, Ion exchange, Adsorption, Membrane Filtration, Electro dialysis & Evaporation –Removal of Organic Constituents – Biological treatment Processes, Chemical OxidationProcesses, Advanced Oxidation processes – Treatability Studies.		
Unit IV	WASTEWATER REUSE AND RESIDUAL MANAGEMENT	9
Individual and Common Effluent Treatment Plants — Joint treatment of industrial and domestic wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse Industrial reuse ,		
Unit V	CASE STUDIES	10
Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Sugar and Distilleries		

Total Periods: 45															
Text Books:															
1. Industrial wastewater management, Treatment & disposal, Water Environment Federation Alexandria Virginia, Third Edition, 2008.															
2. Lawrence K. Wang, Yung Tse Hung, Howard H. Lo and Constantine Yapijakis "Handbook of Industrial and Hazardous waste Treatment", Second Edition, 2004.															
References:															
1. Paul L. Bishop, Pollution Prevention Fundamentals and Practice, McGraw Hill International, Boston, 2000.															
2. Waste water Treatment for pollution control and reuse by Soli. J. Arceivala, Shyam. R. Asolekar, Tata McGraw Hill, 2007															
Course Outcomes:												Blooms Taxonomy			
CO1 Explain the source and types of industrial wastewater and their environmental impacts and choose the regulatory laws pertaining to environmental protection												K2			
CO2 Identify industrial wastewater pollution and implement pollution prevention, waste minimization in industries												K2			
CO3 Apply knowledge and skills to design industrial wastewater treatment schemes												K3			
CO4 Audit and analyze environmental performance of industries to internal, external client, regulatory bodies and design water reuse management techniques												K2			
CO5 Conduct research to develop effective management systems for industrial wastewater that are technically sound, economically feasible and socially acceptable												K2			
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	3	1	2	-	3
CO2	-	3	2	2	-	-	-	3	3	2	-	-	-	-	-
CO3	2	3	3	-	-	-	-	-	3	2	2	3	-	2	3
CO4	2	-	3	-	2	-	2	3	3	-	-	-	-	-	-
CO5	2	3	2	3	-	1	2	-	-	2	3	-	3	-	3
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23CEE040	SOLID AND HAZARDOUS WASTE MANAGEMENT	Category: PEC

		L	T	P	C
		3	0	0	3
Prerequisites • Environmental Engineering • Waste Water Engineering • Solid Waste Management					
Course Objectives: • To impart knowledge and skills relevant to minimization, storage, collection, transport, recycling, processing and disposal of solid and hazardous wastes including the related regulations, engineering principles, design criteria, methods and equipment.					
Unit I	WASTE CLASSIFICATION AND REGULATORY REQUIREMENTS				9
Sources and types of solid and hazardous wastes - need for solid and hazardous waste management salient features of latest Indian legislations on management and handling of solid wastes, hazardous wastes, biomedical wastes, electronic wastes, construction and demolition wastes, plastics and discarded lead acid batteries — elements of integrated waste management and roles of stakeholders - seven elements and seven step approach to integrated solid waste management planning.					
Unit II	WASTE CHARACTERIZATION SOURCE REDUCTION AND RECYCLING				9
Waste sampling and characterization plan - waste generation rates and variation — physical composition, chemical and biological properties – hazardous characteristics – ignitability, corrosivity and TCLP tests –source reduction, segregation and onsite storage of wastes — waste exchange - extended producer responsibility - recycling of plastics, C&D wastes and E wastes.					
Unit III	WASTE COLLECTION TRANSPORT AND MATERIAL RECOVERY				9
Door to door collection of segregated solid wastes - analysis of hauled container and stationery container collection systems - compatibility, storage, labeling and handling of hazardous wastes – principles and design of transfer and transport facilities - hazardous waste transport and manifests - mechanical processing and material separation technologies — Size reduction — size separation - density separation - magenetic separation – compaction – principles and design of material recovery facilities – physico chemical treatment of hazardous wastes - solidification and stabilization – case studies on waste collection and material recovery.					
Unit IV	BIOLOGICAL AND THERMAL PROCESSING OF WASTES				9
Biological and thermos-chemical conversion technologies – composting – biomethanation – incineration – pyrolysis- plasma arc gasification –principles and design of biological and thermal					

treatment facilities - MSW processes to energy with high-value products and specialty By-products operation of facilities and environmental controls - treatment of biomedical wastes – case studies and emerging waste processing technologies.		
Unit V	WASTE DISPOSAL	9
Sanitary and secure landfills - components and configuration– site selection - liner and cover systems - geo synthetic clay liners and geo membranes - design of sanitary landfills and secure landfills- leachate collection, treatment and landfill gas management — landfill construction and operational controls - landfill closure and environmental monitoring — landfill bioreactors — rehabilitation of open dumps and biomining of dumpsites-remediation of contaminated sites- Case studies		
Total Periods: 45		
Text Books:		
1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, “Integrated Solid Waste Management, Mc-Graw Hill India, First edition, 2015.		
2. William A. Worrell, P. Aarne Vesilind, Christian Ludwig, Solid Waste Engineering – A Global erspective, 3rd Edition, Cengage Learning, 2017.		
References:		
1. John Pitchtel,Waste Management Practices, CRC Press,Taylor and Francis Group,2014.		
2. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and "Environmental Resources Management, Hazardous waste Management", Mc-Graw Hill International edition, New York,2010		
Course Outcomes:		Blooms Taxonomy
CO1 Explain the various functional elements of solid and hazardous waste management including the associated legal, health, safety, and cultural issues as well as responsibilities of different stakeholders.		K2
CO2 Apply the knowledge of science and engineering fundamentals to characterize different types of solid and hazardous wastes, assess the factors affecting variation and assess performance of waste treatment and disposal systems		K3
CO3 Design of systems and processes to meet specified needs of waste minimization, storage, collection, transport, recycling, processing and disposal		K3
CO4 Select appropriate methods for processing and disposal of solid and hazardous wastes, taking into account the impact of the solutions in a sustainability context		K2
CO5 Conduct research pertinent to solid and hazardous waste management and communicate effectively to different stakeholders as well as engage in independent lifelong learning		K4

CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	3	0	0	0	2	2	0	0	0	0	0	3	2	0
CO2	3	2	0	2	2	0	0	0	2	0	0	0	2	2	3
CO3	0	0	3	0	0	0	0	0	2	0	0	0	3	2	3
CO4	0	2	0	0	2	2	2	2	0	0	2	0	3	2	0
CO5	0	2	0	0	0	0	0	0	0	1	0	1	0	2	0
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEE041	ENVIRONMENTAL POLICY AND LEGISLATIONS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Environmental Engineering • Waste Water Engineering • Solid Waste Management					
Course Objectives: • The course will analyze the legislative and judicial responses to environmental problems and the administrative system of environment related laws such as air, water, land, and hazardous substances etc. Environment advocacy and approaches for using litigation in environment protection will receive special attention					
Unit I	INTRODUCTION TO ENVIRONMENTAL LEGISLATIONS AND INTERNATIONAL SCENARIO				9
Significance of Environmental Law -International Environmental Law -Development of International Environmental Law -Source and General principals of International Environmental Law –General rights and obligations of States -General Issues of the international law related to environmental protection - Stockholm Declaration-Rio Declaration on Environment and Development-Basel Convention on the Control of Trans boundary Movement of Hazardous Wastes and their disposal- Convention of Biological Diversity-U.N Frame Work Convention on Climate Change-Montreal Protocol on Substances that deplete Ozone Layer-Kyoto Protocol.					
Unit II	INDIAN CONSTITUTIONS AND ENVIRONMENTAL PROTECTION				9

Indian Constitution and Environmental Protection -Constitutional provisions concerning Environment Articles 14,15,(2) (b) 19 (e),21,31,32,38,39,42,47, 48-A,49,51,51-A: Indian Environmental Policy 2006 Administrative machinery for pollution control Common Law & Criminal Law Nuisance, Negligence, Strict liability and Absolute liability, Provisions of IPC relating to environmental problems (public nuisance u/s 268 and others (Sections 269,270,277,284,285,286,425 to 440) Section 133 of Cr.P.C.		
Unit III	REMEDIES FOR ENVIRONMENTAL POLLUTION	9
Common Law Remedies/Remedies under Law of Tort – Penal Remedies – Indian Penal Code and Code of Criminal Procedure – Remedies under Constitutional Law – Writs – Public Interest Litigation Public Liability Insurance Act, 1991 – The National Green Tribunal Act 2010		
Unit IV	MAJOR INDIAN LEGISLATIONS	9
Water Act (1974) Air Act (1981) Environmental Protection Act (1986) Major Notifications, The Municipal solid Wastes (Management and Handling) Rules 2000-Bio Medical Wastes (Management and Handling) Rules 1998- Hazardous Wastes (Management and Handling Rules 1989-Environment Impact Assessment Notifications- Coastal Regulation Zone Notification- Public Hearing Notifications.		
Unit V	ENVIRONMENT AND DEVELOPMENT CASE LAWS	9
Meaning and concept of development - Its impact on environment; conflict between environment and development, Concept of Sustainable Development., Polluter Pay Principle, Precautionary Principle, Public Trust Doctrine. Landmark Judgments - Olum gas leakage case, Rural Litigation and Entitlement Kendra, Dehradun, (1985) Supp SCC 487) Vellore Citizen Welfare Forum v. Union of India, (1996) 5SCC 647) Ganga Pollution case (1988) I SCC) S. Jagannath v. UOI (1997) SCC867) Vellore Citizens welfare forum case M.C. Mehta V. Kamalnath (1997) I SCC 388)		
Total Periods: 45		
Text Books:		
1. Leelakrishnan P., Environmental Law in India, Butterworths,1998		
2. Leelakrishnan P., Environmental Case Book, Lexis Nexis, 2000		
References:		
1. Shanthakumar S. , Environmental Law – An Introduction, Butterworths,2004		
2. Shyam Diwan and Armin Rosencranz, Enviromental Law and Policy in India, Oxford, 2001		
Course Outcomes:		Blooms Taxonomy
CO1 Understand origins and sources of environmental laws, and understand how and by whom environmental laws are made and interpreted		K2
CO2 Understand the key principles of, and actors within, environmental laws		K2
CO3 Understand the National Environmental Policy and Various Legislations		K2

enacted in line with Policy															
CO4 Critically analyze environmental laws within various contexts and to evaluate laws against procedural and substantive criteria													K2		
CO5 Understand and the Legal system operating in India and will be in a position to prepare compliance reports for getting environmental clearance													K2		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	0	0	0	0	0	2	0	2	1	0	0	3	0	0
CO2	0	0	0	0	0	1	2	0	2	1	0	0	3	0	0
CO3	2	0	2	3	0	2	3	3	0	2	0	2	3	0	0
CO4	2	0	2	0	0	2	3	3	0	1	0	2	0	0	0
CO5	0	3	2	3	3	2	3	3	0	2	1	2	3	2	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEE042	ENVIRONMENT, HEALTH AND SAFETY	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Environmental Engineering - Waste Water Engineering					
Course Objectives: To educate overview of EHS in industries and related Indian regulations, types of Health hazards, effect, assessment and control methods and EHS Management System					
Unit I	INTRODUCTION				9
Need for developing Environment, Health and Safety systems in work places- International initiatives, National Policy and Legislations on EHS in India - Regulations and Codes of Practice - Role of trade union safety representatives - Ergonomics.					
Unit II	OCCUPATIONAL HEALTH AND HYGIENE				10
Definition of occupational health and hygiene - Categories of health hazards — Exposure pathways and human responses–Exposure Assessment-occupational exposure limits - Hierarchy of control measures - Role of personal protective equipment and the selection criteria					
Unit III	WORKPLACE SAFETY AND SAFETY SYSTEMS				11

Features of Satisfactory and Safe design of work premises – good housekeeping - lighting and color, Ventilation and Heat Control, Noise, Chemical and Radiation Safety – Electrical Safety – Fire Safety Safety at Construction sites, ETP – Machine guarding – Process Safety, Working at different levels															
Unit IV		HAZARDS AND RISK MANAGEMENT												8	
Safety appraisal – Job Safety Analysis-Control techniques – plant safety inspection – Accident investigation - Analysis and Reporting – Hazard and Risk Management Techniques –Onsite and Offsite emergency Plans. Employee Participation- Education and Training- Case Studies															
Unit V		ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT												7	
Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and implementation and review – ISO 45001-Strucure and Clauses-Case Studies.															
Total Periods: 45															
Text Books:															
1. Industrial Health and Safety Acts and Amendments, by Ministry of Labour and Employment, Government of India															
2. Fundamentals of Industrial Safety and Health by Dr.K.U.Mistry, Siddharth Prakashan, 2012															
References:															
1. The Facility Manager's Guide to Environmental Health and Safety by Brian Gallant, Government Inst Publ., 2007.															
2. Effective Environmental, Health, and Safety Management Using the Team Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services, 2005.															
Course Outcomes:													Blooms Taxonomy		
CO1 Need for EHS in industries and related Indian regulations													K2		
CO2 Various types of Health hazards, effect, assessment and control methods													K2		
CO3 Various safety systems in working environments													K2		
CO4 The methodology for preparation of Emergency Plans and Accident investigation													K2		
CO5 EHS Management System and its elements													K2		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	3	0	3	0	3	0	3	2	0	1	2	0	2	0
CO2	2	2	2	3	0	0	0	0	2	0	0	3	2	2	0

CO3	0	0	2	0	3	3	1	1	2	0	2	3	0	0	0
CO4	0	0	3	2	0	1	2	0	0	0	0	0	2	2	2
CO5	1	0	0	0	2	0	0	0	1	0	1	0	1	0	0
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

VERTICAL -7 – WATER RESOURCES

23CEE043	PARTICIPATORY WATER RESOURCES MANAGEMENT	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites:					
Course Objectives: To gain an insight on local and global perceptions and approaches on participatory water resource management					
Unit I	FUNDAMENTALS: SOCIOLOGY AND PARTICIPATORY APPROACH				9
Sociology – Basic concepts – Perspectives- Social Stratification – Irrigation as a Socio technical Process – Participatory concepts– Objectives of participatory approach					
Unit II	UNDERSTANDING FARMERS PARTICIPATION				9
Farmers participation –need and benefits – Comparisons of cost and benefit -Sustained system performance – Kinds of participation – Context of participation, factors in the environment – WUA – Constraints in organizing FA – Role of Community Organiser – Case Studies.					
Unit III	ISSUES IN WATER MANAGEMENT				9
Multiple use of water – Issues in Inter-sectoral Water Allocation – domestic, irrigation, industrial sectors – modernization techniques – Rehabilitation – Command Area Development – Water delivery systems.					
Unit IV	PARTICIPATORY WATER CONSERVATION				9
Global Challenges -Social – Economic – Environmental – Solutions –Political – Water Marketing – Water Rights -Consumer education – Success Stories Case Studies					
Unit V	PARTICIPATORY WATERSHED DEVELOPMENT				9

Concept and significance of watershed – Basic factors influencing watershed development – Principles of watershed management – Definition of watershed management – Identification of problems – Watershed approach in Government programmes – People’s participation – Entry point activities – Evaluation of watershed management measures.															
Total periods: 45 Periods															
Text Books:															
1. Sivasubramaniyan, K. Water Management, SIMRES Publication, Chennai, 2011.															
2. Uphoff.N., Improving International Irrigation management with Farmer Participation – Getting the process Right – Studies in water Policy and management, No.11, Westview press, Boulder,CO, 1986.															
References:															
1. Chambers Robert, Managing canal irrigation, Cambridge University Press, 1989															
Course Outcomes:													Blooms Taxonomy		
On completion of the course, the student is expected to be able to:															
CO1 Explain sociology concepts, social stratification, and objectives of participatory approaches													K2		
CO2 Analyze farmers’ participation, benefits, constraints, and role of community organization.													K4		
CO3 Interpret issues in water allocation, modernization, rehabilitation, and water delivery systems													K2		
CO4 Evaluate global socio-economic-environmental challenges and propose participatory conservation solutions													K5		
CO5 Apply watershed management principles and evaluate participatory watershed development practices													K3		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	2	2	1	-	2	-	1	3	-	2
CO2	3	3	2	2		3	2	2	1	2	-	2	3	-	3
CO3	3	3	2	2	1	2	3	-	-	2	2	2	3	2	3
CO4	3	3	3	2	1	3	3	2	1	2	2	3	3	2	3
CO5	3	3	3	3	1	2	3	-	1	2	2	3	3	2	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CEE044	GROUND WATER ENGINEERING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites:					
Course Objectives: The objective of this course is enable the student to understand the principles of Groundwater governing Equations, Characteristics of different aquifers and techniques of groundwater model development and management					
Unit I	HYDROGEOLOGICAL PARAMETERS				9
Introduction — Water bearing Properties of Rock — Type of aquifers - Aquifer properties — permeability, specific yield, transmissivity and storage coefficient – Methods of Estimation – GEC norms - Steady state flow - Darcy’s Law - Groundwater Velocity — Dupuit Forchheimer assumption Steady Radial Flow into a Well					
Unit II	WELL HYDRAULICS				9
Unsteady state flow - Theis method - Jacob method – Chow’s method – Law of Times – Theis Recovery – Bailer method – Slug method - tests - Image well theory – Partial penetrations of wells -Well losses – Specific Capacity and Safe yield - Collector well and Infiltration gallery					
Unit III	GROUND WATER MANAGEMENT				9
Need for Management Model – Database for Groundwater Management – Groundwater balance study – Introduction to Mathematical model – Model Conceptualization – Initial and Boundary Condition – Calibration – Validation – Future Prediction – Sensitivity Analysis – Uncertainty –Development of a model					
Unit IV	GROUND WATER QUALITY				9
Ground water chemistry - Origin, movement and quality - Water quality standards – Drinking water Industrial water – Irrigation water - Groundwater Pollution and legislation - Environmental Regulatory requirements					
Unit V	GROUND WATER CONSERVATION				9
Artificial recharge techniques – Reclaimed wastewater recharge – Soil aquifer treatment (SAT) – Aquifer Storage and Recovery (ASR) Seawater Intrusion and Remediation – Ground water Basin management and Conjunctive use – Protection zone delineation, Contamination source inventory and remediation schemes					
Total periods: 45					

Text Books:															
1. Raghunath H.M., "Ground Water Hydrology", New Age International (P) Limited, New Delhi, 2010.															
2. Todd D.K., "Ground Water Hydrology", John Wiley and Sons, New York, 2000.															
References:															
1. Fitts R Charles, "Groundwater Science". Elsevier, Academic Press, 2002															
2. Ramakrishnan, S, Ground Water, K.J. Graph arts, Chennai, 1998.															
3. Chahar BR, Groundwater hydrology, McGraw Hill Education (India) Pvt Ltd, New Delhi, 2015															
4. Rastogi A.K. , Numerical Groundwater Hydrology, 2011															
Course Outcomes:													Blooms Taxonomy		
On completion of the course, the student is expected to be able to:															
CO1 Define the groundwater system basic, types of aquifers, aquifer parameters, movement and its potential for confined and unconfined aquifers													K2		
CO2 Apply the knowledge of groundwater flow in steady and unsteady flow characteristics of well hydraulics													K3		
CO3 Explain the concept of groundwater model development and data base management for groundwater management													K2		
CO4 Describe the importance of artificial recharge and groundwater quality concepts													K2		
CO5 Apply the creative and innovative technique on conservation of groundwater													K3		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	1	3	-	-	1	2	1	2	2	2	2
CO2	3	3	3	-	2	3	-	-	2	2	2	2	2	3	2
CO3	2	2	3	-	3	3	3	-	2	2	2	2	3	3	3
CO4	2	2	2	-	3	3	3	-	3	2	2	3	3	3	3
CO5	2	2	3	3	3	3	3	3	3	2	2	2	3	3	3
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23CEE045	WATER RESOURCES SYSTEMS ENGINEERING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: To introduce the student to the concept of Mathematical approaches for managing the water resources system and apply to operate a water resource system optimally.					
Unit I	SYSTEM APPROACH				9
Definition, classification, and characteristics of systems - Philosophy of modelling – Goals and Objectives – Basics of system analysis concept – steps in systems engineering					
Unit II	LINEAR PROGRAMMING				9
Introduction to Operation research - Linear programming Problem Formulation-graphical solution Simplex method –Sensitivity analysis - application to operation of single purpose reservoir					
Unit III	DYNAMIC PROGRAMMING				9
Bellman’s optimality criteria, problem formulation and solutions — Water Allocation for three state (user), Forward and Backward Recursion techniques in Dynamic Programming - Shortest pipe line route problem - Application to reservoirs capacity expansion					
Unit IV	SIMULATION				9
Basic principles and concepts – Monte Carlo techniques – Model development – Inputs and outputs - Single and multipurpose reservoir simulation models – Deterministic simulation – Rule Curve development for reservoir.					
Unit V	ADVANCED OPTIMIZATION TECHNIQUES				9
Integer and parametric linear programming – Goal programming types – Applications to reservoir release optimization – application of evolutionary algorithms like Genetic algorithm, Particle swarm, Simulated Annealing to reservoir release optimization.					
Total periods: 45					
Text Books:					
1. Bhawe PR, Water Resources Systems, Narosa Publishers,2011					
2. Vedula, S., and Majumdar, P.P. Water Resources Systems — Modeling Techniques and Analysis Tata McGraw Hill, New Delhi, Fifth reprint,2010					

References:															
1. Gupta, P.K., and Man Mohan, “Problems in Operations Research”, (Methods and Solutions), Sultan Chand and Sons, New Delhi,1995.															
2. Chaturvedi, M.C., “Water Resources Systems Planning and Management”, Tata McGraw Hill, New Delhi,1997															
3. Taha, H.A., “Operations Research”, McMillan Publication Co., New York,1995.															
Course Outcomes:													Blooms Taxonomy		
On completion of the course, the student is expected to be able to:															
CO1 Define the economic aspects and analysis of water resources systems for comprehensive and integrated planning of a water resources project													K2		
CO2 Apply the concept of linear programming for optimisation of water resources problems.													K4		
CO3 Explain the concept of dynamic programming and apply in water resource system.													K2		
CO4 Develop the simulation model based on deterministic and stochastic simulation for reservoir operating policy													K2		
CO5 Apply advance optimisation techniques like goal programming, heuristic algorithm in the field of water resources planning and management.													K4		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	2	-	3	2	2	2	2
CO2	3	2	-	-	-	-	-	3	-	2	2	2	2	3	2
CO3	3	3	2	-	2	-	-	2	-	3	2	1	1	3	3
CO4	3	3	3	-	3	2	-	3	-	2	3	3	3	3	3
CO5	3	3	3	3	3	-	2	3	-	3	3	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEE046	WATERSHED CONSERVATION AND MANAGEMENT	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites:					
Course Objectives: - To provide the technical and sociological understanding of a watershed. - To provide a comprehensive discourse on the engineering practices of watershedmanagement for realizing the higher benefits					
Unit I	WATERSHED CONCEPTS				9
Watershed – Definition, Need and Elements – Principles - Influencing Factors: Geology – Soil – Morphological Characteristics - Toposheet - Delineation – Codification – Prioritization – Watershed Atlas.					
Unit II	SOIL CONSERVATION MEASURES				9
Types of Erosion – Water and Wind Erosion: Causes, Factors, Effects and Management – Soil Conservation Measures: Agronomical and Mechanical – Design of Terraces and Bunds - Estimationof Soil Loss – USLE Equation - Sedimentation.					
Unit III	WATER HARVESTING AND CONSERVATION				9
Yield from a Catchment - Traditional Water Harvesting Techniques – Micro-Catchments - Design of Small Water Harvesting Structures: Farm Ponds, Percolation Tanks, Check dams, Grassed Waterways.					
Unit IV	GIS FOR WATERSHED MANAGEMENT				9
Applications of Remote Sensing and Geographical Information System - Role of Decision Support System – Conceptual Models and Case Studies.					
Unit V	WATERSHED MANAGEMENT				9
Project Proposal Formulation - Watershed Development Plan – Entry Point Activities – Watershed Economics - Agroforestry – Grassland Management – Wasteland Management – Watershed Approach in Government Programmes – People’s Participation – Evaluation of Watershed Management Programmes – Integrated Watershed Management – Case studies.					
Total periods: 45					
Text Books:					
1. Ghanashyam Das, Hydrology and Soil Conservation Engineering, Prentice Hall of India Private					

Limited, New Delhi, Second Edition, 2009															
2. Suresh, R. Soil and Water Conservation Engineering, Standard Publishers and Distributors Private Limited, New Delhi, 2020															
References:															
1. Glenn O Schwab. etal, Soil and Water Conservation engineering, Wiley India Private Limited, 2009															
2. Heathcote, I. W. Integrated Watershed Management: Principles and Practice. John Wiley and Sons, Inc., New York, Second Edition 2009.															
3. John G. Lyon, GIS for Water Resources and Watershed Management, CRC Press, 2002.															
4. Vijay P. Singh, Donald K. Frevert, Watershed Models, CRC Press, 2005															
5. Vir Singh, Raj, Watershed Planning and Management, Bio- Green Publisher, 2016															
Course Outcomes:													Blooms Taxonomy		
On Completion of the course the student is expected to															
CO1 Recognize and Interpret the morphological features of a watershed.													K2		
CO2 State, design and sketch the soil conservation structures.													K3		
CO3 Describe the micro catchment and apply the concepts to design the small water harvesting structures.													K2		
CO4 Illustrate the application of modern tools and technology in the management of watershed.													K2		
CO5 Classify the management activities and to develop an integrated watershed development plan													K4		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	1	1	-	1	-	3	2	-	2	2	1	1
CO2	3	2	2	2	1	2	1	1	1	2	1	2	2	2	2
CO3	3	2	2	2	1	2	1	1	1	2	1	2	2	2	2
CO4	-	-	2	-	-	-	-	-	-	2	2	2	2	1	2
CO5	-	-	2	2	-	-	3	3	3	3	2	2	2	2	2
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CEE047	INTEGRATED WATER RESOURCES MANAGEMENT	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites:					
Course Objectives: Students will be introduced to the concepts and principles of IWRM, which is inclusive of the economics, public-private partnership, water & health, water & food security and legal & regulatory settings					
Unit I	CONTEXT FOR IWRM				9
Water as a global issue: Key challenges — Definition of IWRM within the broader context of development — Key elements of IWRM - Principles — Paradigm shift in water management - Complexity of the IWRM process — UN World Water Assessment - SDGs.					
Unit II	WATER ECONOMICS				9
Economic view of water issues: Economic characteristics of water good and services – Non- market monetary valuation – Water economic instruments – Private sector involvement in water resources management: PPP objectives, PPP models, PPP processes, PPP experiences through case studies					
Unit III	LEGAL AND REGULATORY SETTINGS				9
Basic notion of law and governance: Principles of International and National law in the area of water management - Understanding UN law on non-navigable uses of International water courses - International law for groundwater management – World Water Forums – Global Water Partnerships Development of IWRM in line with legal and regulatory framework: Case Studies					
Unit IV	WATER AND HEALTH WITHIN THE IWRM CONTEXT				9
Links between water and health: Options to include water management interventions for health —Health protection and promotion in the context of IWRM – Global burden of Diseases - Health impact assessment of water resources development projects – Case studies					
Unit V	AGRICULTURE IN THE CONCEPT OF IWRM				9
Water for food production: ‘blue’ versus ‘green’ water debate — Water foot print - Virtual water trade for achieving global water and food security - Climate Smart Agriculture - Current water pricing policy– Scope to relook pricing.					

Total periods: 45															
Text Books:															
1. Cech Thomas V., Principles of water resources: history, development, management and policy. John Wiley and Sons Inc., New York. Fourth Edition 2018															
2. Mollinga.P. etal “Integrated Water Resources Management”, Water in South Asia Volume I, Sage Publications, 2006.															
References:															
1. Technical Advisory Committee, Dublin principles for water as reflected in comparative assessment of institutional and legal arrangements for Integrated Water Resources Management, Technical Advisory Committee Background Paper No: 3. Global water partnership, Stockholm, Sweden. 1999.															
2. Technical Advisory Committee, Integrated Water Resources management, Technical Advisory Committee Background Paper No: 4. Global water partnership, Stockholm, Sweden. 2002															
3. Technical Advisory Committee, Effective Water Governance”. Technical Advisory Committee Background Paper No: 7. Global water partnership, Stockholm, Sweden, 2003.															
4. Tony Allan, Virtual Water: Tackling the Threat to Our Planet’s Most Precious Resource, I. B.Taurus, 2011															
5. Convention on the Law of the Non-navigational Uses of International Watercourses. https://legal.un.org/ilc/texts/instruments/english/conventions/8_3_1997.pdf															
Course Outcomes:													Blooms Taxonomy		
On Completion of the course the student is expected to															
CO1 Describe the context and principles of IWRM; Compare the conventional and integrated waysof water management.													K2		
CO2 Select the best economic option among the alternatives; illustrate the pros and cons of PPPthrough case studies.													K3		
CO3 Apply law and governance in the context of IWRM.													K3		
CO4 Discuss the linkages between water-health; develop a HIA framework.													K2		
CO5 Analyse how the virtual water concept pave way to alternate policy options													K4		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	1	-	2	3	-	2	2	3	3	3	2	2
CO2	2	2	2	2	2	2	3	2	3	3	3	3	2	3	2
CO3	2	-	2	2	-	2	3	2	3	3	3	3	2	2	2
CO4	2	2	2	2	-	3	3	2	3	3	3	3	2	2	2

CO5	2	2	2	2	1	3	3	2	3	3	3	3	2	2	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEE048	URBAN WATER INFRASTRUCTURE	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: To impart knowledge and skills relevant to water management in the context of urbanization and relate engineering principles to water supply, storm water and wastewater management, along with related regulations and best management practices from around the world.					
Unit I	URBAN ECOSYSTEM				9
Cities as Ecological system – hybrid ecosystem – Resilience in urban ecosystem. Human components of Ecosystem – Urban pattern and Ecosystem function. Population and Community dynamics, functions of Urban Ecosystem.					
Unit II	URBANHYDROLOGY				9
The urban hydrological cycle – Function – Human induced changes in urban watershed – Hydrological calculation – Runoff – Infiltration – hydrograph.					
Unit III	URBAN STORM WATERMANAGEMENT				9
Design of Drainage System – Roadway Drainage Analysis – Types of inlet – inlet design – Design of storm drain - Storm water management regulations - structural storm management systems –Newer trends in storm water management (Green infrastructure) – installation – operation and maintenance.					
Unit IV	WATER CONSERVATION AND REUSE				9
Trends in supply and demand – indoor conservation – outdoor conservation – water reuse – Rainwater harvesting — public education					
Unit V	WATER GOVERNANCE				9
Challenges in water sector - Institutional setting, Supply Management, Demand Management, Waste water management — Private sector participation, urban service delivery, customer satisfaction, financial resource management – case studies of best practices in cities across the world.					
Total periods: 45					
Text Books:					
1. Anand Chiplunkar, K Seetharam and CheonKheong (ed) (2012), "Good Practices in urban water management" ADB, National University Singapore.					

2. Marina Alberti (2008), "Advances in Urban Ecology", Springer															
3. <u>Mohammad Karamouz</u> , <u>Ali Moridi</u> , <u>Sara Nazif</u> (2010), Urban Water Engineering and Management, 1st Edition, CRC Press															
References:															
1. HormozPazwash (2016), "Urban storm water management", CRC Press															
2. Larry W. Mays, (2004), Urban Stormwater Management Tools, McGraw-Hill Companies															
3. <u>J Parkinson</u> , <u>O Mark</u> (2005) Urban Stormwater Management in Developing Countries, IWA Publishing															
Course Outcomes:													Blooms Taxonomy		
On Completion of the course the student is expected to															
CO1 Explain various functional elements of urban ecosystem.													K2		
CO2 Calculate urban runoff, compute supply and demand of water, draw hydrograph													K3		
CO3 Compare advantages of Newer techniques of green infrastructure and illustrate benefit													K2		
CO4 Assess the Operation and Maintenance needs of urban water systems													K2		
CO5 Propose best management practices for Indian context													K2		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	3	1	3	-	-	-	-	-
CO2	3	3	3	-	-	-	-	3	1	3	-	-	3	-	-
CO3	3	3	2	-	-	2	-	3	1	3	-	-	3	-	-
CO4	2	2	2	3	3	-	2	3	1	3	2	2	3	2	2
CO5	2	1	1	3	3	-	2	3	-	3	2	2	3	2	2
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CEE049	WATER QUALITY AND MANAGEMENT	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites:					
Course Objectives: To understand the fundamentals of mathematical models and their importance in water quality					

modelling, and to impart the skills to use water quality modelling software for surface and groundwater quality modelling.		
Unit I	MODELLING INSIGHTS	9
Engineers and Mathematical models -Water quality models — historical development - different types of models-- steps in model development - importance of model building- calibration and verification of models- finite element, finite difference and finite volume methods		
Unit II	POLLUTION TRANSPORT	9
Transport phenomena — advection, diffusion, dispersion- contamination transport in surface and subsurface water - Simple transport models –steady state and time variable solutions- conservation of mass, momentum and energy balance, governing equation for contaminant fate and transport		
Unit III	SURFACE WATER QUALITY MODELLING	9
Water quality modeling of streams, lakes and estuaries — water quality– model sensitivity — assessing model performance; Models for dissolved oxygen, pathogens and COD, BOD-Streeter Phelp’s model for point and distributed sources — modified streeter Phelp’s equations.		
Unit IV	GROUND WATER QUALITY MODELLING	9
Groundwater flow and mass transport of solutes – groundwater quality modelling using numerical methods – Parameters, Input-output stresses, Initial and Boundary conditions- degradation of organic compounds in subsurface – Model calibration: steady state and unsteady state – sensitivity analysis – Model validation –seawater intrusion – basic concepts and modelling.		
Unit V	WATER QUALITY MANAGEMENT MODELS	9
Exposure to surface water and groundwater quality modelling software’s – MIKE 21, WASP, QUAL2E and MODFLOW – demonstration – case studies – Modeling multilayer groundwater flow system – Artificial recharge feasibility through modeling – Groundwater contamination, restoration and management.		
Total periods: 45		
Text Books:		
1. Steven C. Chapra, “Surface Water Quality Modelling”, Tata McGraw-Hill Companies, Inc., New Delhi 2018		
2. Water Quality Modelling for Rivers and Streams” Authors: Benedini, Marcello, Tsakiris, George, Springer Netherlands 2017		
References:		
1. Steven C. Chapra, “Surface Water Quality Modelling”, Tata McGraw-Hill Companies, Inc., New Delhi 2018		

2. “Water Quality Modelling for Rivers and Streams” Authors: Benedini, Marcello, Tsakiris, George, Springer Netherlands 2017.															
3. “Hydrodynamics and Water Quality: Modelling Rivers, Lakes, and Estuaries”, Zhen-Gang Ji, John Wiley & Sons, 2018.															
4. “Modelling Groundwater Flow and Contaminant Transport By Jacob Bear, A. H.-D. Cheng, Springer Science & Business Media, 2010															
5. “Mathematical Modelling of Groundwater Pollution” Ne-Zheng Sun, Alexander Sun, Springer New York, 2012															
Course Outcomes:													Blooms Taxonomy		
On Completion of the course the student is expected to															
CO1 Know about the principles of water quality modelling.													K1		
CO2 Understand the pollutant transport phenomena in surface and groundwater.													K2		
CO3 Apply the knowledge of surface water quality modelling to predict the water quality of rivers, lakes and estuary.													K3		
CO4 Predict the groundwater contamination transport.													K4		
CO5 Predict water quality of surface and sub surface water using numerical solution.													K4		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	-	-	3	-	-	-	-	-	-	-	2	-	-	2
CO3	-	-	3	2	-	-	-	2	2		2	-	-	-	3
CO4	-	2	3	3	3	-	2	3	2	3	2	-	-	3	-
CO5	-	3	2	3	2	2	-	3	-	3	2	3	3	2	-
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

VERTICAL – VIII- OCEAN ENGINEERING

23CEE050	OCEAN WAVE DYNAMICS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites:					
Course Objectives: To make the students be aware of ocean wave classification, the mass, momentum and wave energy transformations and wave kinematics that are happening in nature and enable them in the prediction and analysis of the wave data					
Unit I	CONSERVATION EQUATIONS OF FLUID FLOW				9
Basic equations – Conservation of mass, moment and Energy - Continuity Equation, Euler's Equation, Newtonian Fluids, Navier-Stokes Equation.					
Unit II	WAVE THEORIES				9
Linear wave theory : Governing Equation, Boundary Conditions and solutions, Dispersion relation, Constancy of wave period. Introduction to non-linear wave theories - Stokes, Cnoidal and Solitary wave theory.					
Unit III	WAVE KINEMATICS				9
Wave celerity, water particle velocities, accelerations, displacements and pressures. Integral properties of waves: Mass flux, Energy and energy flux, Group speed, Momentum and momentum flux.					
Unit IV	WAVE TRANSFORMATIONS				9
Shoaling, bottom friction and damping, refraction, reflection and diffraction. Wave Breaking: Type of breaking, Surf similarity parameter. Keulegan-Carpenter number, Ursell Parameter, Scattering parameter, Reynolds Number					
Unit V	WAVE ANALYSIS				9
Short term wave analysis- Short term wave Height Distribution – Wave period Distribution - Time and Frequency domain Analysis of Wave Records - Long term wave analysis – Gumbel Distribution - Weibull Distribution - Statistics analysis of grouped wave data					
Total periods: 45 PERIODS					
Text Books:					

1. Pourify R.L and Oberlender G.D , Formwork for Concrete Structures, , McGraw Hill Education India ,2015

2. Jha K N, Formwork for Concrete Structures, Tata McGraw Hill Education, 2012.

References:

1. Sarpkaya, T. and Isaacson, M., Mechanics of Wave Forces on Offshore Structures, Van Nostrand Reinhold Co., New York, 1981

2. Dean, R.G. and Dalrymple, R.A., Water wave mechanics for Engineers and Scientists, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1994

3. Ippen, A.T., Estuary and Coastline Hydrodynamics, McGraw-Hill Book Company, inc., New York, 1978

4. Coastal Engineering Manual Volume I and II, Coastal Engineering Research Centre, Dept, of the Army, US Army Corps of Engineers, Washington DC, 2006

5. Sorenson, R.M., Basic Coastal Engineering, A Wiley-Interscience Publication, New York, 1978.

Course Outcomes:

Blooms Taxonomy

CO1: Understand the concept of mass, momentum and wave energy transformations

K2

CO2: Classify the linear and nonlinear wave theories including the Stokes theory, solitary and cnoidal wave theories

K2

CO3: Explain the wave kinematics and its properties.

K2

CO4: Understand the principles of wave transformation

K2

CO5: Analyze of the long term and short term waves

K4

CO - PO & PSO Mapping

Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	0	0	0	0	0	2	0	0	0	0	3	2	3	3
CO2	3	2	0	0	0	3	0	3	0	0	2	2	2	3	3
CO3	3	3	2	0	2	2	0	2	0	0	3	2	3	3	2
CO4	3	3	3	0	3	3	0	3	0	2	2	3	3	3	2
CO5	3	3	3	3	3	3	0	3	2	0	3	3	3	3	3

1 - Low, 2 - Medium, 3 - High , '-' No correlation

23CEE051	MARINE GEOTECHNICAL ENGINEERING					Category: PEC			
						L	T	P	C

		3	0	0	3
Prerequisites • Engineering geology • Soil mechanics					
Course Objectives: • Students mainly focused in understanding the physical and engineering properties of marine soil deposits and select suitable marine foundation as per project requirements					
UNIT I	MARINE SOIL DEPOSITS				9
Marine environment, Physical and engineering properties of marine soils - Specific problems related to marine soil deposits					
UNIT II	SITE INVESTIGATION IN THE CASE OF MARINE SOIL DEPOSITS				9
Challenges of site investigation in marine environment, Different site investigation techniques, sampling techniques, Geophysical methods, Recent advancements in site investigation and sampling used for marine soil deposits.					
UNIT III	BEHAVIOR OF SOILS SUBJECTED TO REPEATED LOADING				9
Effect of wave loading on foundations of marine structures, Behavior of marine deposits under cyclic loading, Cyclic behavior of soils based on fundamental theory of mechanics, Approximate engineering methods.					
UNIT IV	FOUNDATIONS IN MARINE SOIL DEPOSITS				9
Different offshore and nearshore foundations, Gravity platforms, Jack-up rigs, pile foundations. cassions, spudcans.					
UNIT V	MARINE FOUNDATIONS SUBJECTED TO WAVE LOADING				9
Cyclic behavior of soils, empirical models, elastic-plastic models, FEM analysis of marine foundations subjected to wave loading.					
Total periods: 45					
TEXTBOOKS:					
1. Peurifoy, R.L., Schexnayder, C., Schmitt, R.L. and Aviad Shapira., Construction Planning, Equipment and Methods, 9 th Edn. McGraw Hill, Singapore, 2018.					
2. Granberg G.,Popescu M Construction Equipment and Management for Engineers Estimators and Owners, Taylor and Francis Publishers, New York, 2006.					
REFERENCES:					
1. H. G. Poulos. “Marine Geotechnics”, Unwin Hyman Ltd, London, UK, 1988					
2. D. V. Reddy and M. Arockiasamy, “Offshore Structures”, Volume: 1, R.E. Kreiger Pub and Co., 1991					

3. D. Thomson and D. J. Beasley, “Handbook of Marine Geotechnical Engineering”, US Navy, 2012															
COURSE OUTCOMES:													Blooms taxonomy		
On completion of this course, the student is expected to be able to:															
CO1 Understand The Physical And Engineering Properties Of Marine Soil Deposits													K2		
CO2 Explain The Effect Of Wave Loading On Physical And Engineering Properties Of Marine Soil Deposits													K2		
CO3 Execute Investigation Program For Marine Soil Deposits													K3		
CO4 Design Suitable Marine Foundation As Per Project Requirement													K4		
CO5 Develop Numerical Model And Design Marine Foundation Subjected To Wave Loading													K3		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	2	2	2	1	2	3	3	2	3
CO2	2	2	3	2	1	2	1	2	1	1	2	2	2	2	3
CO3	3	2	1	1	1	2	1	2	2	1	1	2	2	1	2
CO4	3	3	2	1	1	1	2	1	2	2	2	1	3	2	2
CO5	2	2	2	1	2	1	1	1	2	1	1	2	3	2	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEE052	COASTAL ENGINEERING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Building materials and construction • Concrete technology					
COURSE OBJECTIVE: • To impart knowledge about sustainable construction and to understand the concepts of sustainable materials, energy calculations, green buildings and environmental effects.					
UNIT I	COASTAL ENVIRONMENT				9
Beaches - Coastal features - Coastal Zonation - EEZ -Inshore and Offshore Areas - Mean Sea level - Basics of Tides and Waves - Coastal Morphology.					

UNIT II	WAVES DYNAMICS	9
Basics of waves - Classification - Wave Theory - Physical Characteristics of different types of waves - Linear Wave Theory - Wave celerity - Velocities -Accelerations - Displacements - Wave dynamics in shallow and deep water conditions.		
UNIT III	NEARSHORE WAVE TRANSFORMATION	9
Shoaling, refraction, diffraction and breaking– Interaction currents and waves- near shore currents- wave run-up and overtopping		
UNIT IV	SEDIMENT DYNAMICS AND TRANSPORT	9
Introduction to sediments, Sediment Analysis, types and sizes of sediments, sedimentation processes, sediment Supply & movement - Cross-shore sediment transport - Long shore sediment transport - Shoreline Changes - Shoreline Evolution - Erosion & Accretion.		
UNIT V	SHORE PROTECTION	9
Design of shore defense structures; Hard Engineering measures - Sea walls, Revetments, Bulkheads, Dikes, Groynes, Breakwaters; Soft Engineering measures — Artificial Reefs, Beach nourishment, Dune regeneration, Salt marsh Creation, Bioshields - Case studies		
Total periods: 45 PERIODS		
Text Books:		
1. Kamphuis, J.W., Introduction to coastal engineering and management, 2000		
2. Dean, R.G. and Dalrymple, R.A., Water wave mechanics for Engineers and Scientists, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1994.		
3. Mani J.S, “Coastal Engineering book”, PHI Publishing Company, 2 nd Edition, 2021		
References:		
1. Ippen, A.T., Estuary and Coastline Hydrodynamics, McGraw-Hill Book Company, Inc., New York, 1978.		
2. Sorenson, R.M., Basic Coastal Engineering, A Wiley-Interscience Publication, NewYork, 1978.		
3. Coastal Engineering Manual, Vol. I-VI, Coastal Engineering Research Centre, Dept. of the Army, US Army Corps of Engineers, Washington DC,2006.		
Course Outcomes:		Blooms Taxonomy
CO1 Understand The Basic Concepts Of Coastal Environment.		K2
CO2 Calculate Sea State Parameters (Wave Height, Wave Period, Water Levels) In Shallow And Deep Water Conditions.		K4
CO3 Understand The Principles Of Near-Shore Wave Transformation.		K2
CO4 Analysis The Sediment And Its Transport Processes.		K3

CO5 Evaluate Measures To Protect Beaches From Erosion Due To Waves And Currents													K4		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	1	1	-	2	3	1	1	-	2	1	3	2	3
CO2	3	1	3	2	1	2	2	-	1	1	1	2	3	2	3
CO3	2	2	3	1	1	1	1	-	-	-	3	1	3	3	3
CO4	3	1	3	2	2	1	3	1	1	1	3	2	3	3	3
CO5	3	1	2	2	2	2	3	1	-	1	3	2	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEE053	OFFSHORE STRUCTURES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Foundation engineering					
Course Objectives:					
Students mainly focused in understanding the offshore environment, types, suitability, and design concepts of offshore structures as per the appropriate requirements					
UNIT I	INTRODUCTION TO OFFSHORE ENVIRONMENT				9
Ocean winds-characterization of wind regime-wind velocity profile, Ocean waves-wave parameters-Introduction to Airy’s wave theory and its applications-brief about time and frequency domain analysis, brief introduction about ocean currents-tides, seaquakes, Ice environment, Ice-sea interactions.					
UNIT II	TYPES OF OFFSHORE STRUCTURES				9
Offshore Structures-need for offshore structures.Types of Offshore Structures -components - materials used-design parameters-suitable environment conditions –construction practices – drawbacks - EIA for Offshore structures					
UNIT III	FORCES ON OFFSHORE STRUCTURES				9
Introduction-Permanent loads-operating loads. Environmental forces-wind force-wave force-current force-seaquake force-Ice force. Force due to tides - Marine growth - Use of API RP 2A guidelines					
UNIT IV	SUBMARINE PIPELINES AND RISERS				9
Pipeline elements-types of pipelines-laying method-materials. Pipe wall thickness verification. Pipeline stability. Design using DNV 81 code.					

Unit V	ACCIDENTAL LOADS AND CORROSION	9
Fire, Blast and Collision- Behaviour of steel at elevated temperature- Fire rating for Hydrocarbon fire, Blast Mitigation-Blast walls- Collision of boats and energy absorption - Corrosion- Corrosion mechanism- Types of corrosion- Offshore structure corrosion zones- Biological corrosion- Preventive measures of corrosion- Online corrosion monitoring- Corrosion fatigue		
Total periods: 45 PERIODS		
Text Books:		
1. Krishna Raju N., "Prestressed concrete", 5th Edition, Tata McGraw Hill Company, New Delhi, 2012.		
2. Pandit.G.S. and Gupta. S.P., "Prestressed Concrete", CBS Publishers and Distributers Pvt. Ltd, 2014.		
References:		
1. Graff, W. J., Introduction to Offshore Structures, Gulf Publ. Co.1981.		
2. Dawson, T. H., Offshore Structural Engineering, Prentice Hall, 1983.		
3. B.C Gerwick, Jr. Construction of Marine and Offshore Structures, CRC Press, Florida, 2000.		
4. Clauss, G, Lehmann, E &Ostergaard, C, Offshore Structures, Vol. 1 & 2, Springer-Verlag, 1992.		
5. Reddy, D. V and Arockiasamy, M., Offshore Structures Vol.1 & 2, Kreiger Publ. Co.1991.		
6. Morgan, N., Marine Technology Reference Book, Butterworths, 1990.		
7. McClelland, B and Reifel, M. D., Planning and Design of fixed Offshore Platforms, Van Nostrand, 1986.		
8. DNV-RP-B101-Corrosion Protection of Floating Protection and Storage Units, 2007.		
9. API RP 2A. Planning, Designing and Constructing Fixed Offshore Platforms, API. 2000.		
Course Outcomes:		Blooms Taxonomy
CO1: Understand the offshore environment and technical terms associated with it.		K2
CO2: Explain the types and choose suitable offshore structures according to environmental conditions		K3
CO3: Investigate various types of forces acting on the offshore structures		K4
CO4: Adapt appropriate codes to design the submarine pipelines		K3
CO5: Discuss about the accidental loads and corrosion on offshore structures		K2
CO - PO & PSO Mapping		

Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	3	3	2	2		1	1	2	1	3	2	3
CO2	1			2	2	2	3		1	1	2	1	2	3	2
CO3	2	3	3	2	3	3	2	1	2	2	3	2	3	3	3
CO4	2	3	3	3	2	1	2	1	1	1	2	1	3	3	3
CO5	1	3	3	3	2	2	1	1	2	2	3	2	2	3	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEE054	PORT AND HARBOUR ENGINEERING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Foundation engineering					
Course Objectives: Students mainly focused in understanding the offshore environment, types, suitability, and design concepts of offshore structures as per the appropriate requirements					
UNIT I	INTRODUCTION				9
Ports and harbors: Classification of ports & harbours – Port and harbor planning and layout – Meteorological, hydrographic and oceanographic data requirements and measurements for port and harbor design					
UNIT II	PORT AND HARBOURLAYOUT OPERATIONS				9
Port and harbour layout for vessels navigation and cargo handling- port buildings, navigation channels – shore infrastructure and utilities, land reclamation – Dredging -equipment, navigation improvement, pipelines and cables					
UNIT III	DESIGN OF PORT				9
Types and classification of ports and harbours in India, Natural ports and manmade ports, major ports, minor ports; Design of port infrastructures with regards to cargo handling , cargo storage and integrated transport of goods					
Unit IV	DESIGN OF HARBOUR				9
Design harbour Infrastructures - design of break water - shore attached and offshore breakwaters design - harbour basin design, approach channel design, turning basin design, with regards to cargo and passenger terminals					
Unit V	CONSTRUCTION ASPECTS AND SMART PORT				9

Planning and construction, expansion of existing jetties and renovation of port –Inland Port Infrastructure - Smart Port : Levels of transformation into a smart port, Artificial Intelligence and Machine Learning, Smart application for ports															
Total periods: 45 PERIODS															
Text Books:															
1. Bruun, Per. Port engineering: vol. 1. Harbor planning, breakwaters, and marine terminals.1989.															
2. A. D. Quinn, “Design and Construction of Port and Marine Structures”, McGraw-Hill Book Company, 2nd Edition, 1972.															
3. C. A. Thoresen, “Port Design- Guidelines and recommendations”, Tapir Publications, Edition 1, 1988.															
4. J. W. Gaythwaite, Van Nostrand , “Design of Marine Facilities for the Berthing, Mooring and Repair of Vessels” 1990															
References:															
1. Bruun, Per. Port engineering: vol. 1. Harbor planning, breakwaters, and marine terminals.1989.															
2. A. D. Quinn, “Design and Construction of Port and Marine Structures”, McGraw-Hill Book Company, 2nd Edition, 1972.															
3. C. A. Thoresen, “Port Design- Guidelines and recommendations”, Tapir Publications, Edition 1, 1988.															
4. J. W. Gaythwaite, Van Nostrand , “Design of Marine Facilities for the Berthing, Mooring and Repair of Vessels” 1990															
Course Outcomes:													Blooms Taxonomy		
CO1: Understand the offshore environment and technical terms associated with it.													K2		
CO2: Explain the types and choose suitable offshore structures according to environmental conditions													K3		
CO3: Investigate various types of forces acting on the offshore structures													K4		
CO4: Adapt appropriate codes to design the submarine pipelines													K2		
CO5: Discuss about the accidental loads and corrosion on offshore structures													K3		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	3	3	2	2		1	1	2	1	3	2	3
CO2	1			2	2	2	3		1	1	2	1	2	3	2
CO3	2	3	3	2	3	3	2	1	2	2	3	2	3	3	3

CO4	2	3	3	3	2	1	2	1	1	1	2	1	3	3	3
CO5	1	3	3	3	2	2	1	1	2	2	3	2	2	3	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEE055	COASTAL HAZARDS AND MITIGATION	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Concrete technology					
Course Objectives: - To provide students understanding of the materials and processes associated with the major natural hazards: floods, earthquakes, tsunamis, landslides and other coastal hazards - To be able to mitigate these hazards based on case studies and respond in the event of a disaster by appropriate strategies.					
UNIT I	INTRODUCTION				9
Introduction to Environmental and Human induced hazards - Natural vs. Man-made hazard - Hazard and disaster, vulnerability, resilience - coping mechanisms					
UNIT II	COASTAL HAZARDS				9
Coastal hazards- Tsunami, Cyclones, Earthquakes, Storm surges, Coastal erosion, Floods, Sea Level Rise– Technological Hazards – causes – impacts – responses – mitigation strategies - early warning systems					
UNIT III	LAW AND POLICY				9
Disaster management law and policy in India – changing pattern of disaster management in India – response and recovery framework - enabling institutions– institutional coordination					
UNIT IV	ADAPTATION AND MITIGATION				9
Coastal Hazards Adaptation Strategy - Adaptation indigenous knowledge - Sectoral adaptations - Disaster risk response frameworks - Mapping and planning for disaster -Community based disaster Mitigation Measures – Indigenous knowledge for disaster Mitigation - NDMA guidelines					
UNIT V	CASE STUDIES				9

Case studies of tsunami (2004 Indian Ocean tsunami), Earthquake (Latur), cyclones (Gaja, 2018 Tamil Nadu), other cyclones, coastal erosion, oil spills, chemical disasters, nuclear disasters – vulnerability of coastal megacities - lessons from building back better.															
Total periods: 45 PERIODS															
Text Books:															
1. Krishna Raju N., "Prestressed concrete", 5th Edition, Tata McGraw Hill Company, New Delhi, 2012.															
2. Pandit.G.S. and Gupta. S.P., "Prestressed Concrete", CBS Publishers and Distributors Pvt. Ltd, 2014.															
References:															
1. Bryant, E., "Natural Hazards", Cambridge University Press, New York, 2006.															
2. Rajib Shaw and RR Krishnamurthy, "Disaster Management: Global Challenges Local Solutions" University Press, 2009															
3. National Disaster Management Agency – Guidelines issued by NDMA such as for earthquakes, tsunamis, cyclones, chemical disasters etc. www.ndma.gov.in															
4. National Disaster Management Division, Ministry of Home Affairs, GoI. http://www.ndmindia.nic.in/ Regularly issued guidelines and training materials especially for disaster management policy, reconstruction of buildings etc															
5. United Nations office for Disaster Risk Reduction www.unisdr.org various publications and guidelines that are constantly updated															
6. Asia Disaster Preparedness Centre. Publications specific to disaster preparedness and response in Asia. www.adpc.net															
7. Bryant, E., "Natural Hazards", Cambridge University Press, New York, 2006.															
Course Outcomes:													Blooms Taxonomy		
CO1 Understand the modern construction techniques used in the sub structure construction.													K2		
CO2 Demonstrate knowledge and understanding of the principles and concepts relevant to super structure construction for buildings													K4		
CO3 Understand the concepts used in the construction of special structures													K2		
CO4 Knowledge on Various strengthening and repair methods for different cases.													K2		
CO5 Identify the suitable demolition technique for demolishing a building.													K3		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1	2	2	1	3	3	2	2	-	1	1	2	1	3	2	3
CO2	1	-	-	2	2	2	3	-	1	1	2	1	2	3	2
CO3	2	3	3	2	3	3	2	1	2	2	3	2	3	3	3
CO4	2	3	3	3	2	1	2	1	1	1	2	1	3	3	3
CO5	1	3	3	3	2	2	1	1	2	2	3	2	2	3	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEE056	COASTAL ZONE MANAGEMENT AND REMOTE SENSING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To be able to “see” the features and components of the coastal zone. - To assess the various living and non-living resources - To understand the need for coastal zone management and to develop an ICM plan. - To provide the coastal and oceanographic applications of satellite remote sensing.					
UNIT I	COASTAL ZONE				9
Coastal Zone – Beach Profile – Surf Zone – Off Shore – Coastal Waters – Coastal sediments - Estuaries– Wetlands and Lagoons – Coastal dunes – Coastal Geomorphology					
UNIT II	COASTAL RESOURCES				9
Types and functions of coastal and marine resources – Renewable and Non-Renewable resources Living marine resources and Nonliving marine resources – Marine minerals-Placer deposits – Hydrocarbon deposits – Polymetallic nodules					
UNIT III	COASTAL ECOSYSTEM				9
Marine ecosystem: Mangroves – Seagrass – Seaweeds - Coral reef – Large marine ecosystem - Climate effects on living marine resources- Biological monitoring of marine ecosystem- Human impacts on marine ecosystem					
UNIT IV	ADAPTATION AND MITIGATION				9
Introduction- What is ICM- Developing an ICM framework- Principles-Goals-defining boundaries – Coastal Regulation Zones (CRZ) for main land and Islands –Environmental Law and policy					
UNIT V	REMOTE SENSING IN COASTAL ZONE MANAGEMENT				9

Sensors and Platforms used for coastal application –Mapping of Coral Reefs, Macroalgae, Mangrove and Wetlands – Coastal Landuse / Land Cover Mapping – Coastal Regulation Zone Mapping – Case studies															
Total periods: 45 PERIODS															
Text Books:															
1. NCSCM strategies and guide line for National implementation of Integrated Coastal zone management, 2013															
2. Ramesh R and Purvaja R , E-learning module on ICZM for UNESCO-HE, The Netherlands, 2006															
3. Dwivedi, S.N., Natarajan, R And Ramachandran, S., “Coastal Zone Management In Tamilnadu”, Madras, 1991															
4. David R. Green, Stephen D. King; Coastal and Marine Geo-Information Systems: Applying the Technology to the Environment, Springer, 2003															
5. Ramamohana Rao P, Suneetha P, “Coastal Zone Management Using Remote Sensing and GIS”, Paperback — Import, 2014.															
Course Outcomes:													Blooms Taxonomy		
CO1 Understand the science and basic of Coastal zone.													K2		
CO2 Assess the living marine resources and non-living marine resources.													K4		
CO3 Learn about importance of different ecosystem available in coastal and marine environment.													K2		
CO4 Understand the coastal regulations for mainland and islands.													K2		
CO5 Acquire knowledge about various satellites and sensors used for marine and coastal environment													K3		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	3	3	2	2	-	1	1	2	1	3	2	3
CO2	1	-	-	2	2	2	3	-	1	1	2	1	2	3	2
CO3	2	3	3	2	3	3	2	1	2	2	3	2	3	3	3
CO4	2	3	3	3	2	1	2	1	1	1	2	1	3	3	3
CO5	1	3	3	3	2	2	1	1	2	2	3	2	2	3	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

VERTICAL IX : DIVERSIFIED COURSES

23CEE057	STEEL CONCRETE COMPOSITE STRUCTURES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Structural analysis					
Course Objectives: To develop an understanding of the effect composite action and assess governing limit states for composite elements.					
UNIT I	INTRODUCTION TO COMPOSITE ACTION				9
Introduction to steel - concrete composite construction – codes – composite design – shear connectors – types of shear connectors – degrees of shear connections – partial and full shear connections.					
UNIT II	DESIGN OF COMPOSITE BEAM				9
Introduce composite beams, including shear studs — Determine the location of a beam’s neutral axis/axes depending on the level of composite action. Calculate shear stud strength and understand strength modifiers - deflection of composite beams.					
UNIT III	DESIGN OF COMPOSITE COLUMN				9
Types of Composite columns – design of encased columns – design of in-filled columns – axial, uni-axial and bi-axially loaded columns.					
UNIT IV	DESIGN OF COMPOSITE SLAB				9
Introduction — Composite slabs — profiled sheeting — sheeting parallel to span — sheeting perpendicular to span.					
UNIT V	CASE STUDIES				9
Case studies on steel concrete composite construction in buildings - seismic behaviour of composite structures					
Total periods: 45					
Text Books:					
1. Johnson R.P., “Composite Structures of Steel and Concrete Beams, Slabs, Columns and Frames for Buildings”, Vol.I, Fourth Edition, Blackwell Scientific Publications, 2018.					
2. Oehlers D.J. and Bradford M.A., “Composite Steel and Concrete Structural Members, Fundamental behaviour”, Revised Edition, Pergamon press, Oxford, 2000.					

References:															
1. Owens.G.W and Knowles.P, "Steel Designers Manual", Seventh Edition, Steel Concrete Institute(UK), Oxford Blackwell Scientific Publications, 2011.															
2. Teaching resource for, "Structural Steel Design," Volume 2 of 3, Institute for Steel Development and Growth (INSDAG), 2002.															
Course Outcomes:												Blooms Taxonomy			
On completion of the course, the student is expected to be able to															
CO1 Describe the effect of composite action has on structural component behaviour.												K2			
CO2 Describe and assess governing limit states for composite beam												K2			
CO3 Describe and assess governing limit states for composite slab												K2			
CO4 Describe and assess governing limit states for composite column.												K2			
CO5 Study and evaluate the case studies related to steel concrete composite constructions of buildings												K3			
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	2	2	3	-	-	-	1	3	2	2	3
CO2	3	1	-	-	2	2	3	-	2	-	-	3	2	2	3
CO3	2	1	2	2	1	3	3	2	-	-	1	3	2	2	2
CO4	1	3	3	2	-	2	3	2	2	2	-	3	3	2	3
CO5	2	2	3	3	-	2	3	2	3	2	1	3	1	2	2
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23CEE058	FINANCE FOR ENGINEERS	Category: PEC			
		L	T	P	C
		3	0	0	3
Course Objectives: ○ To study the concepts of Finance such as fundamentals of management of accounting,Time value of money, comparing alternatives proposals, evaluating alternative investments and management of funds.					

UNIT I	FUNDAMENTALS OF MANAGEMENT ACCOUNTING	9
Basics of accounting - Management accounting, Financial accounting principles- basic concepts, Financial statements – accounting ratios - funds flow statement – cash flow statement.		
UNIT II	TIME VALUE OF MONEY	9
Time Value of Money – Present Value – Future Value – Single amount - Annuity – Cost of Capital – Cost of Debt, Preference, Equity – Proportions- Cost of Capital Calculation – Financial Institutions Considerations.		
UNIT III	COMPARING ALTERNATIVES PROPOSALS	9
Comparing alternatives- NPV – BCR – IRR – ARR – Urgency – Pay Back Period and Break		
UNIT IV	EVALUATING ALTERNATIVE INVESTMENTS	9
Real Estate - Investment Property, Equipment Replace Analysis, Depreciation – Tax before and after depreciation – GST– Input Tax Credit (ITC) – Assessment and Administration of GST – Inflation - Practical knowledge of risk and tax management.		
UNIT V	FUNDS MANAGEMENT	9
Project Finance — Sources of finance - Long-term and short -term finance, Working Capital Management, Inventory valuation, Mortgage Financing - International financial management- foreign currency management - Applications of valuation concepts to real-world cases & examples		
Total periods: 45		
Text Books:		
1.Prasanna Chandra, Projects – Planning, Analysis, Selection, Implementation Review, McGraw Hill Publishing Company Ltd., New Delhi. 2006.		
2.Blank, L.T., and Tarquin,a.J Engineering Economy,4th Edn. Mc-Graw Hill Book Co., 1988		
References:		
1. Collier C and GlaGola C Engineering Economics & Cost Analysis, 3rd Edn. Addison Wesley Education Publishers.,1998.		
2. Patel, B M Project management- strategic Financial Planning, Evaluation and Control, Vikas Publishing House Pvt. Ltd. New Delhi, 2000		
Course Outcomes:		Blooms Taxonomy
On completion of the course, the student is expected to be able to		
CO1 Describe the basic principles of accounting		K5
CO2 Assess the value of money		K2

CO3 Evaluate alternate proposals													K2		
CO4 Evaluate alternative investments													K2		
CO5 Select best source of finance for a project													K4		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	1	3	3	3	3	3	2	3	3	3	2
CO2	2	3	3	2	3	2	2	1	2	2	1	3	3	3	3
CO3	2	3	3	2	3	3	2	1	2	1	1	3	3	3	3
CO4	2	3	3	1	3	2	2	1	2	1	1	3	3	3	3
CO5	2	3	2	2	1	2	2	1	2	1	1	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CEE059	EARTH AND ROCK FILL DAMS	Category: PEC			
		L	T	P	C
		3	0	0	3
Course Objectives: Students are expected to learn reasons for failure and damages of embankments and slopes, various methods of analysis of slopes and remedial techniques to protect the slopes					
UNIT I	DESIGN CONSIDERATION				9
Design consideration, Factors influencing design, Types of earth and rock fill dams, Design details, Provisions to control pore pressure.					
UNIT II	SLOPE STABILITY AND SEEPAGE ANALYSIS				8
Stability of infinite and finite slopes, Method of Slices, Bishop’s method, Flow nets, Stability conditions during construction, Full reservoir and drawdown - cut off walls – Trenches – Importance of drainage and filters.					
UNIT III	HYDRAULIC FRACTURING				9
Introduction, Conditions and mechanisms for hydraulic fracturing, Failure criterion for hydraulic fracturing – cubic specimen with a crack – core with a transverse crack – core with a vertical crack, strike–dip of easiest crack spreading; factors affecting hydraulic fracturing, self-healing of a core crack.					

UNIT IV	FAILURE AND DAMAGES													9		
Failure and damages, Nature and importance of failures in embankment and foundation - Piping, Differential settlement, Foundation slides, Earthquake damage, creep and anisotropic effects, Reservoir wave action, Dispersive piping.																
UNIT V	SLOPE PROTECTION MEASURES													10		
Special design problems, Slope protection, Filter design, Foundation treatment, Earth dams on pervious soil foundation, Application of Geosynthetic materials in filtration. Treatment of rock foundation, Construction Techniques, Quality control and performance measurement																
Total periods: 45																
Text Books:																
1. Rowe, R.K., Geotechnical and Geoenvironmental Engineering Handbook, Kulwer Academic Publishers, 2001.																
2. Anderson, M.G., and Richards, K.S., Slope Stability, John Wiley, 1987.																
References:																
1.Sherard, J.L., Woodward, R.J., Gizienski, R.J. and Clevenger, W.A., Earth and Earth rock dam, John Wiley, 1963.																
2.Chowdhury, D.F., Slope analysis, Prentice Hall, 1988.																
Course Outcomes:														Blooms Taxonomy		
On completion of the course, the student is expected to be able to																
CO1 Assess the causes of failure and damage of embankments and slopes.														K5		
CO2 Apply the knowledge of engineering and analyse the stability of slopes for various seepage conditions and apply the concept in the design of earth and rock fill dams..														K2		
CO3 Apply the knowledge of engineering and assess the stability of dam against hydraulic fracturing and suggest suitable remedial measure														K2		
CO4 Understand the nature of failures and damages in earth and rock fill dams and apply the concept in field to avoid distress.														K2		
CO5 Recommend suitable remedial measures to protect the slopes and implement quality control and monitor its performance														K4		
CO - PO & PSO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	

CO1	3	3	2	3	1	3	3	3	3	3	2	3	3	3	2
CO2	2	3	3	2	3	2	2	1	2	2	1	3	3	3	3
CO3	2	3	3	2	3	3	2	1	2	1	1	3	3	3	3
CO4	2	3	3	1	3	2	2	1	2	1	1	3	3	3	3
CO5	2	3	2	2	1	2	2	1	2	1	1	3	3	3	3
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23CEE060	COMPUTATIONAL FLUID DYNAMICS	Category: PEC			
		L	T	P	C
		3	0	0	3
Course Objectives: • Applying the fundamentals of CFD, and developing case specific governing equations, • Performing finite difference and finite volume based analysis for steady and transient diffusion problems, • Implementing various mathematical schemes under finite volume method for convention diffusion. • Solving complex problems in the field of fluid flow and heat transfer with the support of high speed computers. • Applying the various discretization methods, solution procedure and the concept of turbulence modelling					
UNIT I	GOVERNING EQUATIONS ANDBOUNDARY CONDITIONS				9
Basics of computational fluid dynamics – Governing equations– Continuity, Momentum and Energy equations – Chemical species transport –Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behavior of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations					
UNIT II	FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION				9
Introduction to GIS – Definitions – History of GIS – Components of a GIS – Hardware, Software, Data, People, Methods – Introduction to data quality – Types of data – Spatial, Attribute data – types of					

attributes – scales/levels of measurements – spatial data models – Raster Data Structures – Raster Data Compression – Vector Data Structures – Raster Vs Vector Models – TIN and GRID data models		
UNIT III	FINITE VOLUME METHOD FOR CONVECTION DIFFUSION	9
Steady one-dimensional convection and diffusion – Central, upwind differencing schemes, properties of discretization schemes, Hybrid, Power-law, QUICK Schemes, Conservativeness, Boundedness, Transportiveness.		
UNIT IV	FLOWFIELD ANALYSIS	9
Stream function and vorticity, Representation of the pressure gradient term, Staggered grid – Momentum equations, Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms.		
UNIT V	TURBULENCE MODELS AND MESH GENERATION	9
Turbulence models, mixing length model, Two equation (k- ϵ) models – High and low Reynolds number models, Mesh Generation and refinement Techniques-software tools.		
Total periods: 45		
Text Books:		
1. Versteeg, H.K. and Malalasekera, W. “An Introduction to Computational Fluid Dynamics: The finite volume Method”, Pearson Education, 2014		
2. Ghoshdastidar, P.S., “Computer Simulation of flow and heat transfer”, Tata McGraw Hill, 1998.		
References:		
3. John Campbell, "Introductory Cartography", Wm. C. Brown Publishers, 3 rd Edition, 2004		
4. Chor Pang LO, Albert K. W. Yeung, “Concepts and Techniques of Geographic Information Systems”, Pearson Education, 2nd Edition, November 2016. ISBN: 9789332581883		
Course Outcomes:		Blooms Taxonomy
CO1 Apply the fundamentals of CFD and develop case specific governing equations		K2
CO2 Perform finite difference and finite volume based analysis for steady and transient diffusion problems		K2
CO3 Implement various mathematical schemes under finite volume method for convection diffusion		K4
CO4 Solve complex problems in the field of fluid flow and heat transfer with the support of high speed computers		K2
CO5 Apply the various discretization methods, solution procedure and the concept		K2

of turbulence modelling															
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	3	2	3	-	2	3	-	-	1	2	3	2	2
CO2	3	3	-	2	2	3	2	1	2	-	-	2	3	3	3
CO3	-	3	3	2	3	-	2	3	-	-	1	2	3	3	2
CO4	3	3	-	2	2	3	2	1	2	-	-	2	3	2	3
CO5	3	2	3	3	-	-	2	-	-	-	1	-	2	2	3

1 - Low, 2 - Medium, 3 - High, '-' No correlation

23CEE061	RAINWATER HARVESTING											Category: PEC			
												L	T	P	C
												3	0	0	3

Course Objectives:

To impart knowledge and skills relevant to water conservation and management towards achieving the sustainability in water resources and relate the engineering principles and practices in estimation of runoff, storage, recharge into the ground and maintain the system through the best management practices followed around the world

UNIT I	BASICS OF RWH	9
Water and its sources - Need for water conservation – Types of water demand - Conservation Methods Global and Indian perspectives - National mission and goals towards rainwater harvesting – National water policy - Legislation on rainwater harvesting in India and Tamil Nadu.		
UNIT II	HYDROLOGY AND GROUND WATER	9
Hydrological cycle – Precipitation - Rainfall measurement - Rain-gauges – Hyetograph - Infiltration - Runoff estimation – Rooftop runoff estimation. Ground water - Aquifer Properties – Darcy law and well hydraulics - Steady flow.		
UNIT III	METHODS OF RAINWATER HARVESTING	9
Rainwater harvesting potential of an area - Traditional harvesting practices – Rooftop harvesting - Methods of RWH structures – Site selection for rainwater harvesting - Surface runoff Harvesting - Ground water recharge - Artificial recharge.		

UNIT IV	DESIGN OF RAINWATER HARVESTING STRUCTURES	9
Design Considerations - Components of Rainwater harvesting system - Simple roof water collection system - Design of Storage structure - Design of Recharge structures — Recharge pit - Recharge trench - Recharge well - Gully plug - Contour bund - Percolation tank - Check dam - Recharge shaft - Efficiency of RWH system		
UNIT V	MANAGEMENT OF RWH AND CASE STUDIES	9
Difficulties in RWH - At catchment level - At household level - Evaluation of RWH systems — Maintenance of RWH structures - Modernisation of RWH system - Case studies on best practice of RWH in urban - Success stories of Contemporary practices of RWH in India		
Total periods: 45		
Text Books:		
1. H.M Raghunath “Ground Water” 3rd Edition, New Age International 2007.		
2. Jayarami Reddy.P, (2005) “A Text book of Hydrology” Firewall media Publication		
References:		
1. Proceedings of UNHABITAT Blue water series “Rainwater harvesting and utilization”, Book 2 beneficiaries and capacity builders.		
2. Rain water Harvesting Techniques to Augment Ground Water: Ministry of Water Resources Central Ground Water Board Faridabad,2003.		
Course Outcomes:		Blooms Taxonomy
On completion of the course, the student is expected to be able to		
CO1 Understand the need and importance of water conservation through global and Indian practices of rainwater harvesting		K2
CO2 Understand and apply the concepts of hydrology and groundwater in the estimation of runoff and recharge potentials		K2
CO3 Understand the various types of rainwater harvesting methods and apply it on the field		K3
CO4 Design the various RWH structures to harvest the rainwater in surface and subsurface		K2
CO5 Explain the difficulties of RWH, evaluation methods and maintenance through various case studies.		K2
CO - PO & PSO Mapping		

Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	3	-	-	2	1	2	-	-	2	-	-
CO2	2	-	-	3	-	2	-	-	-	-	-	2	1	2	2
CO3	2	-	3	-	3	-	1	-	-	-	2	-	2	2	2
CO4	2	-	3	-	3	-	1	-	-	-	2	-	2	2	2
CO5	3	3	2	3	2	-	-	-	-	2	-	-	2	-	-

1 - Low, 2 - Medium, 3 - High, '-' No correlation

23CEE062	TRANSPORT AND ENVIRONMENT	Category: PEC			
		L	T	P	C
		3	0	0	3

Course Objectives:

- The objective of this course is to create an awareness / overview of the impact of Transportation Projects on the environment and society.

UNIT I	INTRODUCTION	9
Environmental Inventory, Environmental Assessment, Environmental Impact Assessment (EIA), Environmental Impact of Transportation Projects, Need for EIA, EIA Guidelines for Transportation Project, Historical Development		
UNIT II	METHODOLOGIES	9
Elements of EIA – Screening and Scoping – Methods of Impact Analysis – Applications – Appropriate methodology		
UNIT III	ENVIRONMENTAL IMPACT, PREDICTION AND ASSESSMENT	9
Prediction and Assessment of Impact of Transportation Project at various stages on water, air, noise, land acquisition and resettlement, Socio economic impact, indigenous people, aesthetics, health and safety, energy studies, traffic impact studies, IRC guidelines		
UNIT IV	ENVIRONMENTAL MITIGATION AND MANAGEMENT PLAN	9
Mitigation of the impact on Natural and Man-made Environment, Health, Water, Land, Noise, Air, Public participation, Environmental Management Plan, Energy Conservation, Methods to reduce Global Warming		
UNIT V	EIA CASE STUDIES	9
EIA Case Studies on Highway, Railway - EIA Case Studies on Transit Oriented Development		

(TOD), Compact Cities, Non-Motorised Transport (NMT)

Total periods: 45**Text Books:**

1. . Canter, L.R., Environmental Impact Assessment, McGraw Hill, New Delhi, 1996.

References:

1. John G.Rau and David, C.Hooten, Environmental Impact Analysis Handbook, McGraw Hill Book Company, 1995
2. James H.Banks, Introduction to Transportation Engineering, McGraw Hill Book Company, 2000

Course Outcomes:

Blooms Taxonomy

On completion of the course, the student is expected to be able to

CO1 Understand the basic concepts of Environmental Impact of Assessment**K2****CO2** Apply various methods of analyzing environmental Impact Analysis.**K2****CO3** Gain knowledge on Stage Wise Assessment and Prediction of impact of transportation projects**K3****CO4** Adopt environmental management plan and their impact on earth.**K2****CO5** Reviewing various case studies on environmental impact assessment of transport projects.**K2****CO - PO & PSO Mapping**

Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	1	3	3	2	1	2	3	2	2
CO2	3	1	2	1	1	3	1	3	1	2	1	2	3	2	2
CO3	3	3	3	3	3	3	1	3	2	2	1	2	3	2	2
CO4	3	2	2	2	1	3	1	3	1	2	1	2	3	2	2
CO5	3	2	3	3	1	3	1	3	1	2	1	2	3	2	2

1 - Low, 2 - Medium, 3 - High , '-' No correlation

23CEE063**ENVIRONMENTAL QUALITY MONITORING****Category: PEC****L****T****P****C****3****0****0****3**

Course Objectives:		
To educate the students on the sample collection and various instrumental methods of monitoring the quality of air, water and solid waste.		
UNIT I	MONITORING AND CHARACTERIZATION OF ENVIRONMENT	9
General approach to environmental analysis, Choice of Lab. Vs. Field analysis, Environmental monitoring-current and future status, Lab. Standards, Data quality objectives, statistics in environmental monitoring, Accuracy and precision, detection limit, types of errors, Automated Data acquisition and processing-sensors and transducers, Monitoring Network and real time monitoring		
UNIT II	ENVIRONMENTAL SAMPLING	9
Location, planning, sampling equipment's for water, solids and air, sample storage for physical and chemical contaminants, types of sampling, representative samples, sample preparation techniques- Solvent Extraction, SPE, Head space, Purge and trap and SPME		
UNIT III	WATER ANALYSIS	9
Techniques for analysis of major ions-UV-visible Spectrophotometer, Flame photometer, AAS, ICP (AES and MS), Trace organic pollutants(PCB, dioxins, pesticides) GC and HPLC (Columns Detectors and Application)		
UNIT IV	ATMOSPHERIC ANALYSIS	9
Ambient air and flue gas, Gaseous pollutants-Determination of time weighted average concentration(Absorption trains, solid adsorbents and differential tubes), Direct reading instruments(fluorescence, chemiluminescent, IR and Electrochemical sensors, GC-MS for trace organics, Particulate sampling methods- High volume sampler, personal sampler, PM 10 and 2.5, Metals Direct(XRF) and dissolution methods(AAS/AES)		
UNIT V	ANALYSIS OF SOIL AND WASTE	9
Problem in analysis of soil and Waste -sampling, pretreatment -extraction and clean up, New extraction techniques, Automated soxhlet and solvent extraction, microwave digestion and sonication, SCF(CO ₂), Analysis for trace pollutants, Analysis of leachate		
Total periods: 45		
Text Books:		
1. Reeve, R.N., "Introduction to Environmental Analysis", Analytical Techniques in the Sciences, John Wiley & Sons, Chichester, UK, 2002.		
References:		
1. Barcelo, D.(editor), "Environmental analysis. Techniques, Applications and Quality Assurance", Elsevier, The Netherlands, 1996		

2. Paul R. Loconto Trace Environmental Quantitative Analysis: Principles, Techniques, and Applications, Marcel Dekker; 2nd Edition , 2005

Course Outcomes:													Blooms Taxonomy		
On completion of the course, the student is expected to be able to															
CO1 Understand the basics of environmental monitoring													K2		
CO2 Able to select appropriate sampling protocol for chemical analysis													K2		
CO3 Understand various methods of analysis of pollutants in water													K3		
CO4 Select correct method for toxic pollutants estimation in air													K2		
CO5 Familiar with analysis of land and wastes													K2		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	1	3	3	2	1	2	3	2	2
CO2	3	1	2	1	1	3	1	3	1	2	1	2	3	2	2
CO3	3	3	3	3	3	3	1	3	2	2	1	2	3	2	2
CO4	3	2	2	2	1	3	1	3	1	2	1	2	3	2	2
CO5	3	2	3	3	1	3	1	3	1	2	1	2	3	2	2
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

OPEN ELECTIVE I AND II

23CSO001	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING FUNDAMENTALS	Category: OEC			
		L	T	P	C
		2	0	2	3
Prerequisites					
Course Objectives: The main objectives of this course are to: • Understand the importance, principles, and search methods of AI, • Provide knowledge on predicate logic and Prolog. • Introduce machine learning fundamentals • Study of supervised learning algorithms. • Study about unsupervised learning algorithms.					
Unit I	INTELLIGENT AGENT AND UNINFORMED SEARCH				6

Introduction - Foundations of AI - History of AI - The state of the art - Risks and Benefits of AI - Intelligent Agents - Nature of Environment - Structure of Agent - Problem Solving Agents - Formulating Problems - Uninformed Search - Breadth First Search - Dijkstra's algorithm or uniform-cost search - Depth First Search - Depth Limited Search		
Unit II	PROBLEM SOLVING WITH SEARCH TECHNIQUES	6
Informed Search - Greedy Best First - A* algorithm - Adversarial Game and Search - Game theory - Optimal decisions in game - Min Max Search algorithm - Alpha-beta pruning - Constraint Satisfaction Problems (CSP) - Examples - Map Coloring - Job Scheduling - Backtracking Search for CSP		
Unit III	LEARNING	6
Machine Learning: Definitions – Classification - Regression - approaches of machine learning models - Types of learning - Probability - Basics - Linear Algebra – Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation, Concept of over fitting, under fitting, Bias and Variance - Regression: Linear Regression - Logistic Regression		
Unit IV	SUPERVISED LEARNING	6
Neural Network: Introduction, Perceptron Networks – Adaline - Back propagation networks - Decision Tree: Entropy – Information gain - Gini Impurity - classification algorithm - Rule based Classification - Naïve Bayesian classification - Support Vector Machines (SVM)		
Unit V	UNSUPERVISED LEARNING	6
Unsupervised Learning – Principle Component Analysis - Neural Network: Fixed Weight Competitive Nets - Kohonen Self-Organizing Feature Maps – Clustering: Definition - Types of Clustering – Hierarchical clustering algorithms – k-means algorithm		
LIST OF EXPERIMENTS		
1	Programs for Problem solving with Search - Implement breadth first search - Implement depth first search - Analysis of breadth first and depth first search in terms of time and space - Implement and compare Greedy and A* algorithms.	
2	Supervised learning - Implement the non-parametric locally weighted regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs - Write a program to demonstrate the working of the decision tree based algorithm. - Build an artificial neural network by implementing the back	

	propagation algorithm and test the same using appropriate data sets. Write a program to implement the naïve Bayesian classifier.														
3	Unsupervised learning - Implementing neural network using self-organizing maps - Implementing k-Means algorithm to cluster a set of data. - Implementing hierarchical clustering algorithm.														
Lecture : 30 Practical : 30 Total periods:60															
Text Books:															
1. S. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach”, Prentice Hall, Fourth Edition, 2021															
2. S.N.Sivanandam and S.N.Deepa, Principles of soft computing-Wiley India.3 rd ed,															
References:															
1.Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.															
2.I. Bratko, “Prolog: Programming for Artificial Intelligence”, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.															
3.C. Muller & Sarah Alpaydin, Ethem. Introduction to machine learning. MIT press, 2020.															
Course Outcomes:													Blooms Taxonomy		
CO1: Understand the foundations of AI and the structure of Intelligent Agents													Understand (K2)		
CO2: Use appropriate search algorithms for any AI problem													Apply (K3)		
CO3: Study of learning methods													Understand (K2)		
CO4: Solving problem using Supervised learning													Apply (K3)		
CO5: Solving problem using Unsupervised learning.													Apply (K3)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	–	–	–	1	2	–	2	3	2	–	2
CO2	3	3	3	2	2	–	–	–	1	2	–	2	3	3	3
CO3	2	2	1	2	1	–	–	–	1	2	–	2	2	2	2
CO4	3	3	3	3	2	–	–	–	1	2	–	2	3	3	3
CO5	3	2	3	3	2	–	–	–	1	2	–	2	3	3	3

CO Avg.	2.6	2.2	2.2	2.2	1.75	-	-	1	1.2	2	2	2.2	2.6	2.75	2.6
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CSO002	IOT CONCEPTS AND APPLICATIONS	Category: OEC			
		L	T	P	C
		2	0	2	3
Prerequisites					
Course Objectives: - To apprise students with basic knowledge of IoT that paves a platform to understand physical and logical design of IOT - To teach a student how to analyse requirements of various communication models and protocols for cost-effective design of IoT applications on different IoT platforms. - To introduce the technologies behind Internet of Things(IoT). - To explain the students how to code for an IoT application using Arduino/Raspberry Pi open platform. - To apply the concept of Internet of Things in real world scenario.					
Unit I	INTRODUCTION TO INTERNET OF THINGS				5
Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT					
Unit II	COMPONENTS IN INTERNET OF THINGS				5
Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Units - Communication modules (Bluetooth, Zigbee,Wifi, GPS, GSM Modules)					
Unit III	PROTOCOLS AND TECHNOLOGIES BEHIND IOT				6
IOT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, BigData Analytics, Cloud Computing, Embedded Systems.					
Unit IV	OPEN PLATFORMS AND PROGRAMMING				7
IOT deployment for Raspberry Pi /Arduino platform-Architecture –Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.					
Unit V	IOT APPLICATIONS				7

Business models for the internet of things, Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Smart Agriculture

LIST OF EXPERIMENTS

1	Introduction to Arduino platform and programming
2	Interfacing Arduino to Zigbee module
3	Interfacing Arduino to GSM module
4	Interfacing Arduino to Bluetooth Module
5	Introduction to Raspberry PI platform and python programming
6	Interfacing sensors to Raspberry PI
7	Communicate between Arduino and Raspberry PI using any wireless medium
8	Setup a cloud platform to log the data
9	Log Data using Raspberry PI and upload to the cloud platform
10	Design an IOT based system

Lecture : 30

Practical : 30

Total periods:60

Text Books:

1. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, CISCO Press, 2017

2. Samuel Greengard, The Internet of Things, The MIT Press, 2015

References:

1. Perry Lea, “Internet of things for architects”, Packt, 2018

2. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012

3. IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, IOT Kindle Edition.

4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.

5. ArshdeepBahga, Vijay Madiseti, “Internet of Things – A hands-on approach”, Universities Press, 2015

6. <https://www.arduino.cc/>
[https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet.](https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet)

Course Outcomes:

Blooms Taxonomy

CO 1: Explain the concept of IoT.													Understand (K2)		
CO2: Understand the communication models and various protocols for IoT.													Understand (K2)		
CO3: Design portable IoT using Arduino/Raspberry Pi /open platform													Analyze(K4)		
CO4: Apply data analytics and use cloud offerings related to IoT.													Apply (K3)		
CO5: Analyze applications of IoT in real time scenario.													Analyze(K4)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	1	–	–	2	–	2	2	2	1	3
CO2	3	3	2	2	2	–	–	–	–	2	–	2	3	2	3
CO3	2	2	3	3	3	–	–	–	1	2	–	2	3	3	2
CO4	2	2	2	3	3	–	–	–	1	2	–	3	3	3	2
CO5	2	3	2	2	2	2	2	1	1	2	–	3	3	3	2
CO Avg.	2.4	2.2	2	2.2	2.2	1.5	2	1	1.25	2	2	2.4	2.8	2.4	2.4
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CSO003	DATA SCIENCE FUNDAMENTALS	Category: OEC			
		L	T	P	C
		2	0	2	3
Prerequisites					
Course Objectives: - Familiarize students with the data science process. - Understand the data manipulation functions in Numpy and Pandas. - Explore different types of machine learning approaches. - Understand and practice visualization techniques using tools. - Learn to handle large volumes of data with case studies.					
Unit I	INTRODUCTION				6
Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – data preparation - Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining - Data Warehousing – Basic statistical descriptions of Data.					
Unit II	DATA MANIPULATION				9

Python Shell - Jupyter Notebook - IPython Magic Commands - NumPy Arrays-Universal Functions – Aggregations – Computation on Arrays – Fancy Indexing – Sorting arrays – Structured data – Data manipulation with Pandas – Data Indexing and Selection – Handling missing data – Hierarchical indexing – Combining datasets – Aggregation and Grouping – String operations – Working with time series – High performance		
Unit III	MACHINE LEARNING	5
The modeling process - Types of machine learning - Supervised learning - Unsupervised learning - Semi-supervised learning- Classification, regression - Clustering – Outliers and Outlier Analysis		
Unit IV	DATA VISUALIZATION	5
Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn		
Unit V	HANDLING LARGE DATA	5
Problems - techniques for handling large volumes of data - programming tips for dealing with large data sets- Case studies: Predicting malicious URLs, Building a recommender system - Tools and techniques needed - Research question - Data preparation - Model building – Presentation and automation.		
LIST OF EXPERIMENTS		
1	Download, install and explore the features of Python for data analytics.	
2	Working with Numpy arrays	
3	Working with Pandas data frames	
4	Basic plots using Matplotlib	
5	Statistical and Probability measures a) Frequency distributions b) Mean, Mode, Standard Deviation c) Variability d) Normal curves e) Correlation and scatter plots f) Correlation coefficient g) Regression	
6	Use the standard benchmark data set for performing the following: a)Univariate Analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis.	

7	Apply supervised learning algorithms and unsupervised learning algorithms on any data set.														
8	Apply and explore various plotting functions on any data set.														
Lecture : 30 Practical : 30 Total periods: 60															
Text Books:															
1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.															
2. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016.															
References:															
1. Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017.															
2. Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press,2014.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Gain knowledge on data science process.													Understand (K2)		
CO2: Perform data manipulation functions using Numpy and Pandas.													Understand (K2)		
CO3: Understand different types of machine learning approaches.													Understand (K2)		
CO4: Perform data visualization using tools.													Apply (K3)		
CO5: Handle large volumes of data in practical scenarios.													Apply (K3)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	–	–	–	–	2	–	2	2	2	1
CO2	3	3	2	2	3	–	–	–	–	2	–	2	3	3	1
CO3	3	3	2	2	3	–	–	–	–	2	–	2	3	3	1
CO4	2	2	3	3	3	–	–	–	1	2	–	2	3	3	2
CO5	2	3	3	3	3	–	–	–	1	2	–	3	3	3	2
CO Avg.	2.6	2.8	2.2	2.2	2.6	-	-	-	1	2	-	2.2	2.8	2.8	1.4
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CSO004	AUGMENTED AND VIRTUAL REALITY	Category: OEC			
		L	T	P	C
		2	0	2	3

Prerequisites		
Course Objectives:		
- To impart the fundamental aspects and principles of AR/VR technologies. - To know the internals of the hardware and software components involved in the development of AR/VR enabled applications. - To learn about the graphical processing units and their architectures. - To gain knowledge about AR/VR application development. - To know the technologies involved in the development of AR/VR based applications.		
Unit I	INTRODUCTION	7
Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space-Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies-Input Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System.		
Unit II	VR MODELING	6
Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management.		
Unit III	VR PROGRAMMING	6
VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D		
Unit IV	APPLICATIONS	6
Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education.		
Unit V	AUGMENTED REALITY	5
Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation-Navigation-Wearable devices		

LIST OF EXPERIMENTS		
1	Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender.	
2	Use the primitive objects and apply various projection types by handling camera.	
3	Download objects from asset store and apply various lighting and shading effects.	
4	Model three dimensional objects using various modelling techniques and apply textures over them.	
5	Create three dimensional realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity.	
6	Add audio and text special effects to the developed application.	
7	Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity.	
8	Develop AR enabled applications with interactivity like E learning environment, Virtual walkthroughs and visualization of historic places.	
9	Develop AR enabled simple applications like human anatomy visualization, DNA/RNA structure visualization and surgery simulation.	
10	Develop simple MR enabled gaming applications.	
	Lecture : 30	Practical : 30 Total periods: 60
Text Books:		
1.Charles Palmer, John Williamson, “Virtual Reality Blueprints: Create compelling VR experiences for mobile”, Packt Publisher, 2018		
2. Dieter Schmalstieg, Tobias Hollerer, “Augmented Reality: Principles & Practice”, Addison Wesley, 2016		
3. John Vince, “Introduction to Virtual Reality”, Springer-Verlag, 2004.		
4. William R. Sherman, Alan B. Craig: Understanding Virtual Reality – Interface, Application, Design”, Morgan Kaufmann, 2003		
References:		
1. Steven M. LaValle, Virtual Reality, Cambridge University Press, 2017.		
2. William R. Sherman & Alan B. Craig, Understanding Virtual Reality: Interface, Application, and Design, 2nd Edition, Morgan Kaufmann, 2019.		
3. Doug Bowman, Ernst Kruijff, Joseph J. LaViola, Ivan Poupyrev, 3D User Interfaces: Theory and Practice, Addison-Wesley, 2005.		

Course Outcomes:													Blooms Taxonomy		
CO 1: Understand the basic concepts of AR and VR													Understand (K2)		
CO2: Understand the tools and technologies related to AR/VR													Understand (K2)		
CO3: Working principle of AR/VR related Sensor devices													Understand (K2)		
CO4: Design of various models using modeling techniques													Apply (K3)		
CO5: Develop AR/VR applications in different domains.													Apply (K3)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	3	-	-	-	2	2	1	2	2	1	2
CO2	3	2	2	1	3	-	-	-	3	2	2	3	3	1	2
CO3	3	3	2	2	3	-	-	-	3	2	1	2	3	2	2
CO4	3	3	3	2	3	-	-	-	3	2	2	3	3	2	2
CO5	3	3	3	3	3	-	-	-	3	3	3	3	3	3	3
CO Avg.	2.6	2.8	2.2	2.2	2.6	-	-	-	1	2	-	2.2	2.8	2.8	1.4
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

OPEN ELECTIVE III

23HSO001	ENGLISH FOR COMPETITIVE EXAMINATIONS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
• Course Objectives: • To train the students in the language components essential to face competitive examinations both at the national (UPSC, Banking, Railway, Defence) and the international level (GRE, TOEFL, IELTS). • To enhance an awareness of the specific patterns in language testing and the respective skills to tackle verbal reasoning and verbal ability tests. • To inculcate effective practices in language-learning in order to improve accuracy in usage of grammar and coherence in writing. • To improve students’ confidence to express their ideas and opinions in formal contexts					

To create awareness of accuracy and precision in communication		
UNIT I	Vocabulary and Verbal Skills	9
Orientation on different formats of competitive exams - Vocabulary – Verbal ability – Verbal reasoning - Exploring the world of words – Essential words – Meaning and their usage – Synonyms-antonyms – Word substitution – Word analogy – Idioms and phrases – Commonly confused words – Spellings – Word expansion – New words in use.		
UNIT II	Grammar and Sentence Structure	9
Grammar – Sentence improvement –Sentence completion – Rearranging phrases into sentences – Error identification –Tenses – Prepositions – Adjectives – Adverbs – Subject-verb agreement – Voice – Reported speech – Articles – Clauses – Speech patterns.		
UNIT III	Reading Comprehension and Critical Reading	9
Reading - Specific information and detail – Identifying main and supporting ideas – Speed reading techniques – Improving global reading skills – Linking ideas – Summarising – Understanding argument – Identifying opinion/attitude and making inferences - Critical reading.		
UNIT IV	Writing Skills and Composition	9
Writing – Pre-writing techniques – Mindmap - Describing pictures and facts - Paragraph structure – organising points – Rhetoric writing – Improving an answer – Drafting, writing and developing an argument – Focus on cohesion – Using cohesive devices –Analytic writing – Structure and types of essay – Mind maps – Structure of drafts, letters, memos, emails – Statements of Purpose – Structure, Content and Style.		
Unit V	Listening and Speaking Skills	9
Listening and Speaking – Contextual listening – Listening to instructions – Listening for specific information – Identifying detail, main ideas – Following signpost words – Stress, rhythm and intonation - Speaking to respond and elicit ideas – Guided speaking – Opening phrases – Interactive communication – Dysfluency -Sentence stress – Speaking on a topic – Giving opinions – Giving an oral presentation – Telling a story or a personal anecdote – Talking about oneself - Utterance – Speech acts- Brainstorming ideas – Group discussion.		
Total periods:45		
Text Books:		
1. R.P.Bhatnagar - General English for Competitive Examinations. Macmillan India Limited, 2009.		

References:															
1.Educational Testing Service - The Official Guide to the GRE Revised General Test, Tata McGraw Hill, 2010.															
2.The Official Guide to the TOEFL Test, Tata McGraw Hill, 2010.															
3.R Rajagopalan- General English for Competitive Examinations, McGraw Hill Education (India) Private Limited, 2008.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Expand their vocabulary and gain practical techniques to read and comprehend a wide range of texts with the emphasis required													Understand(K2)		
CO2: Identify errors with precision and write with clarity and coherence													Analyze(K4)		
CO3: Understand the importance of task fulfilment and the usage of task-appropriate vocabulary													Understand(K2)		
CO4: Communicate effectively in group discussions, presentations and interviews													Understand(K2)		
CO5: Write topic based essays with precision and accuracy													Understand(K2)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	3	1	3	3	3	3	1	3	1	3	-	-	-
CO2	2	3	3	2	3	3	3	3	1	3	3	3	-	-	-
CO3	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-
CO4	2	2	2	2	2	2	2	2	3	3	3	3	-	-	-
CO5	2	2	2	2	2	2	2	2	2	3	2	3	-	-	-
CO Avg.	2	2.6	2.6	2	2.6	2.6	2.6	2.6	2	3	2.4	3	2.8	2.8	1.4
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23MGO001	NGOS AND SUSTAINABLE DEVELOPMENT	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - to understand the importance of sustainable development - to acquire a reasonable knowledge on the legal frameworks pertaining to pollution					

control and environmental management to comprehend the role of NGOs in attaining sustainable development		
UNIT I	ENVIRONMENTAL CONCERNS	9
Introduction to sustainable development goals, Global responsibility of environmental concern, Importance of environmental preservation, Environmental threats, Pollution and its types, Effects of Pollution, Pollution control, Treatment of wastes		
UNIT II	ROLE OF NGOS	9
Role of NGO's in national development, NGO's and participatory management, Challenges and limitations of NGO's, Community Development programmes, Role of NGO's in Community Development programmes, Participation of NGO's in environment management, Corporate Social responsibility, NGO's and corporate social responsibility		
UNIT III	SUSTAINABLE DEVELOPMENT	9
Issues and Challenges of Sustainable Development, Bioenergy, Sustainable Livelihoods and Rural Poor in Sustainable Development, Protecting ecosystem services for sustainable development, Non-renewable sources of energy and its effect, Renewable sources of energy for sustainability, Nuclear resources and Legal Regulation of Hazardous Substances, Sustainable Development: Programme and Policies, Sustainability assessment and Indicators		
UNIT IV	NGO'S FOR SUSTAINABILITY	9
Civil Society Initiatives in Environment Management, Civil Society Initiatives for Sustainable Development, Global Initiatives in Protecting Global Environment, World Summit on Sustainable Development (Johannesburg Summit 2002), Ecological economics, Environmental sustainability, Social inclusion, Health for all, education for all, Food security and Water security, NGOs and Sustainable Development strategies		
UNIT V	LEGAL FRAMEWORKS	9
Need for a Legal framework and its enforcement, Legal measures to control pollution, Environmental Legislations in India, Mechanism to implement Environmental Laws in India, Legal Protection of Forests Act 1927, Legal Protection of Wild Life, Role of NGO's in implementing environmental laws, Challenges in the implementation of environmental legislation		
Total periods: 45		
Text Books:		
1. Kulsange, S and Kamble, R. (2019). <i>Environmental NGOs: Sustainability Stewardship</i> . Lap Lambert Academic Publishing, India. ISBN: 978-6200442444.		

2 .Dodds, F. (2007). *NGO Diplomacy: The Influence of Nongovernmental Organizations in International Environmental Negotiations*. MIT Press, Cambridge. ISBN: 978-0262524766.

3 .Ghosh, S. (Ed.). (2019). *Indian Environmental Law: Key Concepts and Principles*. Orient BlackSwan, India. ISBN: 978-9352875795.

References:

1. Kulsange, S and Kamble, R. (2019). *Environmental NGO's: Sustainability Stewardship*, Lap Lambert Academic Publishing, India, ISBN-13: 978-6200442444.

2.Dodds, F. (2007). *NGO diplomacy: The influence of nongovernmental organizations in international environmental negotiations*. Mit Press, Cambridge, ISBN-13: 978-0262524766.

3. Ghosh, S. (Ed.). (2019). *Indian environmental law: Key concepts and principles*. Orient BlackSwan, India, ISBN-13: 978-9352875795.

4. Alan Fowler and Chiku Malunga (2010) *NGO Management: The Earthscan Companion*, Routledge, ISBN-13 : 978-1849711197.

Course Outcomes:

Blooms Taxonomy

CO1: Have a thorough grounding on the issues and challenges being faced in attaining sustainable development

Analyze(K4)

CO2: Have a knowledge on the role of NGOs towards sustainable developemnt

Understand(K2)

CO3: Present strategies for NGOs in attaining sustainable development

Apply(K3)

CO4: Recognize the importance of providing energy, food security and health equity to all members of the society without damaging the environment

Understand(K2)

CO5: Understand the environmental legislations.

Understand(K2)

CO - PO & PSO Mapping

Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	–	2	2	2	–	–	2	–	2	3	2	–
CO2	3	2	2	2	2	–	2	–	–	2	–	2	3	2	–
CO3	2	2	3	3	3	–	2	–	–	2	–	2	3	3	2
CO4	2	2	2	2	2	3	3	2	–	2	–	2	3	2	–
CO5	3	2	2	2	2	–	2	–	–	2	–	2	3	2	–
CO Avg.	2.6	2.2	2.2	2.25	2.2	2.5	2.2	2	-	2	-	2	3	2.2	2

1 - Low, 2 - Medium, 3 - High , '–' No correlation

23MGO002	DEMOCRACY AND GOOD GOVERNANCE	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To understand the role and functioning of regulatory and lobbying institutions - To explore contemporary political economy and development models in India - o analyze the dynamics of civil society and its impact on governance.					
Unit I					9
Regulatory Institutions – SEBI, TRAI, Competition Commission of India					
Unit II					9
Lobbying Institutions: Chambers of Commerce and Industries, Trade Unions, Farmers Associations, etc.					
Unit III					9
Lobbying Institutions: Chambers of Commerce and Industries, Trade Unions, Farmers Associations, etc.					
Unit IV					9
Contemporary Political Economy of Development in India: Policy Debates over Models of Development in India, Recent trends of Liberalisation of Indian Economy in different sectors, E- governance					
Unit V					9
Dynamics of Civil Society: New Social Movements, Role of NGO’s, Understanding the political significance of Media and Popular Culture.					
Total periods:45					
Text Books:					
1. tul Kohli (ed.), <i>The Success of India’s Democracy</i> , Cambridge University Press, 2001.					
2. Corbridge, Stuart and John Harris, <i>Reinventing India: Liberalisation, Hindu Nationalism and Popular Democracy</i> , Oxford University Press, 2000.					
3. J. Dreze and A. Sen, <i>India: Economic Development and Social Opportunity</i> , Clarendon, 1995					
References:					
1.Atul Kohli (ed.): The Success of India’s Democracy, Cambridge University Press, 2001.					
2.Corbridge, Stuart and John Harris: Reinventing India: Liberalisation, Hindu Nationalism and Popular Democracy, Oxford University Press, 2000.					
3.J.Dreze and A.Sen, India: Economic Development and Social Opportunity, Clarendon, 1995.					

4.Saima Saeed: Screening the Public Sphere: Media and Democracy in India,2013															
5.Himat Singh: Green Revolution Reconsidered: The Rural World of Punjab, OUP, 2001.															
6.Jagdish Bhagwati: India in Transition: Freeing The Economy, 1993.															
7.Smitu Kothari: Social Movements and the Redefinition of Democracy, Boulder, Westview, 1993.															
Course Outcomes:												Blooms Taxonomy			
CO 1: Understand the role of regulatory institutions like SEBI, TRAI, Competition Commission												Understand (K2)			
CO2: Examine the role of lobbying institutions such as trade unions, chambers, farmers' associations												Analyze (K4)			
CO3: Understand contemporary political economy and policy debates on development												Understand (K2)			
CO4: Analyze trends in liberalization, e-governance, and sectoral reforms												Analyze (K4)			
CO5: Understand the dynamics of civil society, media, NGOs, and social movements												Understand (K2)			
CO - PO & PSO Mapping:															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	–	–	–	–	–	–	–	-	2	–	-
CO2	2	2	3	2	2	–	2	–	–	–	–	–	2	–	-
CO3	2	2	2	2	2	–	–	–	–	–	–	–	2	–	-
CO4	2	2	2	2	2	–	–	–	–	–	–	–	2	–	-
CO5	2	2	3	2	2	–	2	–	–	–	–	–	2	–	-
CO Avg.	2	2	2.4	2	2	-	2	-	-	-	-	-	2	-	-
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23EEO001	RENEWABLE ENERGY TECHNOLOGIES	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: • To know the Indian and global energy scenario • To learn the various solar energy technologies and its applications. • To educate the various wind energy technologies.					

- To explore the various bio-energy technologies. - To study the ocean and geothermal technologies.		
Unit I	ENERGY SCENARIO	9
Indian energy scenario in various sectors — domestic, industrial, commercial, agriculture, transportation and others — Present conventional energy status — Present renewable energy status- Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans		
Unit II	SOLAR ENERGY	9
Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems — Solar PV applications.		
Unit III	WIND ENERGY	9
Wind data and energy estimation – Betz limit - Site selection for windfarms – characteristics - Wind resource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance — Hybrid systems — Environmental issues - Applications		
Unit IV	BIO-ENERGY	9
Bio resources — Biomass direct combustion — thermochemical conversion - biochemical conversion-mechanical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration — Carbonisation — Pyrolysis - Biogas plants — Digesters –Biodiesel production — Ethanol production - Applications		
Unit V	OCEAN AND GEOTHERMAL ENERGY	9
Small hydro - Tidal energy — Wave energy — Open and closed OTEC Cycles — Limitations — Geothermal energy — Geothermal energy sources - Types of geothermal power plants — Applications - Environmental impact.		
Total periods: 45		
Text Books:		
1. Fundamentals and Applications of Renewable Energy Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, cGraw Hill; First edition (10 December 2020), ISBN-10 : 9390385636.		
2. Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India Learning Private Limited; 2nd edition (1 January 2011), ISBN-10 : 8120344707		

References:															
1. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K., 2012															
2. Rai.G.D., “Non-Conventional Energy Sources”, Khanna Publishers, New Delhi, 2014															
3. Sukhatme.S.P., “Solar Energy: Principles of Thermal Collection and Storage”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.															
4. Tiwari G.N., “Solar Energy – Fundamentals Design, Modelling and applications”, Alpha Science Intl Ltd, 2015															
5. Twidell, J.W. & Weir A., “Renewable Energy Resources”, EFNSpon Ltd., UK, 2015															
Course Outcomes:													Blooms Taxonomy		
CO1: Discuss the Indian and global energy scenario													Analyze(K4)		
CO2: Describe the various solar energy technologies and its applications.													Analyze(K4)		
CO3: Explain the various wind energy technologies													Understand(K2)		
CO4: Explore the various bio-energy technologies													Understand(K2)		
CO5: Discuss the ocean and geothermal technologies.													Understand(K2)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	3	2	2	3	3	3	3	-	-	-
CO2	2	2	2	1	1	1	2	1	2	3	2	3	-	-	-
CO3	2	2	3	3	2	3	2	2	2	3	2	3	-	-	-
CO4	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-
CO5	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-
CO Avg.	2.4	2.2	2.4	2.2	2	2.6	2.4	2.2	2.6	3	2.6	3	-	-	-
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23MEO001	APPLIED DESIGN THINKING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					

Course Objectives:		
• Introduce tools & techniques of design thinking for innovative product • development Illustrate customer-centric product innovation using on simple • use cases Demonstrate development of Minimum usable Prototypes • Outline principles of solution concepts & their evaluation • Describe system thinking principles as applied to complex systems		
UNIT I	DESIGN THINKING PRINCIPLES	9
Exploring Human-centered Design - Understanding the Innovation process, discovering areas of opportunity, Interviewing & empathy-building techniques, Mitigate validation risk with FIR [Forge Innovation rubric] - Case studies		
UNIT II	ENDUSER-CENTRIC INNOVATION	9
Importance of customer-centric innovation - Problem Validation and Customer Discovery - Understanding problem significance and problem incidence - Customer Validation. Target user, User persona & user stories. Activity: Customer development process - Customer interviews and field visit		
UNIT III	APPLIED DESIGN THINKING TOOLS	9
Concept of Minimum Usable Prototype [MUP] - MUP challenge brief - Designing & Crafting the value proposition - Designing and Testing Value Proposition; Design a compelling value proposition; Process, tools and techniques of Value Proposition Design		
UNIT IV	CONCEPT GENERATION	9
Solution Exploration, Concepts Generation and MUP design- Conceptualize the solution concept; explore, iterate and learn; build the right prototype; Assess capability, usability and feasibility. Systematic concept generation; evaluation of technology alternatives and the solution concepts		
UNIT V	SYSTEM THINKING	9
System Thinking, Understanding Systems, Examples and Understandings, Complex Systems		
Total periods: 45		
Text Books:		
1. Steve Blank, (2013), The four steps to epiphany: Successful strategies for products that win, Wiley.		
2.Alexander Osterwalder, Yves Pigneur, Gregory Bernarda, Alan Smith, Trish Papadacos, (2014), Value		
3.Proposition Design: How to Create Products and Services Customers Want, Wiley		
4.Donella H. Meadows, (2015), “Thinking in Systems -A Primer”, Sustainability Institute.		

5.Tim Brown,(2012) “Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation”, Harper Business.																
References:																
1. https://www.ideo.com/pages/design-thinking#process																
2. https://blog.forgefor ward.in/valuation-risk-versus-validation-risk-in-product-innovations 49f253ca8624																
3 . https://blog.forgefor ward.in/product-innovation-rubric-adf5ebdfd356																
4 . https://blog.forgefor ward.in/evaluating-product-innovations-e8178e58b86e																
5 . https://blog.forgefor ward.in/user-guide-for-product-innovation-rubric-857181b253dd																
6 . https://blog.forgefor ward.in/star tup-failure-is-like-true-lie-7812cdf9b85																
Course Outcomes:													Blooms Taxonomy			
CO 1: Apply design thinking principles to human-centered innovation													Apply (K3)			
CO2: Conduct end-user research and create user personas and stories													Apply (K3)			
CO3: Design and test Minimum Usable Prototypes (MUPs)													Apply (K3)			
CO4: Generate and evaluate solution concepts using systematic approaches													Analyze (K4)			
CO5: Apply system thinking to understand complex problems and solutions.													Understand (K2)			
CO - PO & PSO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	2	3	2	1	-	-	-	1	2	2	-	-	2	-	-	
CO2	2	3	3	2	1	-	-	-	1	2	2	-	3	-	-	
CO3	3	2	3	2	1	2	2	2	2	3	2	-	3	-	-	
CO4	3	2	3	3	2	2	2	2	2	3	2	-	3	-	-	
CO5	2	2	2	3	2	2	2	2	2	2	2	-	2	-	-	
CO Avg.	2.4	2.4	2.6	2.2	1.5	2	2	1.75	1.8	2.4	2	-	2.6	-	-	
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation																

23MEO002	REVERSE ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					

Course Objectives:

- The main learning objective of this course is to prepare students for:
- Applying the fundamental concepts and principles of reverse engineering in product design and development.
- Applying the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
- Applying the concept and principles of material identification and process verification in reverse engineering of product design and development.
- Analysing the various legal aspect and applications of reverse engineering in product design and development.
- Understand about 3D scanning hardware & software operations and procedure to generate 3D model

Unit I	INTRODUCTION & GEOMETRIC FORM	9
Definition – Uses – The Generic Process – Phases – Computer Aided Reverse Engineering - Surface and Solid Model Reconstruction – Dimensional Measurement – Prototyping.		
Unit II	MATERIAL CHARACTERISTICS AND PROCESS IDENTIFICATION	9
Alloy Structure Equivalency – Phase Formation and Identification – Mechanical Strength – Hardness –Part Failure Analysis – Fatigue – Creep and Stress Rupture – Environmentally Induced Failure Material Specification - Composition Determination - Microstructure Analysis - Manufacturing Process Verification.		
Unit III	DATA PROCESSING	9
Statistical Analysis – Data Analysis – Reliability and the Theory of Interference – Weibull Analysis – Data Conformity and Acceptance – Data Report – Performance Criteria – Methodology of Performance Evaluation – System Compatibility.		
Unit IV	3D SCANNING AND MODELLING	9
Introduction, working principle and operations of 3D scanners: Laser, White Light, Blue Light - Applications- Software for scanning and modelling: Types- Applications- Preparation techniques for Scanning objects- Scanning and Measuring strategies - Calibration of 3D Scanner- Step by step procedure: 3D scanning - Geometric modelling – 3D inspection- Case studies.		
Unit V	INDUSTRIAL APPLICATIONS	9
Reverse Engineering in the Automotive Industry; Aerospace Industry; Medical Device Industry. Case studies and Solving Industrial projects in Reverse Engineering.Legality: Patent – Copyrights –Trade Secret – Third-Party Materials.		

Total periods: 45															
Text Books:															
1. Robert W. Messler, Reverse Engineering: Mechanisms, Structures, Systems & Materials, 1st Edition, McGraw-Hill Education, 2014															
2. Wego Wang, Reverse Engineering Technology of Reinvention, CRC Press, 2011															
References:															
1. Scott J. Lawrence , Principles of Reverse Engineering, Kindle Edition, 2022															
2. Kevin Otto and Kristin Wood, Product Design: Techniques in Reverse Engineering and New Product Development, Prentice Hall, 2001															
3. Kathryn, A. Ingle, “Reverse Engineering”, McGraw-Hill, 1994.															
4. Linda Wills, “Reverse Engineering”, Kluwer Academic Publishers, 1996															
5. Vinesh Raj and Kiran Fernandes, “Reverse Engineering: An Industrial Perspective”, Springer-Verlag London Limited 2008.															
Course Outcomes:													Blooms Taxonomy		
CO1: Apply the fundamental concepts and principles of reverse engineering in product design and development.													Apply(K3)		
CO2: Apply the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.													Apply(K3)		
CO3: Apply the concept and principles of material identification and process verification in reverse engineering of product design and development													Apply(K3)		
CO4: Apply the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development													Apply(K3)		
CO5: Analyze the various legal aspect. Applications of reverse engineering in product design and development.													Analyze(K4)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	2	2	2	2	-	3	2	-	2	1	-
CO2	3	2	3	2	1	2	-	2	2	2	2	-	3	2	3
CO3	3	2	3	2	1	2	-	2	2	2	2	-	3	2	3
CO4	3	2	3	2	1	2	-	2	2	2	2	-	3	2	3

CO5	2	2	2	1	1	-	-	2	2	2	2	-	2	2	2
CO Avg.	2.6	1.8	2.75	1.75	1.2	2	2	2	2	2.2	2	-	2.6	1.8	2.75
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MEO003	SUSTAINABLE MANUFACTURING	Category: OEC			
		L	T	P	C
		3	0	0	3

Prerequisites

-

Course Objectives:

- To be acquainted with sustainability in manufacturing and its evaluation.
- To provide knowledge in environment and social sustainability.
- To provide the student with the knowledge of strategy to achieve sustainability.
- To familiarize with trends in sustainable operations.
- To create awareness in current sustainable practices in manufacturing industry.

Unit I	ECONOMIC SUSTAINABILITY	9

Industrial Revolution-Economic sustainability: globalization and international issues Sustainability status - Emerging issues- Innovative products- Reconfiguration manufacturing enterprises - Competitive manufacturing strategies - Performance evaluation- Management for sustainability - Assessments of economic sustainability

Unit II	SOCIAL AND ENVIRONMENTAL SUSTAINABILITY	9

Social sustainability – Introduction-Work management -Human rights - Societal commitment - Customers - Business practices -Modelling and assessing social sustainability. Environmental issues pertaining to the manufacturing sector: Pollution - Use of resources -Pressure to reduce costs - Environmental management: Processes that minimize negative environmental impacts - environmental legislation and energy costs - need to reduce the carbon footprint of manufacturing Operations-Modelling and assessing environmental sustainability.

Unit III	SOCIAL AND ENVIRONMENTAL SUSTAINABILITY	9

Sustainability awareness - Measuring Industry Awareness-Drivers and barriers -Availability of sustainability indicators -Analysis of sustainability practicing -Modeling and assessment of sustainable practicing -Sustainability awareness -Sustainability drivers and barriers - Availability of sustainability indicators- Designing questionnaires- Optimizing Sustainability Indexes-Elements – Cost and time model.

Unit IV	MANUFACTURING STRATEGY FOR SUSTAINABILITY	9

Concepts of competitive strategy and manufacturing strategies and development of a strategic improvement programme - Manufacturing strategy in business success strategy formation and formulation - Structured strategy formulation - Sustainable manufacturing system design options - Approaches to strategy formulation - Realization of new strategies/system designs.															
Unit V		TRENDS IN SUSTAINABLE OPERATIONS												9	
Principles of sustainable operations - Life cycle assessment manufacturing and service activities - influence of product design on operations - Process analysis – Capacity management - Quality management - Inventory management - Just-In-Time systems - Resource efficient design - Consumerism and sustainable well-being.															
Total periods:45															
Text Books:															
1. Ibrahim Garbie, “Sustainability in Manufacturing Enterprises Concepts, Analyses and Assessments for Industry 4.0”, Springer International Publishing., United States, 2016, ISBN-13: 978-3319293042.															
2. Davim J.P., “Sustainable Manufacturing”, John Wiley & Sons., United States, 2010,ISBN: 978-1-848-21212-1.															
References:															
1. Jovane F, Emper, W.E. and Williams, D.J., “The ManuFuture Road: Towards Competitive and Sustainable High-Adding-Value Manufacturing”, Springer,2009, United States, ISBN 978-3-540-77011-															
2. Kutz M., “Environmentally Conscious Mechanical Design”, John Wiley & Sons., United States, 2007, ISBN: 978-0-471-72636-4.															
3. Seliger G., “Sustainable Manufacturing: Shaping Global Value Creation”, Springer, United States, 2012, ISBN 978-3-642-27289-9.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Discuss the importance of economic sustainability													Understand(K2)		
CO2: Describe the importance of sustainable practices													Understand(K2)		
CO3: Identify drivers and barriers for the given conditions.													Analyze(K4)		
CO4: Formulate strategy in sustainable manufacturing													Understand(K2)		
CO5: Plan for sustainable operation of industry with environmental, cost consciousness.													Apply(K3)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	2	-	-	-	2	2	-	1	1	2	2	2	1

CO2	3	-	-	-	-	-	2	-	-	1	1	2	1	2	2
CO3	3	-	-	-	-	-	2	3	-	1	1	2	1	2	2
CO4	3	-	3	-	-	-	2		-	1	1	2	2	2	1
CO5	3	-	3	-	-	-	2	2	-	1	1	2	2	2	1
CO Avg.	3	-	2.6	-	-	-	2	2.3	-	1	1	2	1.6	2	1.4
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23EEO002	ELECTRIC AND HYBRID VEHICLES	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: The objective of this course is to prepare the students to know about the general aspects of Electric and Hybrid Vehicles (EHV), including architectures, modelling, sizing, and sub system design and hybrid vehicle control.					
Unit I	DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES				9
Need for Electric vehicle- Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. - Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance-Transmission efficiency- Electric vehicle chassis and Body Design, Electric Vehicle Recharging and Refuelling Systems.					
Unit II	ENERGY SOURCES				9
Battery Parameters- - Different types of batteries – Lead Acid- Nickel Metal Hydride - Lithium ion-Sodium based- Metal Air. Battery Modelling - Equivalent circuits, Battery charging- Quick Charging devices. Fuel Cell- Fuel cell Characteristics- Fuel cell types-Half reactions of fuel cell. Ultra capacitors. Battery Management System.					
Unit III	MOTORS AND DRIVES				9
Types of Motors- DC motors- AC motors, PMSM motors, BLDC motors, Switched reluctance motors working principle, construction and characteristics.					
Unit IV	POWER CONVERTERS AND CONTROLLERS				9

Solid state Switching elements and characteristics – BJT, MOSFET, IGBT, SCR and TRIAC - Power Converters – rectifiers, inverters and converters - Motor Drives - DC, AC motor, PMSM motors, BLDC motors, Switched reluctance motors – four quadrant operations –operating modes															
Unit V		HYBRID AND ELECTRIC VEHICLES												9	
Main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Power Split devices for Hybrid Vehicles - Operation modes - Control Strategies for Hybrid Vehicle - Economy of hybrid Vehicles - Case study on specification of electric and hybrid vehicles.															
Total periods:45															
Text Books:															
1.Iqbal Husain, “ Electric and Hybrid Vehicles-Design Fundamentals”, CRC Press,2003															
2.Mehrdad Ehsani, “ Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, CRCPress,2005.															
References:															
1. James Larminie and John Lowry, “Electric Vehicle Technology Explained “ John Wiley & Sons,2003															
2. Lino Guzzella, “ Vehicle Propulsion System” Springer Publications,2005															
3. Ron HodKinson, “Light Weight Electric/ Hybrid Vehicle Design”, Butterworth Heinemann Publication,2005.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Understand the operation and architecture of electric and hybrid vehicles													Understand(K2)		
CO2: Identify various energy source options like battery and fuel cell													Analyze(K4)		
CO3: Select suitable electric motor for applications in hybrid and electric vehicles.													Analyze(K4)		
CO4: Explain the role of power electronics in hybrid and electric vehicles													Understand(K2)		
CO5: Analyse the energy and design requirement for hybrid and electric vehicles.													Analyze(K4)		
CO - PO & PSO Mapping															
Particular	Po 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	1	-	3	2	-	-	-	-	2	-	1	3
CO2	1	1	2	1	-	3	2	-	-	-	-	2	-	1	3
CO3	1	1	2	1	-	3	2	-	-	-	-	2	-	1	3
CO4	1	1	2	1	-	3	2	-	-	-	-	2	-	1	3

CO5	1	1	2	1	-	3	2	-	-	-	-	2	-	1	3
CO Avg.	1	1	2	1	-	3	2	-	-	-	-	2	-	1	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23ECO002	SPACE ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - Use the standard atmosphere tables and equations. - Find lift and drag coefficient data from NACA plots. - Apply the concept of static stability to flight vehicles. - Describe the concepts of stress, strain, Young’s modulus, Poisson’s ratio, yield strength. - Demonstrate a basic knowledge of dynamics relevant to orbital mechanics.					
Unit I	STANDARD ATMOSPHERE				9
History of aviation – standard atmosphere - pressure, temperature and density altitude.					
Unit II	AERODYNAMICS				9
Aerodynamic forces – Lift generation Viscosity and its implications - Shear stress in a velocity profile - Lagrangian and Eulerian flow field - Concept of a streamline – Aircraft terminology and geometry - Aircraft types - Lift and drag coefficients using NACA data.					
UNIT III	PERFORMANCE AND PROPULSION				9
Viscous and pressure drag - flow separation - aerodynamic drag - thrust calculations -thrust/power available and thrust/power required.					
UNIT IV	AIRCRAFT STABILITY AND STRUCTURAL THEORY				9
Degrees of freedom of aircraft motions - stable, unstable and neutral stability - concept of static stability - Hooke’s Law- brittle and ductile materials - moment of inertia - section modulus.					
UNIT V	SPACE APPLICATIONS				9
History of space research - spacecraft trajectories and basic orbital manoeuvres - six orbital elements - Kepler’s laws of orbits - Newtons law of gravitation.					
Total periods:45					

Text Books:															
1. John D. Anderson, Introduction to Flight, 8 th Ed., McGraw-Hill Education, New York, 2015.															
2. E. Rathakrishnan, “Introduction to Aerospace Engineering: Basic Principles of Flight”, John Wiley, NJ, 2021.															
3. Stephen. A. Brandt, “Introduction to Aeronautics: A design perspective”; American Institute of Aeronautics & Astronautics, 1997.															
References:															
1. Kermode, A.C., “Mechanics of Flight”, Himalayan Book, 1997.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Illustrate the history of aviation & developments over the years													Understand(K2)		
CO2: Ability to identify the types & classifications of components and control systems													Analyze(K4)		
CO3: Explain the basic concepts of flight & Physical properties of Atmosphere													Understand(K2)		
CO4: Identify the types of fuselage and constructions.													Analyze(K4)		
CO5: Distinguish the types of Engines and explain the principles of Rocket													Understand(K2)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	1	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	2	3	2	-	-	2	-	2	2	-	-	2	2	-
CO3	2	1	2	-	-	-	-	-	-	-	-	-	1	-	-
CO4	3	2	3	2	-	-	2	-	2	2	-	-	2	2	-
CO5	2	1	2	-	-	-	-	-	2	1	-	-	2	1	-
CO Avg.	2.4	1.5	2.2	2	-	-	2	-	2	1.6	-	-	1.6	1.6	-
1 - Low, 2 - Medium, 3 - High, ‘-’ No correlation															

23MGO004	INDUSTRIAL MANAGEMENT	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: To introduce fundamental concepts of industrial management					

- To understand the approaches to the study of Management - To learn about Decision Making, Organizing and leadership - To analyze the Managerial Role and functions - To know about the Supply Chain Management		
UNIT I	INTRODUCTION	9
Technology Management - Definition - Functions - Evolution of Modern Management - Scientific Management Development of Management Thought. Approaches to the study of Management, Forms of Organization -Individual Ownership - Partnership - Joint Stock Companies - Co-operative Enterprises - Public Sector Undertakings, Corporate Frame Work- Share Holders - Board of Directors - Committees - Chief Executive Line and Functional Managers,-Financial-Legal-Trade Union		
UNIT II	FUNCTIONS OF MANAGEMENT	9
Planning - Nature and Purpose - Objectives - Strategies – Policies and Planning Premises - Decision Making - Organizing - Nature and Process - Premises - Departmentalization - Line and staff - Decentralization -Organizational culture, Staffing - selection and training .Placement - Performance appraisal - Career Strategy – Organizational Development. Leading - Managing human factor - Leadership .Communication, Controlling - Process of Controlling - Controlling techniques, productivity and operations management - Preventive control, Industrial Safety.		
UNIT III	ORGANIZATIONAL BEHAVIOUR	9
Definition - Organization - Managerial Role and functions -Organizational approaches, Individual behaviour - causes - Environmental Effect - Behaviour and Performance, Perception - Organizational Implications. Personality - Contributing factors - Dimension – Need Theories - Process Theories - Job Satisfaction, Learning and Behaviour-Learning Curves, Work Design and approaches.		
Unit IV	GROUPDYNAMICS	9
Group Behaviour - Groups - Contributing factors - Group Norms, Communication - Process - Barriers to communication - Effective communication, leadership - formal and informal characteristics – Managerial Grid - Leadership styles - Group Decision Making - Leadership Role in Group Decision, Group Conflicts - Types -Causes - Conflict Resolution -Inter group relations and conflict, Organization centralization and decentralization - Formal and informal - Organizational Structures Organizational Change and Development -Change Process – Resistance to Change - Culture and Ethics		
Unit V	MODERN CONCEPTS	9
Management by Objectives (MBO) - Management by Exception (MBE),Strategic Management - Planning for Future direction - SWOT Analysis -Evolving development strategies, information technology in management Decisions support system-Management Games Business Process Re- engineering(BPR) –		

Enterprises Resource Planning (ERP) - Supply Chain Management (SCM) - Activity Based Management (AM) - Global Perspective - Principles and Steps Advantages and disadvantage															
Total periods:45															
Text Books:															
1. Tephenn P. Robbins & Mary Coulter – Management, 14th Edition, Pearson, 2021.															
2. Harold Koontz & Heinz Weihrich – Essentials of Management, McGraw-Hill Education, 2010.															
3. Robert Kreitner & Mamata Mohapatra – Management, Cengage Learning, 2012.															
References:															
1. James A.F. Stoner, R. Edward Freeman & Daniel R. Gilbert – Management, Pearson, 2008.															
2. Peter Drucker – Management: Tasks, Responsibilities, Practices, Harper Business, 2007.															
3. Richard L. Daft – Management, 12th Edition, Cengage Learning, 2015.															
Course Outcomes:													Blooms Taxonomy		
CO1: Understand the basic concepts of industrial management													Understand(K2)		
CO2: Identify the group conflicts and its causes.													Apply(K3)		
CO3: Perform swot analysis													Analyze(K4)		
CO4 : Analyze the learning curves													Analyze(K4)		
CO5 : Understand the placement and performance appraisal													Understand(K2)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	-
CO2	-	3	2	3	-	-	-	-	-	-	-	-	-	-	2
CO3	2	3	2	3	-	-	-	-	-	-	-	-	1	2	3
CO4	2	2	3	3	-	-	-	-	-	-	-	-		3	3
CO5	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO Avg.	2	2.2	2.3	3	-	-	-	-	-	-	-	-	1.6	2	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MGO003	QUALITY ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					

Course Objectives:		
- Developing a clear knowledge in the basics of various quality concepts. - Facilitating the students in understanding the application of control charts and its techniques. - Developing the special control procedures for service and processoriented industries. - Analyzing and understanding the process capability study. - Developing the acceptance sampling procedures for incoming raw material.		
UNIT I	INTRODUCTION	9
Quality Dimensions–Quality definitions–Inspection–Quality control–Quality Assurance–Quality planning–Quality costs–Economics of quality– Quality loss function		
UNIT II	CONTROL CHARTS	9
Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- $\bar{X}$, R and S charts, attribute control charts - p, np, c and u- Construction and application		
UNIT III	SPECIAL CONTROL PROCEDURES	9
Warning and modified control limits, control chart for individual measurements, multi-vari chart, $\bar{X}$ chart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts.		
UNIT IV	STATISTICAL PROCESS CONTROL	9
Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits.		
UNIT V	ACCEPTANCE SAMPLING	9
The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables, MIL-STD-105D and MIL-STD-414E & IS 2500 standards.		
Total periods: 45		
Text Books:		
1. Douglas C. Montgomery – <i>Introduction to Statistical Quality Control</i> , 8th Edition, Wiley, 2020.		
2. Juran, J.M., & Godfrey, A.B. – <i>Juran's Quality Handbook</i> , 6th Edition, McGraw-Hill, 2016.		
References:		
1. Montgomery, D.C. – <i>Design and Analysis of Experiments</i> , 9th Edition, Wiley, 2017.		
2. Grant, E.L., & Leavenworth, R.S. – <i>Statistical Quality Control</i> , 8th Edition, McGraw-Hill, 2000.		
Course Outcomes:		Blooms Taxonomy
CO1: Control the quality of processes using control charts for variables in		Apply(K3)

manufacturing industries.															
CO2: Control the occurrence of defective product and the defects in manufacturing companies.													Apply(K3)		
CO3: Control the occurrence of defects in services.													Apply(K3)		
CO4: Analyzing and understanding the process capability study.													Analyze(K4)		
CO5: Developing the acceptance sampling procedures for incoming raw material.													Understand(K2)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	-	3	-	-	1	2	-	-	2	1	-	-
CO2	-	3	3	-	3	3	-	-	3	-	-	3	-	2	-
CO3	3	3	3	-	3	-	-	-	3	-	-	3	1	-	-
CO4	3		2	-	3	-	-	-	-	-	1	-	1	-	-
CO5	-	2		-	3	-	-	-	3	-	-	3	-	-	1
CO Avg.	2.6	2.7	2.7	-	3	3	-	1	2.7	-	1	2.7	1	2	1
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CHO001	FIRE SAFETY ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: • To enable the students to acquire knowledge of Fire and Safety Studies • To learn about the effect of fire on materials used for construction, the method of test for non- combustibility & fire resistance					

- To learn about fire area, fire stopped areas and different types of fire-resistant doors - To learn about the method of fire protection of structural members and their repair due to fire damage. - To develop safety professionals for both technical and management through systematic and quality-based study programmers'		
Unit I	INHERENT SAFETY CONCEPTS	9
Compartment fire-factors controlling fire severity, ventilation controlled and fuel controlled fires; Spread of fire in rooms, within building and between buildings. Effect of temperature on the properties of structural materials- concrete, steel, masonry and wood; Behavior of non-structural materials on fire- plastics, glass, textile fibres and other house hold materials.		
Unit II	PLANT LOCATIONS	9
Compartment temperature-time response at pre-flashover and post flashover periods; Equivalence of fire severity of compartment fire and furnace fire; Fire resistance test on structural elements- standard heating condition, Indian standard test method, performance criteria.		
Unit III	WORKING CONDITIONS	9
Fire separation between building- principle of calculation of safe distance. Design principles of fire resistant walls and ceilings; Fire resistant screens- solid screens and water curtains; Local barriers; Fire stopped areas-in roof, in fire areas and in connecting structures; Fire doors- Low combustible, Non-combustible and Spark-proof doors; method of suspension of fire doors; Air-tight sealing of doors.		
Unit IV	FIRE SEVERITY AND REPAIR TECHNIQUES	9
Fabricated fire proof boards-calcium silicate, Gypsum, Vermiculite, and Perlite boards; Fire protection of structural elements - Wooden, Steel and RCC.. Reparability of fire damaged structures- Assessment of damage to concrete, steel, masonry and timber structures, Repair techniques- repair methods to reinforced concrete Columns, beams and slabs, Repair to steel structural members, Repair to masonry structures		
Unit V	WORKING AT HEIGHTS	9
Safe Access - Requirement for Safe Work Platforms- Stairways - Gangways and Ramps-Fall Prevention & Fall Protection - Safety Belts - Safety nets - Fall Arrestors- Working on Fragile Roofs - Work Permit Systems-Accident Case Studies.		
Total periods:45		
Text Books:		
1. Roytman, M. Y, "Principles of fire safety standards for building construction". Amerind Publishing Co. Pvt. Ltd., New Delhi, 1975		

2. John A. Purkiss,"Fire safety engineering design of structures" (2nd edn.), Butterworth Heinemann, Oxford, UK,2009.															
References:															
1. Smith, E.E. and Harmathy, T.Z. (Editors),"Design of buildings for fire safety". ASTM Special Publication 685, American Society for Testing and Materials, Boston, U.S.A,1979.															
2. Butcher, E. G. and Parnell, A. C, "Designing of fire safety". JohnWiley and Sons Ltd., New York, U.S.A.1983.															
3. Jain, V.K,"Fire safety in buildings" (2nd edn.). New Age International(P) Ltd., New Delhi,2010. 4. Hazop&Hazan,"Identifying and Assessing Process Industry Hazards", Fourth Edition ,1999															
4. Frank R. Spellman, Nancy E. Whiting,"The Handbook of Safety Engineering: Principles and Applications", 2009.															
Course Outcomes:													Blooms Taxonomy		
CO1: Understand the effect of fire on materials used for construction													Understand(K2)		
CO2: Understand the method of test for non-combustibility and fire resistance; and will be able to select different structural elements and their dimensions for a particular fire resistance rating of a building.													Understand(K2)		
CO3: To understand the design concept of fire walls, fire screens, local barriers and fire doors and able to select them appropriately to prevent fire spread.													Understand(K2)		
CO4: To decide the method of fire protection to RCC, steel, and wooden structural elements and their repair methods if damaged due to fire.													Understand(K2)		
CO5: Describe the safety techniques and improve the analytical and intelligence to take the right decision at right time.													Understand(K2)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	1	-	-	1	-	-	-	-	-	-	-	-	-
CO2	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	1	-	2	-	-	-	3	-	-	1	-	-	-	-	-
CO4	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
CO5	2	-	1	-	-	1	1	1	-	1	-	1	-	-	-
CO Avg.	1.6	-	1.75	-	-	1	1.6	1	-	1	-	1	-	-	-
1 - Low, 2 - Medium, 3 - High , '- ' No correlation															

23CEO001	INTRODUCTION TO NON-DESTRUCTIVE TESTING	Category: OEC

		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives:					
- Understanding the basic importance of NDT in quality assurance. - Imbibing the basic principles of various NDT techniques, its applications, limitations, codes and standards. - Equipping themselves to locate a flaw in various materials, products. - Applying apply the testing methods for inspecting materials in accordance with industry specifications and standards. - Acquiring the knowledge on the selection of the suitable NDT technique for a given application					
Unit I	INTRODUCTION TO NDT & VISUAL TESTING				9
Concepts of Non-destructive testing-relative merits and limitations-NDT Versus mechanical testing, Fundamentals of Visual Testing – vision, lighting, material attributes, environmental factors, visual perception, direct and indirect methods – mirrors, magnifiers, boroscopes and fibrosopes – light sources and special lighting					
Unit II	LIQUID PENETRANT & MAGNETIC PARTICLE TESTING				9
Liquid Penetrant Inspection: principle, applications, advantages and limitations, dyes, developers and cleaners, Methods & Interpretation.Magnetic Particle Inspection: Principles, applications, magnetization methods, magnetic particles, Testing Procedure, demagnetization, advantages and limitations, – Interpretation and evaluation of test indications					
Unit III	EDDY CURRENT TESTING & THERMOGRAPHY				9
Eddy Current Testing: Generation of eddy currents– properties– eddy current sensing elements, probes, Instrumentation, Types of arrangement, applications, advantages, limitations – Factors affecting sensing elements and coil impedance, calibration, Interpretation/Evaluation. Thermography- Principle, Contact & Non-Contact inspection methods, Active & Passive methods, Liquid Crystal – Concept, example, advantages & limitations. Electromagnetic spectrum, infrared thermography- approaches, IR detectors, Instrumentation and methods, applications.					
Unit IV	ULTRASONIC TESTING & AET				9
Ultrasonic Testing: Types of ultrasonic waves, characteristics, attenuation, couplants, probes, EMAT. Inspection methods-pulse echo, transmission and phased array techniques, types of scanning and displays, angle beam inspection of welds, time of flight diffraction (TOFD) technique, Thickness determination by ultrasonic method, Study of A, B and C scan presentations, calibration. Acoustic Emission Technique –					

Introduction, Types of AE signal, AE wave propagation, Source location, Kaiser effect, AE transducers, Principle, AE parameters, AE instrumentation, Advantages & Limitations, Interpretation of Results, Applications.		
Unit V	RADIOGRAPHY TESTING	9
Sources-X-rays and Gamma rays and their characteristics-absorption, scattering. Filters and screens, Imaging modalities-film radiography and digital radiography (Computed, Direct, Real Time, CT scan). Problems in shadow formation, exposure factors, inverse square law, exposure charts, Penetrometers, safety in radiography.		
Total periods:45		
Text Books:		
Baldev Raj, T. Jayakumar and M. Thavasimuthu, Practical Non Destructive Testing, Alpha Science International Limited, 3rd edition, 2002.		
J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGraw-Hill Education, 2nd edition, 2011.		
Ravi Prakash, “Non-Destructive Testing Techniques”, 1st revised edition, New Age International Publishers, 2010.		
References:		
ASM Metals Handbook, V-17, "Nondestructive Evaluation and Quality Control", American Society of Metals, USA, 2001.		
Barry Hull and Vernon John, "Nondestructive Testing", Macmillan, 1989.		
Chuck Hellier, “Handbook of Nondestructive Evaluation”, Mc Graw Hill, 2012.		
Louis Cartz, "Nondestructive Testing", ASM International, USA, 1995.		
Course Outcomes:		Blooms Taxonomy
CO1: Realize the importance of NDT in various engineering fields.		Apply(K3)
CO2: Basic knowledge of surface NDE techniques which enables to carry out various inspection in accordance with the established procedures.		Understand(K2)
CO3: Calibrate the instrument and inspect for in-service damage in the components by means of Eddy current testing as well as Thermography testing.		Understand(K2)
CO4: Differentiate various techniques of UT and AET and select appropriate NDT methods for better evaluation.		Understand(K2)
CO5: Interpret the results of Radiography testing and also have the ability to analyse the influence of various parameters on the testing.		Understand(K2)

CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	3	-	-	2	2	-	-	-	2	1	2	-
CO2	3	1	2	2	-	-	2	2	-	-	-	2	2	2	1
CO3	3	2	1	2	-	-	2	2	-	-	-	2	2	2	-
CO4	3	1	2	2	-	-	2	2	-	-	-	2	2	2	2
CO5	3	2	2	2	-	-	2	2	-	-	-	2	2	2	1
CO Avg.	2.8	1.6	1.8	2.2	-	-	2	2	-	-	-	2	1.8	2	1.3
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23MEO004	MECHATRONICS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: • Selecting sensors to develop mechatronics systems. • Explaining the architecture and timing diagram of microprocessor, and also interpret and develop programs. • Designing appropriate interfacing circuits to connect I/O devices with microprocessor. • Applying PLC as a controller in mechatronics system. • Designing and develop the apt mechatronics system for an application.					
Unit I	INTRODUCTION AND SENSORS				9
Introduction to Mechatronics – Systems – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and Dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance Sensors – Strain Gauges – Eddy Current Sensor – Hall Effect Sensor –Temperature Sensors – Light Sensors.					
Unit II	8085 MICROPROCESSORS				9
Introduction – Pin Configuration - Architecture of 8085 – Addressing Modes – Instruction set, Timing diagram of 8085.					
Unit III	PROGRAMMABLE PERIPHERAL INTERFACE				9

Introduction – Architecture of 8255, Keyboard Interfacing, LED display – Interfacing, ADC and DAC Interface, Temperature Control – Stepper Motor Control – Traffic Control Interface.		
Unit IV	PROGRAMMABLE LOGIC CONTROLLER	9
Introduction – Architecture – Input / Output Processing – Programming with Timers, Counters and Internal relays – Data Handling – Selection of PLC.		
Unit V	ACTUATORS AND MECHATRONICS SYSTEM DESIGN	9
Types of Stepper and Servo motors – Construction – Working Principle – Characteristics, Stages of Mechatronics Design Process – Comparison of Traditional and Mechatronics Design Concepts with Examples – Case studies of Mechatronics Systems – Pick and Place Robot – Engine Management system – Automatic Car Park Barrier.		
Total periods:45		
Text Books:		
1. Bolton W., “Mechatronics”, Pearson Education, 6th Edition, 2015.		
2. Ramesh S Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, Penram International Publishing Private Limited, 6th Edition, 2013.		
References:		
1. Bradley D.A., Dawson D., Buru N.C. and Loader A.J., “Mechatronics”, Chapman and Hall, 1993.		
2. Davis G. Alciatore and Michael B. Histan, “Introduction to Mechatronics and Measurement systems”, McGraw Hill Education, 2011.		
3. Devadas Shetty and Richard A. Kolk, “Mechatronics Systems Design”, Cengage Learning, 2010.		
4. Nitaigour Premchand Mahalik, “Mechatronics Principles, Concepts and Applications”, McGraw Hill Education, 2015.		
5. Smaili. A and Mrad. F, “Mechatronics Integrated Technologies for Intelligent Machines”, Oxford University Press, 2007.		
Course Outcomes:		Blooms Taxonomy
CO1: Select sensors to develop mechatronics systems.		Apply(K3)
CO2: Explain the architecture and timing diagram of microprocessor, and also interpret and develop programs.		Understand(K2)
CO3: Design appropriate interfacing circuits to connect I/O devices with microprocessor.		Apply(K3)

CO 4: Apply PLC as a controller in mechatronics system.													Understand(K2)		
CO 5: Design and develop the apt mechatronics system for an application.													Understand(K2)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	3	-	2	-	-	-	-	-	2	3	2	3
CO2	3	2	1	3	-	2	-	-	-	-	-	2	3	2	3
CO3	3	2	1	3	-	2	-	-	-	-	-	2	3	2	3
CO4	3	2	1	3	-	2	-	-	-	-	-	2	3	2	3
CO5	3	2	1	3	-	2	-	-	-	-	-	2	3	2	3
CO Avg.	3	2	1	3	-	2	-	-	-	-	-	2	3	2	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MEO005	FOUNDATION OF ROBOTICS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To study the kinematics, drive systems and programming of robots. - To study the basics of robot laws and transmission systems. - To familiarize students with the concepts and techniques of robot manipulator, its kinematics.					
Unit I	FUNDAMENTALS OF ROBOT				9
Robot – Definition – Robot Anatomy – Co-ordinate systems, Work Envelope, types and classification – specifications – Pitch, yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and their functions – Need for Robots – Different Applications.					
Unit II	ROBOT KINEMATICS				9
Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices.					
Unit III	ROBOT DRIVE SYSTEMS AND END EFFECTORS				9

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of All These Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic grippers, vacuum grippers, internal grippers and external grippers, selection and design considerations of a gripper		
Unit IV	SENSORS IN ROBOTICS	9
Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion, image storage, lighting techniques, image processing and analysis – data reduction, segmentation, feature extraction, object recognition, other algorithms, applications – Inspection, identification, visual serving and navigation.		
Unit V	PROGRAMMING AND APPLICATIONS OF ROBOT	9
Teach pendant programming, lead through programming, robot programming languages – VAL programming – Motion Commands, Sensors commands, End-Effector Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields.		
Total periods:45		
Text Books:		
1. Ganesh.S.Hedge, "A textbook of Industrial Robotics", Lakshmi Publications, 2006.		
2. Mikell.P.Groover , "Industrial Robotics – Technology, Programming and applications" McGraw Hill 2 ND edition 2012.		
References:		
1. Fu K.S. Gonalz R.C. and ice C.S.G."Robotics Control, Sensing, Vision and Intelligence", McGraw Hill book co. 2007.		
2. YoramKoren, "Robotics for Engineers", McGraw Hill Book, Co., 2002.		
3. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill 2005.		
4. John. J.Craig, "Introduction to Robotics: Mechanics and Control" 2nd Edition, 2002.		
5. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer India reprint, 2010.		
Course Outcomes:		Blooms Taxonomy
CO1: Interpret the features of robots and technology involved in the control.		Analyze(K4)
CO2: Apply the basic engineering knowledge and laws for the design of robotics.		Apply(K3)
CO3: Explain the basic concepts like various configurations, classification and parts of end effectors compare various end effectors and grippers and tools and		Understand(K2)

sensors used in robots.															
CO4: Explain the concept of kinematics, degeneracy, dexterity and trajectory planning.													Understand(K2)		
CO5: Demonstrate the image processing and image analysis techniques by machine vision system.													Understand(K2)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	-	-	-	1	-	-	3
CO2	3	2	1	1	-	-	-	-	-	-	-	1	-	-	3
CO3	3	2	1	1	-	-	-	-	-	-	-	1	-	-	3
CO4	3	2	1	1	-	-	-	-	-	-	-	1	-	-	3
CO5	3	2	1	1	-	-	-	-	-	-	-	1	-	-	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MEO006	FUNDAMENTALS OF AERONAUTICAL ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: • To acquire the knowledge on the Historical evaluation of Airplanes • To learn the different component systems and functions • To know the concepts of basic properties and principles behind the flight • To learn the basics of different structures & construction • To learn the various types of power plants used in aircrafts					
Unit I	HISTORY OF FLIGHT				8
Balloon flight-ornithopter-Early Airplanes by Wright Brothers, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years					
Unit II	AIRCRAFT CONFIGURATIONS AND ITS CONTROLS				10
Different types of flight vehicles, classifications-Components of an airplane and their functions- Conventional control, powered control- Basic instruments for flying-Typical systems for control actuation					
Unit III	BASICS OF AERODYNAMICS				9
Physical Properties and structures of the Atmosphere, Temperature, pressure and altitude relationships,					

Newton’s Law of Motions applied to Aeronautics-Evolution of lift, drag and moment. Aerofoils, Mach number, Maneuvers															
Unit IV		BASICS OF AIRCRAFT STRUCTURES												9	
General types of construction, Monocoque, semi-monocoque and geodesic constructions, typical wing and fuselage structure. Metallic and non-metallic materials. Use of Aluminium alloy, titanium, stainless steel and composite materials. Stresses and strains-Hooke’s law- stress-strain diagrams- elastic constants-Factor of Safety.															
Unit V		BASICS OF PROPULSION												9	
Basic ideas about piston, turboprop and jet engines – use of propeller and jets for thrust production- Comparative merits, Principle of operation of rocket, types of rocket and typical applications, Exploration into space.															
Total periods:45															
Text Books:															
1.Anderson, J.D., Introduction to Flight, McGraw-Hill; 8th edition , 2015															
2.Rathakrishnan, “Introduction to Aerospace Engineering: Basic Principles of Flight”, John Wiley, NJ, 2021															
3.Stephen.A. Brandt, Introduction to aeronautics: A design perspective, 2nd edition, AIAA Education Series, 2004.															
References:															
1.Sadhu Singh, “Internal Combustion Engines And Gas Turbine”-, Sskatararaia & Sons, 2015															
2.Kermode , “Flight Without Formulae”, -, Pitman; 4th Revised edition 1989															
Course Outcomes:													Blooms Taxonomy		
CO1:Illustrate the history of aircraft & developments over the years													Analyze(K4)		
CO2:Ability to identify the types & classifications of components and control systems													Analyze(K4)		
CO3:Explain the basic concepts of flight & Physical properties of Atmosphere													Understand(K2)		
CO4:Identify the types of fuselage and constructions.													Understand(K2)		
CO5:Distinguish the types of Engines and explain the principles of Rocket													Analyze(K4)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	-	-	-	-	-	-	-	-	2	-	-
CO2	2	2	2	1	2	-	-	-	-	-	-	-	2	-	-
CO3	2	2	1	1	-	-	-	-	-	-	-	-	2	-	-

CO4	2	2	2	2	1	-	-	-	-	-	-	-	2	-	-
CO5	3	2	2	2	2	-	-	-	-	-	-	-	3	-	-
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEO002	REMOTE SENSING CONCEPTS	Category: OEC			
		L	T	P	C
		3	0	0	3

Prerequisites**Course Objectives:**

- To introduce the concepts of remote sensing processes and its components.
- To expose the various remote sensing platforms and sensors and to introduce the elements of data interpretation

Unit I	REMOTE SENSING AND ELECTROMAGNETIC RADIATION	9

Definition – components of RS – History of Remote Sensing – Merits and demerits of data collation between conventional and remote sensing methods - Electromagnetic Spectrum – Radiation principles - Wave theory, Planck’s law, Wien’s Displacement Law, Stefan’s Boltzmann law, Kirchoff’s law – Radiation sources: active & passive - Radiation Quantities

Unit II	EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL	9

Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows - Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance – Spectroradiometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water – solid surface scattering in microwave region.

Unit III	ORBITS AND PLATFORMS	9

Motions of planets and satellites – Newton’s law of gravitation - Gravitational field and potential - Escape velocity - Kepler’s law of planetary motion - Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms - Ground based, Airborne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Lagrange Orbit.

Unit IV	SENSING TECHNIQUES	9

Classification of remote sensors – Resolution concept : spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors - High Resolution Sensors - LIDAR , UAV – Orbital and

sensor characteristics of live Indian earth observation satellites															
Unit V		DATA PRODUCTS AND INTERPRETATION												9	
Photographic and digital products – Types, levels and open source satellite data products – selection and procurement of data– Visual interpretation: basic elements and interpretation keys - Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification															
Total periods:45															
Text Books:															
1.Thomas M.Lillesand, Ralph W. Kiefer and Jonathan W. Chipman, Remote Sensing and Image interpretation, John Wiley and Sons, Inc, New York,2015.															
2.George Joseph and C Jeganathan, Fundamentals of Remote Sensing,Third Edition Universities Press (India) Private limited, Hyderabad, 2018															
References:															
1.Janza, F.Z., Blue H.M. and Johnson,J.E. Manual of Remote Sensing. Vol.1, AmericanSociety of Photogrametry, Virginia, USA, 2002.															
2.Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press, 1995															
3.Paul Curran P.J. Principles of Remote Sensing. Longman, RLBS, 1988.															
4.Introduction to Physics and Techniques of Remote Sensing , Charles Elachi and Jacob Van Zyl, 2006 Edition II, Wiley Publication.															
5.Basudeb Bhatta, Remote Sensing and GIS, Oxford University Press, 2011															
Course Outcomes: On completion of the course, the student is expected to													Blooms Taxonomy		
CO 1: Understand the concepts and laws related to remote sensing													Understand(K2)		
CO2:Understand the interaction of electromagnetic radiation with atmosphere and earth material													Understand(K2)		
CO3:Acquire knowledge about satellite orbits and different types of satellites													Understand(K2)		
CO4:Understand the different types of remote sensors													Understand(K2)		
CO5:Gain knowledge about the concepts of interpretation of satellite imagery													Understand(K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	-	-	-	-	-	-	-	-	2	-	-

CO2	2	1	1	1	-	-	-	-	-	-	-	-	2	-	-
CO3	2	1	2	1	-	-	-	-	-	-	-	-	2	-	-
CO4	2	1	2	1	-	-	-	-	-	-	-	-	2	-	-
CO5	2	1	2	1	-	-	-	-	-	-	-	-	2	-	-
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEO003	URBAN AGRICULTURE	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To introduce the students the principles of agricultural crop production and the production practices of crops in modern ways. - To delineate the role of agricultural engineers in relation to various crop production practices					
Unit I	INTRODUCTION				9
Benefits of urban agriculture- economic benefits, environmental benefits, social and cultural benefits, educational, skill-building and job training benefits, health, nutrition and food accessibility benefits.					
Unit II	VERTICAL FARMING				9
Vertical farming- types, green facade, living/green wall-modular green wall , vegetated mat wall- Structures and components for green wall system: plant selection, growing media, irrigation and plant nutrition: Design, light, benefits of vertical gardening. Roof garden and its types. Kitchen garden, hanging baskets: The house plants/ indoor plants					
Unit III	SOIL LESS CULTIVATION				9
Hydroponics, aeroponics, aquaponics: merits and limitations, costs and Challenges, backyard gardens- tactical gardens- street landscaping- forest gardening, greenhouses, urban beekeeping					
Unit IV	MODERN CONCEPTS				9
Growth of plants in vertical pipes in terraces and inside buildings, micro irrigation concepts suitable for roof top gardening, rain hose system, Green house, polyhouse and shade net system of crop production on roof tops					
Unit V	WASTE MANAGEMENT				9

Concept, scope and maintenance of waste management- recycle of organic waste, garden wastes- solid waste management-scope, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues, waste utilization															
TOTAL : 45 PERIODS															
Text Books:															
1.Martellozzo F and J S Landry. 2020. Urban Agriculture. Scitus Academics Llc.															
2.Rob Roggema. 2016. Sustainable Urban Agriculture and Food Planning. Routledge Taylor and Francis Group.															
3.Akrong M O. 2012. Urban Agriculture. LAP Lambert Academic Publishing.															
References:															
1.Agha Rokh A. 2008. Evaluation of ornamental flowers and fishes breeding in Bushehr urban wastewater using a pilot-scale aquaponic system. Water and Wastewater, 19 (65): 47–53.															
2.Agrawal M, Singh B, Rajput M, Marshall F and Bell J. N. B. 2003. Effect of air pollution on peri-urban agriculture: A case study. Environmental Pollution, 126 (3): 323–															
3. https://www.sciencedirect.com/science/article/pii/S0269749103002458#aep-section-id24 .															
4.Jac Smit and Joe Nasr. 1992. Urban agriculture for sustainable cities: using wastes and idle land and water bodies as resources. Environment and Urbanization, 4 (2):141-152.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Demonstrate the principles behind crop production and various parameters that influences the crop growth on roof tops													Understand(K2)		
CO2: Explain different methods of crop production on roof tops													Understand(K2)		
CO3: Explain nutrient and pest management for crop production on roof tops													Understand(K2)		
CO4: Illustrate crop water requirement and irrigation water management on roof tops													Analyze(K4)		
CO5: Explain the concept of waste management on roof tops.													Understand(K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	-	-	-	-	-	-	-	-	2	-	-
CO2	2	1	1	1	-	-	-	-	-	-	-	-	2	-	-
CO3	2	1	2	1	-	-	-	-	-	-	-	-	2	-	-
CO4	2	1	2	1	-	-	-	-	-	-	-	-	2	-	-
CO5	2	1	2	1	-	-	-	-	-	-	-	-	2	-	-
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEO004	DRINKING WATER SUPPLY AND TREATMENT	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: To equip the students with the principles and design of water treatment units and distribution system.					
Unit I	SOURCES OF WATER				9
Public water supply system – Planning, Objectives, Design period, Population forecasting; Water demand – Sources of water and their characteristics, Surface and Groundwater – Impounding Reservoir – Development and selection of source – Source Water quality – Characterization – Significance – Drinking Water quality standards					
Unit II	CONVEYANCE FROM THE SOURCE				9
Water supply – intake structures – Functions; Pipes and conduits for water – Pipe materials – Hydraulics of flow in pipes – Transmission main design – Laying, jointing and testing of pipes – appurtenances – Types and capacity of pumps – Selection of pumps and pipe materials.					
Unit III	WATER TREATMENT				9
Objectives – Unit operations and processes – Principles, functions, and design of water treatment plant units, aerators of flash mixers, Coagulation and flocculation — sand filters - Disinfection — Construction, Operation and Maintenance aspects.					
Unit IV	ADVANCED WATER TREATMENT				9
Water softening – Desalination- R.O. Plant – demineralization – Adsorption - Ion exchange– Membrane Systems - Iron and Manganese removal - Defluoridation - Construction and Operation and Maintenance aspects					
Unit V	WATER DISTRIBUTION AND SUPPLY				9
Requirements of water distribution – Components – Selection of pipe material – Service reservoirs - Functions – Network design – Economics - Computer applications – Appurtenances – Leak detection- Principles of design of water supply in buildings – House service connection – Fixtures and fittings, systems of plumbing and types of plumbing.					
Total periods:45					
Text Books:					

1.Garg. S.K., "Water Supply Engineering", Khanna Publishers, Delhi, September 2008.																
2.Punmia B.C, Arun K.Jain, Ashok K.Jain, “ Water supply Engineering” Lakshmi publication private limited, New Delhi, 2016.																
3.Rangwala "Water Supply and Sanitary Engineering", February 2022																
4.Birdie.G.S., "Water Supply and Sanitary Engineering", Dhanpat Rai and sons, 2018.																
References:																
1.Fair. G.M., Geyer.J.C., "Water Supply and Wastewater Disposal", John Wiley and Sons, 1954.																
2.Babbitt.H.E, and Donald.J.J, "Water Supply Engineering" , McGraw Hill book Co, 1984.																
3.Steel. E.W.et al., "Water Supply Engineering" , Mc Graw Hill International book Co, 1984.																
4.Duggal. K.N., “Elements of public Health Engineering”, S.Chand and Company Ltd, New Delhi, 1998.																
Course Outcomes:													Blooms Taxonomy			
CO 1: Understanding of water quality criteria and standards, and their relation to public health													Understand(K2)			
CO2: Ability to design the water conveyance system													Understand(K2)			
CO3: Ability to knowledge in various unit operations and processes in water treatment													Understand(K2)			
CO4: Ability to understand the various systems for advanced water treatment													Understand(K2)			
CO5: Insight into the structure of drinking water distribution system													Apply(K3)			
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	-	3	-	-	-	-	-	3	-	3	-	-	3	-	-	
CO2	-	3	-	2	-	2	-	-	-	3	-	-	3	-	-	
CO3	-	-	-	2	-	2	-	-	-	3	-	-	3	-	-	
CO4	-	-	3	2	-	-	-	3	2	3	-	-	3	-	-	
CO5	-	-	3	2	-	-	1	-	2	3	-	1	-	-	-	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation																

23EE0003	ELECTRIC VEHICLE TECHNOLOGY												Category: OEC			
													L	T	P	C

		3	0	0	3
Prerequisites					
Course Objectives: - To provide knowledge about electric machines and special machine - To understand the basics of power converters - To know the concepts of controlling DC and AC drive systems - To understand the architecture and power train components. - To impart knowledge on vehicle control for standard drive cycles of hybrid electrical vehicles (HEVs)					
Unit I	ROTATING POWER CONVERTERS				9
Magnetic circuits- DC machine and AC machine –Working principle of Generator and Motor-DC and AC - Voltage and torque equations — Characteristics and applications. Working principle of special machines like: Brushless DC motor, Switched reluctance motor and PMSM					
Unit II	STATIC POWER CONVERTERS				9
Working and Characteristics of Power Diodes, MOSFET and IGBT. Working of uncontrolled rectifiers, controlled rectifiers (Single phase and Three phase), DC choppers, single and three phase inverters, Multilevel inverters and Matrix Converters					
Unit III	CONTROL OF DC AND AC MOTOR DRIVES				9
Speed control for constant torque, constant HP operation of all electric motors - DC/DC chopper based four quadrant operation of DC motor drives, inverter based V/f Operation (motoring and braking) of induction motor drives, Transformation theory, vector control operation of Induction motor and PMSM, Brushless DC motor drives, Switched reluctance motor (SRM) drives					
Unit IV	HYBRID ELECTRIC VEHICLE ARCHITECTURE AND POWER TRAIN COMPONENTS				9
History of evolution of Electric Vehicles - Comparison of Electric Vehicles with Internal Combustion Engines - Architecture of Electric Vehicles (EV) and Hybrid Electric Vehicles (HEV) — Plug-in Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes					
Unit V	MECHANICS OF HYBRID ELECTRIC VEHICLES AND CONTROL OF VEHICLES				9
Fundamentals of vehicle mechanics - tractive force, power and energy requirements for standard drive cycles of HEV's - motor torque and power rating and battery capacity. HEV supervisory control - Selection of modes - power spilt mode - parallel mode - engine brake mode - regeneration mode - series parallel					
Total periods:45					

References:															
1. Stephen D. Umans, “Fitzgerald & Kingsley’s Electric Machinery”, Tata McGraw Hill, 7 th Edition, 2020.															
2. Bogdan M. Wilamowski, J. David Irwin, The Industrial Electronics Handbook, Second Edition, Power Electronics and Motor Drives, CRC Press, 2011															
3. Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven D. Pekarek “Analysis of Electric Machinery and Drive Systems”, 3 rd Edition, Wiley-IEEE Press, 2013.															
4. Rashid M.H., “Power Electronics Circuits, Devices and Applications ", Pearson, fourth Edition, 10 th Impression 2021															
5. Iqbal Husain, ‘Electric and Hybrid Electric Vehicles’, CRC Press, 2021															
6. Wei Liu, ‘Hybrid Electric Vehicle System Modeling and Control’, Second Edition, WILEY, 2017															
Course Outcomes:													Blooms Taxonomy		
CO 1: : Able to understand the principles of conventional and special electrical machines													Analyze(K4)		
CO2: Acquired the concepts of power devices and power converters.													Apply(K3)		
CO3: Able to understand the control for DC and AC drive systems													Understand(K2)		
CO4: Learned the electric vehicle architecture and power train components.													Apply(K3)		
CO5: Acquired the knowledge of mechanics of electric vehicles and control of electric vehicles													Apply(K3)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			3								3	3	3
CO2	3	2	2			3			3				3	3	3
CO3	3			3		2	2						3	3	3
CO4	3	2	2		3								3	3	3
CO5	3		2								2		3	3	3
CO Avg.	3	2	2	3	3	1	2		3		2		3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23EEO004	INTRODUCTION TO PLC PROGRAMMING	Category: OEC			
		L	T	P	C
		3	0	0	3

Prerequisites		
•		
Course Objectives:		
● Understand basic PLC terminologies digital principles, PLC architecture and operation. ● Familiarize different programming language of PLC. ● Develop PLC logic for simple applications using ladder logic. ● Understand the hardware and software behind PLC and SCADA. ● Exposures about communication architecture of PLC/SCADA.		
Unit I	INTRODUCTION TO PLC	9
Introduction to PLC: Microprocessor, I/O Ports, Isolation, Filters, Drivers, Microcontrollers/DSP, PLC/DDC- PLC Construction: What is a PLC, PLC Memories, PLC I/O, , PLC Special I/O, PLC Types		
Unit II	PLC INSTRUCTIONS	9
PLC Basic Instructions: PLC Ladder Language- Function block Programming- Ladder/Function Block functions- PLC Basic Instructions, Basic Examples (Start Stop Rung, Entry/Reset Rung)- Configuration of Sensors, Switches, Solid State Relays-Interlock examples- Timers, Counters, Examples		
Unit III	PLC PROGRAMMING	9
Different types of PLC program, Basic Ladder logic, logic functions, PLC module addressing, registers basics, basic relay instructions, Latching Relays, arithmetic functions, comparison functions, data handling, data move functions, timer-counter instructions, input-output instructions, sequencer instructions		
Unit IV	COMMUNICATION OF PLC AND SCADA	9
Communication Protocol – Modbus, HART, Profibus- Communication facilities SCADA: - Hardware and software, Remote terminal units, Master Station and Co mmunication architectures		
Unit V	CASE STUDIES	9
Stepper Motor Control- Elevator Control-CNC Machine Control- conveyor control-Interlocking Problems		
SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)		
1	Market survey of the recent PLCs and comparison of their features.	
2	Summarize the PLC standards	
3	Familiarization of any one programming language (Ladder diagram/ Sequential Function Chart/ Function Block Diagram/ Equivalent open source software)	
4	Market survey of Communication Network Used for PLC/SCADA.	
Total periods:45 Periods		

Text Books:															
1.Frank Petruzzula, Programmable Logic Controllers, Tata Mc-Graw Hill Edition															
2.John W. Webb, Ronald A. Reis, Programmable Logic Controllers Principles and Applications, PHI publication															
References:															
1.MadhuchanndMitra and SamerjitSengupta, Programmable Logic Controllers Industrial Automation an Introduction, Penram International Publishing Pvt. Ltd.															
2.J. R. Hackworth and F. D. Hackworth, Programmable Logic Controllers Principles andApplications, Pearson publication															
Course Outcomes:													Blooms Taxonomy		
CO 1: Know the basic requirement of a PLC input/output devices and architecture. (L1)													Understand(K2)		
CO2: Ability to apply Basics Instruction Sets used for ladder Logic and Function Block Programming.(L2)													Analyze(K4)		
CO3: Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block.(L3)													Apply(K3)		
CO4: Able to develop a PLC logic for a specific application on real world problem. (L5													Analyze(K4)		
CO5: Ability to Understand the Concepts of Communication used for PLC/SCADA.(L1)													Understand(K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	1	-	1	-	-	-	-	-
CO2	3	3	2	-	-	-	-	1	-	1	2	-	-	-	2
CO3	3	3	3	3	1	-	-	1	-	1	-	-	-	-	-
CO4	3	3	-	3	3	-	-	1	-	1	-	-	3	3	-
CO5	3	3	3	2	1	-	-	1	-	1	-	-	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CHO002	NANO TECHNOLOGY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Unit I	INTRODUCTION				9
General definition and size effects–important nano structured materials and nano particles- importance of nano materials- Size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nanomaterials- surface area - band gap energy and applications. Photochemistry and Electrochemistry of nanomaterials –Ionic properties of nanomaterials- Nano catalysis.					
Unit II	SYNTHESIS OF NANOMATERIALS				9
Bottom up and Top-down approach for obtaining nano materials - Precipitation methods – sol gel technique – high energy ball milling, CVD and PVD methods, gas phase condensation, magnetron sputtering and laser deposition methods – laser ablation, sputtering					
Unit III	NANO COMPOSITES				9
Definition- importance of nanocomposites- nano composite materials-classification of composites-metal/metal oxides, metal-polymer- thermoplastic based, thermoset based and elastomer based- influence of size, shape and role of interface in composites applications.					
Unit IV	NANO STRUCTURES AND CHARACTERIZATION TECHNIQUES				9
Classifications of nanomaterials - Zero dimensional, one-dimensional and two-dimensional nanostructures- Kinetics in nanostructured materials- multilayer thin films and superlattice- clusters of metals, semiconductors and nanocomposites. Spectroscopic techniques, Diffraction methods, thermal analysis method, BET analysis method					
Unit V	APPLICATIONS OF NANO MATERIALS				9
Overview of nanomaterials properties and their applications, nano painting, nano coating, nanomaterials for renewable energy, Molecular Electronics and Nanoelectronics – Nanobots- Biological Applications. Emerging technologies for environmental applications- Practice of nanoparticles for environmental remediation and water treatment.					
Total periods: 45					
Text Books:					
1.Mick Wilson, Kamali Kannangara,Geoff Smith, Michelle Simmom, Burkhard Raguse, “ Nano Technology: Basic Science & Engineering Technology”, 2005, Overseas Press					
2.G. Cao, “Nanostructures & Nanomaterials: Synthesis, Properties &Applications” Imperial College					

Press, 2004															
3.William A Goddard “Handbook of Nanoscience, Engineering and Technology”, 3 rd Edition, CRC Taylor and Francis group 2012															
References:															
1.R.H.J.Hannink & A.J.Hill, Nanostructure Control, Wood Head Publishing Ltd.,Cambridge, 2006.															
2.C.N.R.Rao, A.Muller, A.K.Cheetham, The Chemistry of Nanomaterials: Synthesis, Properties and Applications Vol. I & II, 2nd edition, 2005, Wiley VCH Verlag Gbtl & Co															
3.Ivor Brodie and Julius J.Muray,’The physics of Micro/Nano — Fabrication’,Springer International Edition,2010															
Course Outcomes:													Blooms Taxonomy		
CO 1: understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications.													Understand(K2)		
CO2: able to acquire knowledge about the different types of nano material synthesis													Understand(K2)		
CO3: describes about the shape, size,structure of composite nano materials and their interference													Understand(K2)		
CO4: understand the different characterization techniques for nanomaterials													Understand(K2)		
CO5: develop a deeper knowledge in the application of nanomaterials in different fields.													Analyze(K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	3	3	-	-	-	1	1	-	3	1	1	3
CO2	2	3	1	3	3	-	-	-	1	1	-	3	2	1	3
CO3	2	2	2	3	3	1	1	-	1	1	-	3	2	1	3
CO4	2	2	1	3	3	1	1	1	1	-	1	3	1	1	3
CO5	2	2	1	3	3	1	1	1	1	-	1	3	2	1	3
23MEO007	FUNCTIONAL MATERIALS											Category: OEC			
												L	T	P	C
												3	0	0	3
Prerequisites															

Course Objectives:		
● The course emphasis on the molecular self assembly and materials for polymer electronics		
Unit I	INTRODUCTION	9
Historical Perspectives, Lessons from the Nature, Engineering the Functions, Tuning the functions, Multiscale Modeling and Computation, Classification of Functional Materials, Functional Diversity of Materials, Hybrid Materials, Technological Relevance, Societal Impact		
Unit II	MOLECULAR SELF ASSEMBLY	9
Molecular Organization, Self-Assembly in Biology, Energetics of Self-Organization, A Few Case Studies, Synthetic Protocols and Challenges, Solvent-assisted Self-Assembly, Directed Assembly- Langmuir-Blodgett and Langmuir-Schaefer techniques, Technological Applications of SAMs.		
Unit III	BIO-INSPIRED MATERIALS	9
Bio-inspired materials, Classification, Biomimicry, Spider Silk, Lotus Leaf, Gecko feet, Synovial fluid, 'Bionics'-Bio-inspired Information Technologies, Artificial Sensory Organs, Biomineralization- En route to Nanotechnology		
Unit IV	SMART OR INTELLIGENT MATERIALS	9
Criteria for Smartness, Significance of Smart Materials, Representative Examples like Smart Gels and Polymers, Electro/Magneto Rheological Fluids, Smart Electroceramics, Technical Limitations and Challenges, Functional Nanocomposites, Polymer-carbon nanotube composites.		
Unit V	MATERIALS FOR POLYMER ELECTRONICS	9
Polymers for Electronics, Organic Light Emitting Diodes, Working Principle of OLEDs, Illustrated Examples, Organic Field-Effect Transistors Operating Principle, Design Considerations, Polymer FETs vs Inorganic FETs, Liquid Crystal Displays, Engineering Aspects of Flat Panel Displays, Intelligent Polymers for Data Storage, Polymer-based Data Storage-Principle, Magnetic Vs. Polymer-based Data Storage.		
Total periods:45		
Text Books:		
1.Vijayamohanan K. Pillai and MeeraParthasarathy, "Functional Materials: A chemist's perspective", Universities Press Hyderabad (2012)		
2. Functional Materials: A Chemist's Perspective by Vijayamohanan K. Pillai & Meera Parthasarathy (Universities Press, 2012)		
3. Nanotechnology: Principles and Practices by B.S. Murthy, R.S. Ramesh, & B. Raj		

References:															
1.Stephen Manne “Biomimetic Materials Chemistry” Wiley-VCH Newyork, 1966.															
2. Anomaterials: Synthesis, Properties, And Applications by K. S. Rajasekaran & K. R. Srivastava															
Course Outcomes:														Blooms Taxonomy	
CO 1: Students will be able to differentiate among various functional properties and select appropriate material for certain functional applications, analyze the nature and potential of functional material.														Analyze(K4)	
CO2: Explain molecular self-assembly processes in nature and synthetic systems.														Understand(K2)	
CO3: Analyze bio-inspired materials and their technological applications														Analyze (K4)	
CO4: Evaluate smart/intelligent materials for specific engineering applications														Evaluate(K5)	
CO5: Apply functional materials in polymer electronics, including OLEDs, FETs, and data storage devices.														Apply (K3)	
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	1	2	1	1	1	-	-	-	3	-	-	-
CO2	3	2	2	1	1	2	1	1	1	-	-	-	-	-	-
CO3	3	3	2	1	1	2	1	2	1	-	-	-	-	-	-
CO4	3	3	2	1	1	3	1	3	2	-	-	-	-	-	-
CO5	3	2	3	1	1	3	1	3	2	-	-	-	-	-	-

23BMO001	BIOMEDICAL INSTRUMENTATION	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives:					
● The course emphasis on the molecular safe assembly and materials for polymer electronics					
Unit I	ELECTRODE CONFIGURATIONS				9
Bio signals characteristics – Origin of bio potential and its propagation. Frequency and amplitude ranges. Electrode configurations: Electrode-electrolyte interface, electrode-skin interface impedance, polarization effects of electrode – non-polarizable electrodes. Unipolar and bipolar configuration, classification of electrodes					

Unit II	Biosignal Characteristics	9
Bio signals characteristics – ECG-frequency and amplitude ranges – Einthoven’s triangle, standard 12 lead system. EEG – EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. EMG – Electrode configuration -unipolar and bipolar mode.		
Unit III	Bioamplifiers	9
Need for bio-amplifier – Differential bio-amplifier – Single ended amplifier – Band pass filtering, isolation amplifiers – transformer and optical isolation – isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference		
Unit IV	Measurement Of Bio Signals	9
Temperature, respiration rate and pulse rate measurements. Blood Pressure – indirect methods: auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers – systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurements.		
Unit V	Biochemical Measurements	9
Biochemical sensors – pH, pO ₂ and pCO ₂ , Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors. Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer.		
Total periods:45		
Text Books:		
1. Leslie Cromwell, “Biomedical Instrumentation and measurement”, 2nd edition, Prentice hall of India, New Delhi, 2015		
2. John G. Webster, “Medical Instrumentation Application and Design”, 4th edition, Wiley India Pvt Ltd, New Delhi, 2015		
3. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi, 2003		
References:		
1. John Enderle, Susan Blanchard, Joseph Bronzino, “Introduction to Biomedical Engineering”, second edition, Academic Press, 2005		
2. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, Pearson Education, 2004		
Course Outcomes:		
		Blooms Taxonomy

CO 1: Students will be able to differentiate among various functional properties and select appropriate material for certain functional applications, analyze the nature and potential of functional material.													Analyze(K4)		
CO2: Explain molecular self-assembly processes in nature and synthetic systems.													Understand(K2)		
CO3: Analyze bio-inspired materials and their technological applications													Analyze (K4)		
CO4: Evaluate smart/intelligent materials for specific engineering applications													Evaluate(K5)		
CO5: Apply functional materials in polymer electronics, including FETs, ISFET													Apply (K3)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	1	2	1	1	1	-	-	-	3	-	-	-
CO2	3	2	2	1	1	2	1	1	1	-	-	-	-	-	-
CO3	3	3	2	1	1	2	1	2	1	-	-	-	-	-	-
CO4	3	3	2	1	1	3	1	3	2	-	-	-	-	-	-
CO5	3	2	3	1	1	3	1	3	2	-	-	-	-	-	-

23BTO001	TRADITIONAL INDIAN FOODS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: To help students acquire a sound knowledge on diversities of foods, food habits and patterns in India with focus on traditional foods					
Unit I	HISTORICAL AND CULTURAL PERSPECTIVES				9
Food production and accessibility - subsistence foraging, horticulture, agriculture and pastoralization, origin of agriculture, earliest crops grown. Food as source of physical sustenance, food as religious and					
Unit II	TRADITIONAL METHODS OF FOOD PROCESSING				9
Traditional methods of milling grains – rice, wheat and corn – equipments and processes as compared to modern methods. Equipments and processes for edible oil extraction, paneer, butter and ghee manufacture – comparison of traditional and modern methods. Energy costs, efficiency, yield, shelf life and nutrient content comparisons. Traditional methods of food preservation – sundrying, osmotic drying, brining, pickling and smoking.					

Unit III	TRADITIONAL FOOD PATTERNS	9
Typical breakfast, meal and snack foods of different regions of India. Regional foods that have gone Pan Indian / Global. Popular regional foods; Traditional fermented foods, pickles and preserves, beverages, snacks, desserts and sweets, street foods; IPR issues in traditional foods		
Unit IV	COMMERCIAL PRODUCTION OF TRADITIONAL FOODS	9
Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods – types marketed, turnover; role of SHGs, SMES industries, national and multinational companies; commercial production and packaging of traditional beverages such as tender coconut water, neera, lassi, buttermilk, dahi. Commercial production of intermediate foods – ginger and garlic pastes, tamarind pastes, masalas (spice mixes), idli and dosa batters.		
Unit V	HEALTH ASPECTS OF TRADITIONAL FOODS	9
Comparison of traditional foods with typical fast foods / junk foods – cost, food safety, nutrient composition, bioactive components; energy and environmental costs of traditional foods; traditional foods used for specific ailments / illnesses		
Total periods: 45		
Text Books:		
1. Sen, Colleen Taylor “Food Culture in India” Greenwood Press, 2005.		
2. Davidar, Ruth N. “Indian Food Science: A Health and Nutrition Guide to Traditional Recipes: East West Books, 2001		
References:		
1. Sen, Colleen Taylor , <i>Food Culture in India</i> , Greenwood Press, 2005.		
2. Davidar, Ruth N. , <i>Indian Food Science: A Health and Nutrition Guide to Traditional Recipes</i> , East West Books, 2001.		
Course Outcomes:	Blooms Taxonomy	
CO 1: To understand the historical and traditional perspective of foods and food habits	Understand(K2)	
CO2: To understand the wide diversity and common features of traditional Indian foods and meal patterns	Understand(K2)	
CO3: Understand traditional food processing methods and their comparison to modern methods.	Understand(K2)	
CO4: Learn about the commercial production of traditional foods and beverages.	Analyze(K4)	
CO5: Understand the health aspects and nutritional comparison of traditional foods vs. fast foods.	Understand(K2)	

CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	3	2	1	2	1	1	0	0	3	3	2
CO2	3	3	2	1	3	3	2	1	2	1	1	0	3	3	3
CO3	3	2	3	2	3	3	2	1	1	1	1	0	3	3	3
CO4	3	3	3	3	3	2	3	2	2	2	1	0	3	3	3
CO5	3	3	2	2	3	3	2	2	1	1	0	0	3	3	3

23BTO002	INTRODUCTION TO FOOD PROCESSING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - The course aims to introduce the students to the area of Food Processing. - This is necessary for effective understanding of a detailed study of food processing and technology subjects. - This course will enable students to appreciate the importance of food processing with respect to the producer, manufacturer and consumer.					
UNIT I	PROCESSING OF FOOD AND ITS IMPORTANCE				9
Source of food - plant, animal and microbial origin; different foods and groups of foods as raw materials for processing — cereals, pulses, grains, vegetables and fruits, milk and animal foods, sea weeds, algae, oil seeds & fats, sugars, tea, coffee, cocoa, spices and condiments, additives; need and significance of processing these foods.					
UNIT II	METHODS OF FOOD HANDLING AND STORAGE				9
Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods.					
UNIT III	LARGE-SCALE FOOD PROCESSING				12
Milling of grains and pulses; edible oil extraction; Pasteurisation of milk and yoghurt; canning and bottling of foods; drying — Traditional and modern methods of drying, Dehydration of fruits, vegetables, milk, animal products etc; preservation by use of acid, sugar and salt; Pickling and curing					

with microorganisms, use of salt, and microbial fermentation; frying, baking, extrusion cooking, snack foods.															
UNIT IV		FOOD WASTES IN VARIOUS PROCESSES											6		
Waste disposal-solid and liquid waste; rodent and insect control; use of pesticides; ETP; selecting and installing necessary equipment.															
UNIT V		FOOD HYGIENE											9		
Food related hazards — Biological hazards — physical hazards — microbiological considerations in foods. Food adulteration — definition, common food adulterants, contamination with toxic metals, pesticides and insecticides; Safety in food procurement, storage handling and preparation; Relationship of microbes to sanitation, Public health hazards due to contaminated water and food; Personnel hygiene; Training& Education for safe methods of handling and processing food; sterilization and disinfection of manufacturing plant; use of sanitizers, detergents, heat, chemicals, Cleaning of equipment and premises.															
Total periods:45															
Text Books:															
1.Karnal, Marcus and D.B. Lund “Physical Principles of Food Preservation”. Rutledge, 2003.															
2.VanGarde, S.J. and Woodburn. M “Food Preservation and Safety Principles and Practice”.Surbhi Publications, 2001.															
3.Sivasankar, B. “Food Processing & Preservation”, Prentice Hall of India, 2002.															
4.Khetarpaul, Neelam, “Food Processing and Preservation”, Daya Publications, 2005.															
References:															
1. Karnal, Marcus and D.B. Lund , <i>Physical Principles of Food Preservation</i> , Routledge, 2003.															
2. VanGarde, S.J. and Woodburn, M. , <i>Food Preservation and Safety Principles and Practice</i> , Surbhi Publications, 2001.															
Course Outcomes:													Blooms Taxonomy		
CO1:Understand the significance of food processing and raw materials for processing.													Understand(K2)		
CO2: Learn methods for handling, storing, and preserving food materials.													Analyze(K4)		
CO3: Gain knowledge of large-scale food processing techniques and methods.													Analyze(K4)		
CO4: Understand food waste management, including disposal and pest contro													Understand(K2)		
CO5: : Understand food hygiene, safety standards, and contamination prevention.													Understand(K2)		
CO - PO & PSO Mapping															
Particular	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO

	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	1	3	2	1	1	1	-	-	-	3	-	-
CO2	3	3	2	2	-	-	-	1	1	1	1	-	3	-	-
CO3	3	3	3	3	3	3	2	1	2	1	-	-	3	-	-
CO4	2	2	2	2	2	2	2	2	1	1	-	-	3	-	-
CO5	3	3	2	3	3	3	2	2	1	1	-	-	3	-	-
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23BTO003	IPR FOR PHARMA INDUSTRY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To provide the basic fundamental knowledge of different forms of Intellectual Property Rights in national and international level. - To provide the significance of the Intellectual Property Rights about the patents, copyrights, industrial design, plant and geographical indications. - This paper is to study significance of the amended patent act on pharma industry.					
UNIT I	INTRODUCTION- INTELLECTUAL PROPERTY RIGHTS				9
Introduction, Types of Intellectual Property Rights -patents, plant varieties protection, geographical indicators, copyright, trademark, trade secrets.					
UNIT II	PATENTS				9
Patents-Objective, Introduction, Requirement for patenting- Novelty, Inventive step (Non-obviousness) and industrial application (utility), Non-patentable inventions, rights of patent owner, assignment of patent rights, patent specification (provisional and complete), parts of complete specification, claims, procedure for obtaining patents, compulsory license.					
UNIT III	PLANT VARIETY-TRADITIONAL KNOWLEDGE – GEOGRAPHICAL INDICATIONS				9

Plant variety- Justification, criteria for protection of plant variety and protection in India. Traditional knowledge- Concept of traditional knowledge, protection of traditional knowledge under Intellectual Property frame works in national level and Traditional knowledge digital library (TKDL). Geographical Indications — Justification for protection, National and International position.		
UNIT IV	ENFORCEMENT AND PRACTICAL ASPECTS OF IPR	9
Introduction – civil remedies – injunction, damage, account of profit – criminal remedies – patent, trademark. Practical aspects – Introduction, benefits of licensing, licensing of basic types of IPR, licensing clauses of IPR. Case studies of patent infringement, compulsory licensing, simple patent license agreements.		
UNIT V	INTERNATIONAL BACKGROUND OF INTELLECTUAL PROPERTY	9
International Background of Intellectual Property- Paris Convention, Berne convention, World Trade Organization (WTO), World Intellectual Property Organization (WIPO), Trade Related Aspects of Intellectual Property Rights (TRIPS) and Patent Co-operation Treaty (PCT).		
Total periods:45		
Text Books:		
1.N. Nagpal, M. Arora, M.R.D. Usman, S. Rahar, “Intellectual Property Rights” Edu creation Publishing, New Delhi, 2017.		
2.The Patents Act, 1970 (Bare Act with Short Notes) (New Delhi: Universal Law Publishing Company Pvt. Ltd. 2012.		
3.B.S. Rao, P.V. Appaji, “Intellectual Property Rights in Pharmaceutical Industry: Theory and Practice”, 2015.		
References:		
1.Patents for Chemicals, Pharmaceuticals, & Biotechnology-Fundamentals of Global Law, Practice and Strategy. Philip W. Grubb, Oxford University Press, 2004.		
2.Basic Principles of patent law — Basics principles and acquisition of IPR. Ramakrishna T. CIPRA, NLSIU, Bangalore, 2005		
3.S. Lakshmana Prabu, TNK. Suriyaprakash, “Intellectual Property Rights”, 1st ed., In Tech open access, Croatia, 2017.		
Course Outcomes: The student will be able to		Blooms Taxonomy
CO1: Understand and differentiate the categories of intellectual property rights.		Understand(K2)
CO2: Describe about patents and procedure for obtaining patents.		Understand(K2)
CO3: Distinguish plant variety, traditional knowledge and geographical		Understand(K2)

indications under IPR.															
CO4: Provide the information about the different enforcements and practical aspects involved in protection of IPR.													Apply(K3)		
CO5: Understand the interrelationships between different Intellectual Property Rights on International Society.													Understand(K2)		
CO - PO & PSO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3		2	-	-	-	-	2	2	-	-	-	-	-
CO2	-	3	3	-	-	-	2	2	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-	2	2	-	-	-	1	-	-	-
CO4	-	-	-	-	2	-	3	3	-	2	2		-	-	-
CO5	-	3	-	-	-	-	3		-	2	-	1	-	-	-
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CHO003	BASICS OF TEXTILE FINISHING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: To enable the students to understand the basics and different types of finishes required for textile materials and machines used for finishing.					
UNIT I	RESIN FINISHING				9
Importance of finishing and its classification. Resin finishing: Mechanism of creasing, Types of Resins .Anti crease, wash and wear, durable press resin finishing. Study about eco friendly method of anti crease finishing.					
UNIT II	FLAME PROOF & WATERPROOF				9
Concept of Flame proof & flame retardancy. Flame retardant finishes for cotton, Concept of waterproof and water repellent Finishes, Durable & Semi durable and Temporary finishes, Concept of Antimicrobial finish.					
UNIT III	SOIL RELEASE AND ANTISTATIC FINISHES				9
Soil Release Finishing: Mechanism of soil retention & soil release. Anti pilling Finishing: chemical					

and mechanical methods to produce anti pilling. Concept of UV Protection finishes- Concept of antistatic finishes.															
UNIT IV		MECHANICAL FINISHES												9	
Mechanical finishing of textile materials - calendaring, compacting, Sanforising, Peach finishing. Object of Heat setting. Various methods of heat setting and mechanism of heat setting.															
UNIT V		STIFFENING AND SOFTENING												9	
Concept of stiffening and softening of textile materials. Mechanism in the weight reduction of PET.Concept of Micro encapsulation techniques in finishing process, Nano finish, Plasma Treatment and Bio finishing.															
Total periods:45															
Text Books:															
1.V.A.Shennai, "Technology of Finishing", Vol X, Sevak Publications, Mumbai															
2.Perkins, W.S., “Textile colouration and finishing”, Carolina Academic Press., U.K, ISBN: 0890898855.2004.															
References:															
1.Microencapsulation in finishing, Review of progress of Colouration, SDC, 2001 62															
2.Chakraborty, J.N, Fundamentals and Practices in colouration of Textiles, Woodhead Publishing India, 2009, ISBN-13:978-81-908001-4-3															
3.W. D. Schindler and P. J. Hauser "Chemical finishing of textiles", Woodhead Publishing Cambridge England,2004.															
Course Outcomes:														Blooms Taxonomy	
CO1: Basics of Resin Finishing Process.														Understand(K2)	
CO2: Concept of Flame proof & flame retardancy, waterproof and water repellent, Antimicrobial finishes.														Understand(K2)	
CO3: Concept of Soil Release, Anti Pilling, UV Protection and Antistatic finishes.														Understand(K2)	
CO4: Concept of Mechanical finishing.														Understand(K2)	
CO5: Basics of Micro encapsulation techniques, Nano finish, Plasma Treatment.														Understand(K2)	
CO - PO & PSO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	1	1	1	1	1	1	-	-	-	2	3	-	-
CO2	3	2	2	1	1	1	1	1	1	-	-	0	2	-	-

CO3	3	2	2	1	1	1	1	1	1	-	-	0	2	-	-
CO4	3	2	3	2	1	2	2	1	1	-	-	0	3	-	-
CO5	3	3	2	1	1	3	2	2	1	-	-	0	3	-	-
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CHO004	INDUSTRIAL ENGINEERING FOR GARMENT INDUSTRY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisite					
Course Objectives: To enable the students to learn about basics of industrial engineering and different tools of industrial engineering and its application in apparel industry					
Unit I	INTRODUCTION				9
Scope of industrial engineering in apparel Industry, role of industrial engineers. Productivity: Definition - Productivity, Productivity measures .Reduction of work content due to the product and process, Reduction of ineffective time due to the management, due to the worker. Causes for low productivity in apparel industry and measures for improvement.					
Unit II	WORK STUDY				9
Definition, Purpose, Basic procedure and techniques of work-study.Work environment — Lighting, Ventilation, Climatic condition on productivity. Temperature control, humidity control, noise control measures. Safety and ergonomics on work station and work environment Material Handling — Objectives, Classification and characteristics of material handling equipments, Specialized material handling equipments.					
Unit III	METHOD STUDY				9
Definition, Objectives, Procedure, Process charts and symbols. Various charts — Charts indicating process sequence: Outline process chart, flow process chart (man type, material type and equipment type); Charts using time scale — multiple activity chart. Diagrams indicating movement — flow diagram, string diagram, cycle graph, chrono cycle graph, travel chart MOTION STUDY:Principle of motion economy, Two handed process chart, micro motion analysis — therbligs, SIMO chart.					
Unit IV	WORK MEASUREMENT				9

Definition, purpose, procedure, equipments, techniques. Time study - Definition, basics of time study- equipments. Time study forms, Stop watch procedure. Predetermined motion time standards (PMTS). Time Study rating, calculation of standard time, Performance rating — relaxation and other allowances. Calculation of SAM for different garments, GSD.															
Unit V		WORK STUDY APPLICATION												9	
Application of work study techniques in cutting, stitching and packing in garment industry. Workaids in sewing, Pitch diagram, Line balancing, Capacity planning, scientific method of training.															
Total periods:45															
Text Books:															
1.George Kanwaty, “Introduction to Work Study “, ILO, Geneva, 1996, ISBN: 9221071081 ISBN-13: 9789221071082															
2.Enrick N. L., “Time study manual for Textile industry”, Wiley Eastern (P) Ltd., 1989, ISBN: 0898740444 ISBN-13: 9780898740448															
3.Khanna O. P., and Sarup A., “Industrial Engineering and Management”, Dhanpat Rai Publications, New Delhi, 2010, ISBN: 818992835X / ISBN: 978-8189928353															
References:															
1.Norberd Lloyd Enrick., “Industrial Engineering Manual for Textile Industry”, Wiley Eastern															
2.(P) Ltd., New Delhi, 1988, ISBN: 0882756311 ISBN-13: 9780882756318															
3.Chuter A. J., “Introduction to Clothing Production Management”, Wiley-Black well Science,															
4.U.S. A., 1995, ISBN: 0632039396 ISBN-13: 9780632039395															
Course Outcomes:													Blooms Taxonomy		
CO1: Fundamental concepts of industrial Engineering and productivity													Understand(K2)		
CO2: Method study													Understand(K2)		
CO3: Motion analysis													Analyze(K4)		
CO4: Work measurement and SAM													Understand(K2)		
CO5: Ergonomics and its application to garment industry.													Understand(K2)		
CO - PO & PSO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	3	3	2	1	1	2	2	1	2	2	1	1	-
CO2	1	2	3	3	2	1	1	2	2	1	2	2	1	1	-
CO3	1	2	3	3	2	1	1	2	2	1	2	2	1	1	-

CO4	1	2	3	3	2	1	1	2	2	1	3	2	1	1	-
CO5	1	2	3	3	2	1	2	2	2	1	3	2	1	1	-
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CHO004	BASICS OF TEXTILE MANUFACTURE	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: To enable the students to learn about the basics of fibre forming, yarn production, fabric formation, coloration of fabrics and garment manufacturing					
UNIT I	NATURAL FIBRES				9
Introduction: Definition of staple fibre, filament; Classification of natural and man-made fibres, essential and desirable properties of fibres. Production and cultivation of Natural Fibers: Cultivation of cotton, production of silk (sericulture), wool and jute — physical and chemical structure of these fibres..					
UNIT II	REGENERATED AND SYNTHETIC FIBRES				9
Production sequence of regenerated and modified cellulosic fibres: viscose rayon, Acetate Rayon, high wet modulus and high tenacity fibres; synthetic fibres — chemical structure, fibre forming polymers, production principles.					
UNIT III	BASICS OF SPINNING				9
Spinning — principle of yarn formation, sequence of machines for yarn production with short staple fibres and blends, principles of opening and cleaning machines; yarn numbering - calculations					
UNIT IV	BASICS OF WEAVING				9
Woven fabric — warp, weft, weaving, path of warp; looms — classification, handloom and its parts, powerloom, automatic looms, shuttleless looms, special type of looms; preparatory machines for weaving process and their objectives; basic weaving mechanism - primary, secondary and auxiliary mechanisms,					
UNIT V	BASICS OF KNITTING AND NONWOVEN				9
Knitting — classification, principle, types of fabrics; nonwoven process –classification, principle, types of fabrics.					
Total periods:45					
Text Books:					

1.Mishra S. P. , “A Text Book of Fibre Science and Technology”, New Age Publishers, 2000, ISBN: 8122412505															
2.Marks R., and Robinson. T.C., “Principles of Weaving”, The Textile Institute, Manchester, 1989, ISBN: 0 900739 258.															
3.Spencer D.J., “Knitting Technology”, III Ed., Textile Institute, Manchester, 2001, ISBN: 185573 333 1.															
References:															
1.Hornberer M., Eberle H., Kilgus R., Ring W. and Hermeling H., “Clothing Technology: From Fibre to Fabric”, Europa LehrmittelVerlag, 2008, ISBN: 3808562250 / ISBN: 978- 3808562253.															
2.Wynne A., “Motivate Series-Textiles”, Maxmillan Publications, London, 1997.															
3.Carr H. and Latham B., “The Technology of Clothing Manufacture” Backwell Science, U.K., 1994, ISBN: 0632037482 / ISBN:13: 9780632037483.Klein W., “The Rieter Manual of															
4.Spining, Vol.1”, Rieter Machine Works Ltd., Winterthur, 2014, ISBN 10 3-9523173-1-4 / ISBN 13 978-3-9523173-1-0.															
5.Klein W., “The Rieter Manual of Spinning, Vol.2”, Rieter Machine Works Ltd., Winterthur, 2014, ISBN 10 3-9523173-2-2 / ISBN 13 978-3-9523173-2-7.															
6.Klein W., “The Rieter Manual of Spinning, Vol.1-3”, Rieter Machine Works Ltd., Winterthur, 2014, ISBN 10 3-9523173-3-0 / ISBN 13 978-3-9523173-3-4.															
7.Talukdar. M.K., Sriramulu. P.K., and Ajgaonkar. D.B., “Weaving: Machines, Mechanisms, Management”, Mahajan Publishers, Ahmedabad, 1998, ISBN: 81-85401-16-0.															
8.Morton W. E., and Hearle J. W. S., “Physical Properties of Textile Fibres”, The Textile Institute, Washington D.C., 2008, ISBN 978-1-84569-220-95.															
Course Outcomes:													Blooms Taxonomy		
CO1: Classification of fibres and production of natural fibres													Understand(K2)		
CO2: Regenerated and synthetic fibres													Understand(K2)		
CO3: Yarn spinning													Understand(K2)		
CO4: Weaving													Understand(K2)		
CO5: Knitting and nonwoven													Understand(K2)		
CO - PO & PSO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-
CO2	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-

CO3	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-
CO4	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-
CO5	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23CHO006	INTRODUCTION TO PETROLEUM REFINING AND PETROCHEMICALS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: The course is aimed to Gain knowledge about petroleum refining process and production of petrochemical products.					
UNIT I	ORIGIN, FORMATION AND REFINING OF CRUDE OIL				9
Origin, Formation and Evaluation of Crude Oil. Testing of Petroleum Products. Refining of Petroleum - Atmospheric and Vacuum Distillation.					
UNIT II	CRACKING				9
Cracking, Thermal Cracking, Vis-breaking, Catalytic Cracking (FCC), Hydro Cracking, Coking and Air Blowing of Bitumen					
UNIT III	REFORMING AND HYDROTREATING				9
Catalytic Reforming of Petroleum Feed Stocks. Lube oil processing- Solvent Treatment Processes, Dewaxing, Clay Treatment and Hydrofining. Treatment Techniques: Removal of Sulphur Compounds in all Petroleum Fractions to improve performance.					
UNIT IV	INTRODUCTION TO PETROCHEMICALS				9
Petrochemicals - Cracking of Naphtha and Feed stock gas for the production of Ethylene, Propylene, Isobutylene and Butadiene. Production of Acetylene from Methane, and Extraction of Aromatics.					
UNIT V	PRODUCTION OF PETROCHEMICALS				9
Production of Petrochemicals like Dimethyl Terephthalate(DMT), Ethylene Glycol, Synthetic glycerine, Linear Alkyl Benzene (LAB), Acrylonitrile, Methyl Methacrylate (MMA), Vinyl Acetate Monomer, Phthalic Anhydride, Maleic Anhydride, Phenol, Acetone, Methanol, Formaldehyde, Acetaldehyde, Pentaerythritol and production of Carbon Black.					
Total periods:45					
Text Books:					

1.Nelson, W. L., “Petroleum Refinery Engineering”, 4th Edition., McGraw Hill, New York,1985.																
2.Wiseman. P., "Petrochemicals", UMIST Series in Science and Technology, John Wiley & Sons,1986.																
References:																
1.Bhaskara Rao, B. K., “Modern Petroleum Refining Processes”, 2nd Edition, Oxford and IBH Publishing Company, New Delhi, 1990.																
2.Bhaskara Rao, B. K. “A Text on Petrochemicals”, 1st Edition, Khanna Publishers																
Course Outcomes: On the completion of the course students are expected to													Blooms Taxonomy			
CO1: Understand the classification, composition and testing methods of crude petroleum and its products. Learn the mechanism of refining process.													Understand(K2)			
CO2: Understand the insights of primary treatment processes to produce the precursors.													Understand(K2)			
CO3: Study the secondary treatment processes cracking, vis-breaking and coking to produce more petroleum products.													Understand(K2)			
CO4: Appreciate the need of treatment techniques for the removal of sulphur and other impurities from petroleum products.													Analyze(K4)			
CO5: Understand the societal impact of petrochemicals and learn their manufacturing processes.													Understand(K2)			
CO - PO & PSO Mapping																
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	
CO1	3	2	3	2	2	2	2	1	1	1	0	0	3	3	2	
CO2	3	2	2	2	2	2	2	1	1	0	0	0	3	3	2	
CO3	3	2	3	2	2	2	2	1	1	1	0	0	3	3	2	
CO4	3	3	2	3	3	2	2	2	1	1	1	1	3	3	3	
CO5	3	2	2	2	2	1	1	1	1	0	1	0	3	2	2	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation																
23EEO005	ENERGY CONSERVATION AND MANAGEMENT												Category: OEC			
													L	T	P	C
													3	0	0	3
Prerequisites																

Course Objectives:		
At the end of the course, the student is expected to		
• understand and analyse the energy data of industries • carryout energy accounting and balancing • conduct energy audit and suggest methodologies for energy savings and • utilise the available resources in optimal ways		
UNIT I	INTRODUCTION	9
Energy - Power – Past & Present scenario of World; National Energy consumption Data – Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.		
UNIT II	ELECTRICAL SYSTEMS	9
Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.		
UNIT III	THERMAL SYSTEMS	9
Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution & Usage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories		
UNIT IV	ENERGY CONSERVATION IN MAJOR UTILITIES	9
Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems –Cooling Towers – D.G. sets		
UNIT V	ECONOMICS	9
Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept		
Total periods:45		
Text Books:		
1,Energy Manager Training Manual (4 Volumes) available at www.energymanagertraining.com . a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.		
References:		
1.Witte. L.C., P.S. Schmidt, D.R. Brown, “Industrial Energy Management and Utilisation” Hemisphere Publ, Washington, 1988.		

2.Callaghn, P.W. “Design and Management for Energy Conservation”, Pergamon Press, Oxford, 1981.															
3.Dryden. I.G.C., “The Efficient Use of Energy” Butterworths, London, 1982															
4.Turner. W.C., “Energy Management Hand book”, Wiley, New York, 1982.															
5.Murphy. W.R. and G. Mc KAY, “Energy Management”, Butterworths, London 1987															
Course Outcomes:													Blooms Taxonomy		
CO1: Remember the knowledge for Basic combustion and furnace design and selection of thermal and mechanical energy equipment.													Understand(K2)		
CO2: Study the Importance of Stoichiometry relations, Theoretical air required for complete combustion.													Understand(K2)		
CO3: Skills on combustion thermodynamics and kinetics.													Understand(K2)		
CO4: Studied different heat treatment furnace.													Understand(K2)		
CO5: Practical and theoretical knowledge burner design.													Apply(K3)		
CO - PO & PSO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	3	2	2	2	2	1	1	1	-	-	3	-	-
CO2	3	2	2	2	2	2	2	1	1	1	-	-	3	-	-
CO3	3	3	3	2	2	2	2	1	1	1	-	-	3	-	-
CO4	3	2	3	2	2	2	2	1	1	1	-	-	3	-	-
CO5	3	3	3	2	3	3	3	1	1	1	-	-	3	-	-
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CHO007	BASICS OF PLASTICS PROCESSING	Category: OEC			
		L	T	P	C
		3	0	0	3

Prerequisites		
Course Objectives: - Understand the fundamentals of plastics processing, such as the relationships between material structural properties and required processing parameters, and so on - To gain practical knowledge on the polymer selection and its processing - Understanding the major plastic material processing techniques (Extrusion, Injection molding, Compression and Transfer molding, Blow molding, Thermoforming and casting) - To understand suitable additives for plastics compounding - To Propose troubleshooting mechanisms for defects found in plastics products manufactured by various processing techniques		
UNIT I	INTRODUCTION TO PLASTICS PROCESSING	9
Introduction to plastic processing – Principles of plastic processing: processing of plastics vs. metals and ceramics. Factors influencing the efficiency of plastics processing: molecular weight, viscosity and rheology. Difference in approach for thermoplastic and thermoset processing. Additives for plastics compounding and processing: antioxidants, light stabilizers, UV stabilizers, lubricants, impact modifiers, flame retardants, antistatic agents, stabilizers and plasticizers. Compounding: plastic compounding techniques, plasticization, pelletization.		
UNIT II	EXTRUSION	9
Extrusion – Principles of extrusion. Features of extruder: barrel, screw, types of screws, drive mechanism, specifications, heating & cooling systems, types of extruders. Flow mechanism: process variables, die entry effects and exit instabilities. Die swell, Defects: melt fracture, shark skin, bambooning. Factors determining efficiency of an extruder. Extrusion of films: blown and cast films. Tube/pipe extrusion. Extrusion coating: wire & cable. Twin screw extruder and its applications. Applications of extrusion and new developments.		
UNIT III	INJECTION MOLDING	9
Injection molding – Principles and processing outline, machinery, accessories and functions, specifications, process variables, mould cycle. Types of clamping: hydraulic and toggle mechanisms. Start-up and shut down procedures-Cylinder nozzles- Press capacity projected area -Shot weight Basic theoretical concepts and their relationship to processing - Interaction of moulding process aspect effects in quoted variables. Basic mould types. Reciprocating vs. plunger type injection moulding. Thermoplastic vs. thermosetting injection moulding. Injection moulding vs. other plastic processing techniques. State-of-the art injection moulding techniques - Introduction to trouble shooting		
UNIT IV	COMPRESSION AND TRANSFER MOLDING	9

Compression moulding – Basic principles of compression and transfer moulding-Meaning of terms-Bulk factor and flow properties, moulding materials, process variables and process cycle, Inter relation between flow properties-Curing time-Mould temperature and Pressure requirements. Preforms and preheating- Techniques of preheating. Machines used-Types of compression mould- positive, semi-positive and flash. Common moulding faults and their correction- Finishing of mouldings. Transfer moulding: working principle, equipment, Press capacity-Integral moulds and auxiliary ram moulds, moulding cycle, moulding tolerances, pot transfer, plunger transfer and screw transfer moulding techniques, advantages over compression moulding		
UNIT V	BLOW MOLDING, THERMOFORMING AND CASTING	9
Blow moulding: principles and terminologies. Injection blow moulding. Extrusion blow moulding. Design guidelines for optimum product performance and appearance. Thermoforming: principle, vacuum forming, pressure forming mechanical forming. Casting: working principle, types and applications.		
Total periods:45		
Text Books:		
1. S. S. Schwart, S. H. Goodman , <i>Plastics Materials and Processes</i> , Van Nostrand Reinhold Company Inc. (1982).		
2. F. Hensen (Ed.) , <i>Plastic Extrusion Technology</i> , Hanser Gardner (1997).		
3. W. S. Allen and P. N. Baker , <i>Handbook of Plastic Technology, Volume-1: Plastic Processing Operations [Injection, Compression, Transfer, Blow Molding]</i> , CBS Publishers and Distributors (2004).		
References:		
1.S. S. Schwart, S. H. Goodman, <i>Plastics Materials and Processes</i> , Van Nostrad Reinhold Company Inc. (1982).		
2.F. Hensen (Ed.), <i>Plastic Extrusion Technology</i> , Hanser Gardner (1997).		
3.W. S. Allen and P. N. Baker, <i>Hand Book of Plastic Technology, Volume-1, Plastic Processing Operations [Injection, Compression, Transfer, Blow Molding]</i> , CBS Publishers and Distributors (2004).		
4.M. Chanda, S. K. Roy, <i>Plastic Technology handbook</i> , 4th Edn., CRC Press (2007).		
5.I. I. Rubin, <i>Injection Molding Theory & Practice</i> , Society of Plastic Engineers, Wiley (1973).		
6.D.V. Rosato, M. G. Rosato, <i>Injection Molding Hand Book</i> , Springer (2012).		
7.M. L. Berins (Ed.), <i>SPI Plastic Engineering Hand Book of Society of Plastic Industry Inc.</i> , Springer (2012).		
8.B. Strong, <i>Plastics: Material & Processing</i> , A, Pearson Prentice hall (2005).		

9.D.V Rosato, Blow Molding Hand Book, Carl Hanser Verlag GmbH & Co (2003).															
Course Outcomes:													Blooms Taxonomy		
CO1: Ability to find out the correlation between various processing techniques with product properties.													Understand(K2)		
CO2: Understand the major plastics processing techniques used in moulding (injection, blow, compression, and transfer), extrusion, thermoforming, and casting.													Understand(K2)		
CO3: Acquire knowledge on additives for plastic compounding and methods employed for the same													Understand(K2)		
CO4: Familiarize with the machinery and ancillary equipment associated with various plastic processing techniques.													Understand(K2)		
CO5: Select an appropriate processing technique for the production of a plastic product													Understand(K2)		
CO - PO & PSO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	3	2	2	1	1	1	-	-	3	3	-
CO2	3	3	3	3	3	2	2	1	1	1	-	-	3	3	-
CO3	2	2	3	2	2	2	1	1	1	1	-	-	3	3	-
CO4	3	2	3	3	3	3	2	2	1	1	-	-	3	3	-
CO5	3	3	3	3	3	3	2	1	1	1	-	-	3	3	-
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23ECO003	SIGNALS AND SYSTEMS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					

Course Objectives:		
- To understand the basic properties of signal & systems - To know the methods of characterization of LTI systems in time domain - To analyze continuous time signals and system in the Fourier and Laplace domain - To analyze discrete time signals and system in the Fourier and Z transform domain		
UNIT I	CLASSIFICATION OF SIGNALS AND SYSTEMS	9
Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids_Classification of signals — Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - Classification of systems- CT systems and DT systems- — Linear & Nonlinear, Time- variant& Time-invariant,Causal & Non-causal, Stable & Unstable.		
UNIT II	ANALYSIS OF CONTINUOUS TIME SIGNALS	9
Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and Properties		
UNIT III	LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS	9
Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel.		
UNIT IV	ANALYSIS OF DISCRETE TIME SIGNALS	9
Baseband signal Sampling–Fourier Transform of discrete time signals (DTFT)– Properties of DTFT - Z Transform & Properties		
UNIT V	LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS	9
Impulse response–Difference equations-Convolution sum- Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel.		
Total periods:		
Text Books:		
1.Oppenheim, Willsky and Hamid, “Signals and Systems”, 2nd Edition, Pearson Education, New Delhi, 2015.(Units I - V)		
2.Simon Haykin, Barry Van Veen, “Signals and Systems”, 2nd Edition, Wiley, 2002.		
References:		
1.B. P. Lathi, “Principles of Linear Systems and Signals”, 2 nd Edition, Oxford, 2009.		
2.M. J. Roberts, “Signals and Systems Analysis using Transform methods and MATLAB”, McGraw- Hill Education, 2018.		
3.John Alan Stuller, “An Introduction to Signals and Systems”, Thomson, 2007.		

Course Outcomes: At the end of the course, the student will be able to													Blooms Taxonomy		
CO1: determine if a given system is linear/causal/stable													Understand(K2)		
CO2: determine the frequency components present in a deterministic signal													Understand(K2)		
CO3: characterize continuous LTI systems in the time domain and frequency domain													Understand(K2)		
CO4: characterize discrete LTI systems in the time domain and frequency domain													Understand(K2)		
CO5: compute the output of an LTI system in the time and frequency domains													Understand(K2)		
CO - PO & PSO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	3	-	3	2	-	-	-	-	-	3	-	-	1
CO2	3	-	3	-	-	2	-	-	-	-	-	3	-	3	-
CO3	3	3	-	-	3	2	-	-	-	-	-	3	2	-	-
CO4	3	3	-	-	3	2	-	-	-	-	-	3	-	3	1
CO5	3	3	-	3	3	2	-	-	-	-	-	3	-	3	1
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23ECO004	FUNDAMENTALS OF ELECTRONIC DEVICES AND CIRCUITS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To give a comprehensive exposure to all types of devices and circuits constructed with discrete components. This helps to develop a strong basis for building linear and digital integrated circuits - To analyze the frequency response of small signal amplifiers - To design and analyze single stage and multistage amplifier circuits - To study about feedback amplifiers and oscillators principles - To understand the analysis and design of multi vibrators					
UNIT I	SEMICONDUCTOR DEVICES				9

PN junction diode, Zener diode, BJT, MOSFET, UJT –structure, operation and V-I characteristics, Rectifiers – Half Wave and Full Wave Rectifier, Zener as regulator		
UNIT II	AMPLIFIERS	9
Load line, operating point, biasing methods for BJT and MOSFET, BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response –Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.		
UNIT III	MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER	9
Cascode amplifier, Differential amplifier – Common mode and Difference mode analysis – Tuned amplifiers – Gain and frequency response – Neutralization methods.		
UNIT IV	FEEDBACK AMPLIFIERS AND OSCILLATORS	9
Advantages of negative feedback – Analysis of Voltage / Current, Series , Shunt feedback Amplifiers – positive feedback–Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.		
UNIT V	POWER AMPLIFIERS AND DC/DC CONVERTERS	9
Power amplifiers- class A-Class B-Class AB-Class C-Temperature Effect- Class AB Power amplifier using MOSFET –DC/DC convertors – Buck, Boost, Buck-Boost analysis and design.		
Total periods:		
Text Books:		
1.David A. Bell, "Electronic Devices and Circuits", Oxford Higher Education press, 5 th Edition, 2010.		
2.Robert L. Boylestad and Louis Nasheresky, “Electronic Devices and Circuit Theory”, 10th Edition, Pearson Education / PHI, 2008.		
3.Adel .S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", Oxford University Press, 7 th Edition, 2014.		
References:		
1. Donald.A. Neamen, "Electronic Circuit Analysis and Design", Tata McGraw Hill, 3 rd Edition, 2010.		
2.D.Schilling and C.Belove, "Electronic Circuits", McGraw Hill, 3 rd Edition, 1989		
3.Muhammad H.Rashid, "Power Electronics", Pearson Education / PHI , 2004.		
Course Outcomes: At the end of the course the students will be able to		Blooms Taxonomy
CO1: Explain the structure and working operation of basic electronic devices.		Understand(K2)
CO2: Design and analyze amplifiers.		Apply(K3)
CO3: Analyze frequency response of BJT and MOSFET amplifiers		Understand(K2)

CO4: Design and analyze feedback amplifiers and oscillator principles.													Analyze(K4)		
CO5: Design and analyze power amplifiers and supply circuits.													Analyze(K4)		
CO - PO & PSO Mapping													Analyze(K4)		
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	2	1	-	-	-	-	-	1	2	1	1
CO2	3	2	2	3	2	2	-	-	-	-	-	1	2	1	1
CO3	3	3	3	2	1	2	-	-	-	-	-	1	2	1	1
CO4	3	3	2	3	2	2	-	-	-	-	-	1	2	1	1
CO5	3	2	3	2	2	1	-	-	-	-	-	1	2	1	1
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MEO008	FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: • To understand the global trends and development methodologies of various types of products and services • To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems • To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification					
Unit I	BASICS OF PRODUCT DEVELOPMENT				9
Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends - Introduction to Product Development Methodologies and Management - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle – Product Development Planning and Management.					
Unit II	REQUIREMENTS AND SYSTEM DESIGN				9

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - System Design & Modeling - Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.		
Unit III	DESIGN AND TESTING	9
Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – Challenges in Integration of Engineering Disciplines - Concept Screening & Evaluation - Detailed Design - Component Design and Verification – Mechanical, Electronics and Software Subsystems - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – Prototyping - Introduction to Rapid Prototyping and Rapid Manufacturing - System Integration, Testing, Certification and Documentation		
Unit IV	SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT	9
Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - Sustenance -Maintenance and Repair – Enhancements - Product EoL - Obsolescence Management – Configuration Management - EoL Disposal		
Unit V	BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY	9
The Industry - Engineering Services Industry - Product Development in Industry versus Academia –The IPD Essentials - Introduction to Vertical Specific Product Development processes - Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.		
Total periods: 45 PERIODS		
Text Books:		
1. Book specially prepared by NASSCOM as per the MoU.		
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.		
References:		
1. Hiriappa B, “Corporate Strategy – Managing the Business”, Author House, 2013.		
2. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2004.		
3. Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning – Concepts”, Second Edition, Prentice Hall, 2003.		
3. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013		

Course Outcomes:													Blooms Taxonomy		
CO 1: Define, formulate, and analyze a problem													Understand(K2)		
CO2: Solve specific problems independently or as part of a team													Apply(K3)		
CO3: Gain knowledge of the Innovation & Product Development process in the Business Context													Analyze(K4)		
CO4: Work independently as well as in teams													Understand(K2)		
CO5: Manage a project from start to finish.													Understand(K2)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	-	-	-	-	-	1	-	1	-	-	-
CO2	3	2	3	1	-	-	-	-	-	1	-	1	-	-	-
CO3	3	2	3	1	1	-	-	1	1	1	-	1	-	-	-
CO4	3	2	3	1	1	-	-	1	1	1	-	1	-	-	-
CO5	3	2	3	1	1	-	-	1	1	1	-	1	-	-	-
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23BMO002	ASSISTIVE TECHNOLOGY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To know the hardware requirement various assistive devices - To understand the prosthetic and orthotic devices - To know the developments in assistive technology					
Unit I	CARDIAC ASSIST DEVICES				9
Cardiac functions and parameters, principle of External counter pulsation techniques, intra aortic balloon pump, Auxillary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves, cardiac pacemaker.					
Unit II	HEMODIALYSERS				9

Physiology of kidney, Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyser monitoring and functional parameters.		
Unit III	HEARING AIDS	9
Anatomy of ear, Common tests — audiograms, air conduction, bone conduction, masking techniques, SISI, Hearing aids — principles, drawbacks in the conventional unit, DSP based hearing aids		
Unit IV	PROSTHETIC AND ORTHODIC DEVICES	9
Hand and arm replacement — different types of models, externally powered limb prosthesis, feedback in orthotic system, functional electrical stimulation, sensory assist devices		
Unit V	RECENT TRENDS	9
Transcutaneous electrical nerve stimulator, bio-feedback, assistive devices in drug delivery		
Total periods: 45 PERIODS		
Text Books:		
1. Joseph D. Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press, 2006		
2. Marion. A. Hersh, Michael A. Johnson, Assistive Technology for visually impaired and blind, Springer Science & Business Media, 1st edition, 12-May-2010		
3. Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino, Clinical Engineering, CRC Press, 1st edition, 2010.		
References:		
1. Kenneth J. Turner Advances in Home Care Technologies: Results of the match Project, Springer, 1st edition, 2011.		
2. Gerr M. Craddock Assistive Technology-Shaping the future, IOS Press, 1st edition, 2003.		
3. 3D Printing in Orthopaedic Surgery, Matthew Dipaola, Elsevier 2019 ISBN 978-0-323-662116		
4. Cardiac Assist Devices, Daniel Goldstein (Editor), Mehmet Oz (Editor), Wiley-Blackwell April 2000 ISBN: 978-0-879-93449-1.		
Course Outcomes:		Blooms Taxonomy
CO 1: Interpret the various mechanical techniques that will help in assisting the heart functions.		Understand(K2)
CO2: Describe the underlying principles of hemodialyzer machine.		Understand(K2)
CO3: Indicate the methodologies to assess the hearing loss.		Understand(K2)
CO4: Evaluate the types of assistive devices for mobilization.		Understand(K2)
CO5: Explain about TENS and biofeedback system.		Understand(K2)

CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	-	-	-	-	-	-	-	-	-	-
CO2	3	1	1	1	1	-	-	-	-	-	-	-	-	-	-
CO3	3	1	1	1	1	-	-	-	-	-	-	-	-	-	-
CO4	3	1	1	1	1	-	-	-	-	-	-	-	-	-	-
CO5	3	1	1	1	1	-	-	-	-	-	-	-	-	-	-
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23MAO001	OPERATIONS RESEARCH	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: • Determine the optimum solution for linear programming problems. • Study the Transportation and assignment models and various techniques to solve them. • Acquire the knowledge of optimality, formulation and computation of integer programming problems.					
Unit I	LINEAR PROGRAMMING				9
Formulation of linear programming models – Graphical solution – Simplex method - Big M Method – Two phase simplex method - Duality - Dual simplex method.					
Unit II	TRANSPORTATION AND ASSIGNMENT PROBLEMS				9
Matrix form of Transportation problems – Loops in T.P – Initial basic feasible solution – Transportation algorithm – Assignment problem – Unbalanced assignment problems .					
Unit III	INTEGER PROGRAMMING				9
Introduction – All and mixed I.P.P – Gomory’s method – Cutting plane algorithm – Branch and bound algorithm – Zero – one programming.					
Unit IV	DYNAMIC PROGRAMMING PROBLEMS				9
Recursive nature of computation – Forward and backward recursion – Resource Allocation model – Cargo – loading model – Work – force size model - Investment model – Solution of L.P.P by dynamic programming .					

Unit V	NON - LINEAR PROGRAMMING PROBLEMS												9		
Lagrange multipliers – Equality constraints – Inequality constraints – Kuhn – Tucker Conditions – Quadratic programming.															
Total periods: 45 PERIODS															
Text Books:															
1. Kanti Swarup, P.K.Gupta and Man Mohan, " Operations Research " , Sultan Chand & Sons, New Delhi, Fifth Edition , 1990.															
2. Taha. H.A, " Operations Research — An Introduction , Pearson Education, Ninth Edition , New Delhi, 2012.															
References:															
1. J.K.Sharma , " Operations Research - Theory and Applications " Mac Millan India Ltd , Second Edition , New Delhi , 2003.															
2. Richard Bronson & Govindasami Naadimuthu , " Operations Research " (Schaum's Outlines — TMH Edition) Tata McGraw Hill, Second Edition, New Delhi, 2004.															
3. Pradeep Prabhakar Pai , " Operations Research and Practice", Oxford University Press, New Delhi , 2012.															
4. J.P.Singh and N.P.Singh , " Operations Research , Ane Books Pvt.Ltd, New Delhi , 2014.															
5. F.S.Hillier and G.J. Lieberman, " Introduction to Operations Research " , Tata McGraw Hill, Eighth Edition , New Delhi, 2005.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Could develop a fundamental understanding of linear programming models, able to develop a linear programming model from problem description, apply the simplex method for solving linear programming problems.													Understand(K2)		
CO2: analyze the concept of developing, formulating, modeling and solving transportation and assignment problems.													Understand(K2)		
CO3: solve the integer programming problems using various methods													Analyze(K4)		
CO4: conceptualize the principle of optimality and sub-optimization, formulation and computational procedure of dynamic programming.													Apply(K3)		
CO5: determine the optimum solution for non linear programming problems.													Understand(K2)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	0	0	0	0	0	0	2	0	0	2	-	-	-
CO2	3	3	3	2	0	0	0	0	2	0	0	2	-	-	-

CO3	3	3	0	0	0	0	0	0	2	0	0	2	-	-	-
CO4	3	3	0	0	0	0	0	0	2	0	0	2	-	-	-
CO5	3	3	2	2	0	0	0	0	2	0	0	2	-	-	-
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MAO002	ALGEBRA AND NUMBER THEORY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To introduce the basic notions of groups, rings, fields which will then be used to solve related problems. - To examine the key questions in the Theory of Numbers. - To give an integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject.					
Unit I	GROUPS AND RINGS				9
Groups: Definition - Properties - Homomorphism - Isomorphism - Cyclic groups - Cosets - Lagrange's theorem. Rings: Definition - Sub rings - Integral domain - Field - Integer modulo n - Ring homomorphism					
Unit II	FINITE FIELDS AND POLYNOMIALS				9
Rings - Polynomial rings - Irreducible polynomials over finite fields - Factorization of polynomials over finite fields.					
Unit III	DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS				9
Division algorithm- Base-b representations – Number patterns – Prime and composite numbers – GCD – Euclidean algorithm – Fundamental theorem of arithmetic – LCM.					
Unit IV	DIOPHANTINE EQUATIONS AND CONGRUENCES				9
Linear Diophantine equations – Congruence’s – Linear Congruence’s - Applications : Divisibility tests - Modular exponentiation - Chinese remainder theorem – 2x2 linear systems.					
Unit V	CLASSICAL THEOREMS AND MULTIPLICATIVE FUNCTIONS				9
Wilson’s theorem – Fermat’s Little theorem – Euler’s theorem – Euler’s Phi functions – Tau and Sigma functions.					
Total periods:45 PERIODS					

Text Books:															
1. Grimaldi, R.P and Ramana, B.V., "Discrete and Combinatorial Mathematics", Pearson Education, 5 th Edition, New Delhi, 2007.															
2. Thomas Koshy, "Elementary Number Theory with Applications", Elsevier Publications, New Delhi, 2002.															
References:															
1. San Ling and Chaoping Xing, "Coding Theory — A first Course", Cambridge Publications, Cambridge, 2004															
2. Niven.I, Zuckerman.H.S., and Montgomery, H.L., "An Introduction to Theory of Numbers", John Wiley and Sons, Singapore, 2004.															
3. Lidl.R., and Pitz. G, "Applied Abstract Algebra", Springer Verlag, New Delhi, 2 nd Edition, 2006.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts													Understand(K2)		
CO2: Demonstrate accurate and efficient use of advanced algebraic techniques.													Analyze(K4)		
CO3: The students should be able to demonstrate their mastery by solving non-trivial problems related to the concepts, and by proving simple theorems about the, statements proven by the text													Understand(K2)		
CO4: Apply Diophantine Equations and Modular Arithmetic													Apply(K3)		
CO5: Master Classical Theorems and Functions in Number Theory.													Understand(K2)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	-	-	-	2	1	-	1	2	2	-	-	-
CO2	3	3	1	1	3	1	2	1	1	1	2	2	-	-	-
CO3	3	3	2	1	3	1	3	1	1	1	2	3	-	-	-
CO4	3	3	2	2	3	2	2	1	1	1	2	3	-	-	-
CO5	2	2	1	-	3	1	2	1	1	1	3	3	-	-	-
1 - Low, 2 - Medium, 3 - High, '-' - No correlation															

23MAO003	LINEAR ALGEBRA	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To test the consistency and solve system of linear equations. - To find the basis and dimension of vector space. - To obtain the matrix of linear transformation and its eigenvalues and eigenvectors. - To find orthonormal basis of inner product space and find least square approximation. - To find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.					
Unit I	MATRICES AND SYSTEM OF LINEAR EQUATIONS				9
Matrices - Row echelon form - Rank - System of linear equations - Consistency - Gauss elimination method - Gauss Jordan method.					
Unit II	VECTOR SPACES				9
Vector spaces over Real and Complex fields - Subspace – Linear space - Linear independence and dependence - Basis and dimension.					
Unit III	LINEAR TRANSFORMATION				9
Linear transformation - Rank space and null space - Rank and nullity - Dimension theorem– Matrix representation of linear transformation - Eigenvalues and eigenvectors of linear transformation – Diagonalization.					
Unit IV	INNER PRODUCT SPACES				9
Inner product and norms - Properties - Orthogonal, Orthonormal vectors - Gram Schmidt orthonormalization process - Least square approximation.					
Unit V	EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION				9
Eigen value Problems : Power method, Jacobi rotation method - Singular value decomposition – QR decomposition.					
Total periods: 45					
Text Books:					
1. Faires J.D. and Burden R., Numerical Methods, Brooks/Cole (Thomson Publications), New Delhi,					

2002.															
2. Friedberg A.H, Insel A.J. and Spence L, Linear Algebra, Pearson Education, 5 th Edition, 2019.															
References:															
1. Bernard Kolman, David R. Hill, Introductory Linear Algebra, Pearson Educations, New Delhi, 8 th Edition, 2009.															
2. Gerald C.F. and Wheatley P.O, Applied Numerical Analysis, Pearson Educations, New Delhi, 7 th Edition, 2007.															
3. Kumareshan S, Linear Algebra - A geometric approach, Prentice Hall of India, New Delhi Reprint, 2010.															
4. Richard Branson, Matrix Operations, Schaum's outline series, 1989.															
5. Strang G, Linear Algebra and its applications, Thomson (Brooks / Cole) New Delhi, 4 th Edition, 2005.															
6. Sundarapandian V, Numerical Linear Algebra, Prentice Hall of India, New Delhi, 2014.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Test the consistency and solve system of linear equations.													Understand(K2)		
CO2: Find the basis and dimension of vector space.													Understand(K2)		
CO3: Obtain the matrix of linear transformation and its eigenvalues and eigenvectors.													Understand(K2)		
CO4: Find orthonormal basis of inner product space and find least square approximation.													Understand(K2)		
CO5: Find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.													Analyze(K4)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	2	1	1	1	1	3	-	-	-
CO2	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
CO3	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
CO4	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
CO5	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

OPEN ELECTIVE – IV

23HSO002	PROJECT REPORT WRITING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic English grammar knowledge • Fundamental writing skills (paragraph writing, coherence, cohesion) • Understanding of general communication skills					
Course Objectives: • Understand the essentials of project writing. • Perceive the difference between general writing and technical writing • Assimilate the fundamental features of report writing. • Understand the essential differences that exist between general and technical writing. • Learn the structure of a technical and project report.					
Unit I					9
Writing Skills – Essential Grammar and Vocabulary – Passive Voice, Reported Speech, Concord, Signpost words, Cohesive Devices – Paragraph writing - Technical Writing vs. General Writing.					
Unit II					9
Project Report – Definition, Structure, Types of Reports, Purpose – Intended Audience – Plagiarism – Report Writing in STEM fields – Experiment – Statistical Analysis.					
Unit III					9
Structure of the Project Report: (Part 1) Framing a Title – Content – Acknowledgement – Funding Details - Abstract – Introduction – Aim of the Study – Background - Writing the research question - Need of the Study/Project Significance, Relevance – Determining the feasibility – Theoretical Framework.					
Unit IV					9
Structure of the Project Report: (Part 2) – Literature Review, Research Design, Methods of Data Collection - Tools and Procedures - Data Analysis - Interpretation - Findings –Limitations -Recommendations – Conclusion – Bibliography.					
Unit V					9

Proof reading a report – Avoiding Typographical Errors – Bibliography in required Format – Font – Spacing – Checking Tables and Illustrations – Presenting a Report Orally – Techniques.															
Total Periods :45 PERIODS															
Text Books:															
1. Gerson, S. J., & Gerson, S. M. Technical Communication: Process and Product, 7th Edition, Prentice Hall, 2012.															
2. Riordan, Daniel. Technical Report Writing Today, Cengage Learning, 1998.															
References:															
1. Gerson and Gerson - Technical Communication: Process and Product, 7th Edition, Prentice Hall(2012)															
2. Virendra K. Pamecha - Guide to Project Reports, Project Appraisals and Project Finance (2012)															
3. Daniel Riordan - Technical Report Writing Today (1998)															
Darla-Jean Weatherford - Technical Writing for Engineering Professionals (2016) Penwell Publishers.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Write effective project reports.													Understand		
CO2: Use statistical tools with confidence.													Apply		
CO3: Explain the purpose and intension of the proposed project coherently and with clarity.													Understand		
CO4: Create writing texts to suit achieve the intended purpose.													Create		
CO5: Master the art of writing winning proposals and projects.													Apply		
CO-PO Mapping															
Particular	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	1	1	1	3	2	2	3	3	3	3	-	-	-
CO2	2	2	2	1	1	1	2	1	2	3	2	3	-	-	-
CO3	2	2	3	3	2	3	2	2	2	3	2	3	-	-	-
CO4	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-
CO5	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-
1- Low, 2- Medium, 3- High, ‘- ‘-No correlation															

23CEO008	BASICS OF INTEGRATED WATER RESOURCES MANAGEMENT	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					

Basic understanding of water resources and environmental studies.		
Course Objectives: - To introduce the interdisciplinary approach of water management. - To develop knowledge base and capacity building on IWRM.		
Unit I	OVERVIEW OF IWRM	9
Facts about water - Definition – Key challenges - Paradigm shift - Water management Principles - Social equity - Ecological sustainability – Economic efficiency - SDGs - World Water Forums.		
Unit II	WATER USE SECTORS: IMPACTS AND SOLUTION	9
Water users: People, Agriculture, ecosystem and others - Impacts of the water use sectors on water resources - Securing water for people, food production, ecosystems and other uses - IWRM relevance in water resources management.		
Unit III	WATER ECONOMICS	9
Economic characteristics of water good and services – Economic instruments – Private sector involvement in water resources management - PPP experiences through case studies.		
Unit IV	RECENT TREANDS IN WATER MANAGEMENT	9
River basin management - Ecosystem Regeneration – 5 Rs - WASH - Sustainable livelihood - Water management in the context of climate change.		
Unit V	IMPLEMENTATION OF IWRM	9
Barriers to implementing IWRM - Policy and legal framework - Bureaucratic reforms and inclusive development - Institutional Transformation - Capacity building - Case studies on conceptual framework of IWRM.		
Total Periods :45 PERIODS		
Text Books:		
1. Cech Thomas V., Principles of water resources: history, development, management and policy. John Wiley and Sons Inc., New York. 2003.		
2. Mollinga P. et al. “Integrated Water Resources Management”, Water in South Asia Volume I, Sage Publications, 2006.		
References:		
1. Technical Advisory Committee, Background Papers No: 1, 4 and 7, Stockholm, Sweden. 2002.		
2. IWRM Guidelines at River Basin Level (UNESCO, 2008).		
3. Tutorial on Basic Principles of Integrated Water Resources Management ,CAP-NET. http://www.pacificwater.org/userfiles/file/IWRM/Toolboxes/introduction%20to%20iwrn/Tutorial_text.pdf		
4. Pramod R. Bhave, 2011, Water Resources Systems, Narosa Publishers.		

4. The 17 Goals, United Nations, <https://sdgs.un.org/goals>.

Course Outcomes:													Blooms Taxonomy		
CO 1: Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.													Apply		
CO2: Discuss on the different water uses; how it is impacted and ways to tackle these impacts.													Understand		
CO3: Explain the economic asOECts of water and choose the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.													Understand		
CO4: Illustrate the recent trends in water management.													Apply		
CO5: Understand the implementation hitches and the institutional frameworks.													Understand		
CO-PO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	2	2	2	1	1	1	1	3	-	-	-
CO2	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
CO3	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
CO4	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
CO5	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
1- Low, 2- Medium, 3- High, '-' -No correlation															

23MAO004	ADVANCED NUMERICAL METHODS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Understanding of calculus and linear algebra. • Knowledge of ordinary and partial differential equations. • Familiarity with basic numerical methods and programming concepts.					
Course Objectives: • To impart knowledge on numerical methods that will come in handy to solve numerically the problems that arise in engineering and technology. This will also serve as a precursor for future research.					
Unit I	ALGEBRAIC EQUATIONS AND EIGENVALUE PROBLEM				9

System of nonlinear equations : Fixed point iteration method - Newton's method; System of linear equations: Thomas algorithm for tri diagonal system - SOR iteration methods ; Eigen value problems: Given's method - Householder's method.		
Unit II	INTERPOLATION	9
Central difference: Stirling and Bessel's interpolation formulae ; Piecewise spline interpolation: Piecewise linear, piecewise quadratic and cubic spline ; Least square approximation for continuous data (upto 3rd degree).		
Unit III	NUMERICAL METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS	9
Explicit Adams - Bashforth Techniques - Implicit Adams - Moulton Techniques, Predictor -Corrector Techniques - Finite difference methods for solving two - point linear boundary value problems - Orthogonal Collocation method.		
Unit IV	FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS	9
Laplace and Poisson's equations in a rectangular region : Five point finite difference schemes - Leibmann's iterative methods - Dirichlet's and Neumann conditions – Laplace equation in polar coordinates : Finite difference schemes .		
Unit V	FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATIONS	9
Parabolic equations : Explicit and implicit finite difference methods – Weighted average approximation - Dirichlet's and Neumann conditions – First order hyperbolic equations - Method of characteristics - Different explicit and implicit methods; Wave equation : Explicit scheme – Stability of above schemes.		
Total Periods :45 PERIODS		
Text Books:		
1. Grewal, B.S., "Numerical Methods in Engineering & Science ", Khanna Publications, Delhi, 2013.		
2. Gupta, S.K., "Numerical Methods for Engineers", (Third Edition), New Age Publishers, 2015.		
3. Jain, M.K., Iyengar, S.R.K. and Jain, R.K., "Computational Methods for Partial Differential Equations", New Age Publishers, 1994.		
References:		
1. Saumyen Guha and Rajesh Srivastava, "Numerical methods for Engineering and Science", Oxford Higher Education, New Delhi, 2010.		
2. Burden, R.L., and Faires, J.D., “Numerical Analysis – Theory and Applications”, 9 th Edition, Cengage Learning, New Delhi, 2016.		

3. Gupta S.K., “Numerical Methods for Engineers”, 4th Edition, New Age Publishers, 2019.															
4. Sastry, S.S., “Introductory Methods of Numerical Analysis”, 5th Edition, PHI Learning, 2015.															
5. Morton, K.W. and Mayers D.F., "Numerical solution of Partial Differential equations", Cambridge University press, Cambridge, 2002.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Demonstrate the understandings of common numerical methods for nonlinear equations, system of linear equations and eigenvalue problems													Understand		
CO2: Understand the interpolation theory													Understand		
CO3: Understand the concepts of numerical methods for ordinary differential equations													Understand		
CO4: Demonstrate the understandings of common numerical methods for elliptic equations													Understand		
CO5: Understand the concepts of numerical methods for time dependent partial differential equations													Understand		
CO-PO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	2	2	2	1	1	1	1	3	-	-	-
CO2	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
CO3	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
CO4	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
CO5	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
1- Low, 2- Medium, 3- High, ‘-’ -No correlation															

23MAO005	RANDOM PROCESSES	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Probability and Statistics – Understanding of probability theory, random variables, and basic distributions. • Linear Algebra – Knowledge of matrices, vectors, and operations on them. • Signals and Systems / Calculus – Familiarity with linear systems, differential equations, and basic signal analysis.					

Course Objectives:

- To introduce the basic concepts of probability, one and two dimensional random variables with applications to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in communication networks.
- To acquaint with specialized random processes which are apt for modelling the real time scenario.
- To understand the concept of correlation and spectral densities.
- To understand the significance of linear systems with random inputs.

Unit I	RANDOM VARIABLES	9
Discrete and continuous random variables – Moments – Moment generating functions – Joint Distribution- Covariance and Correlation – Transformation of a random variable.		
Unit II	RANDOM PROCESSES	9
Classification – Characterization – Cross correlation and Cross covariance functions - Stationary Random Processes – Markov process - Markov chain.		
Unit III	SPECIAL RANDOM PROCESSES	9
Bernoulli Process – Gaussian Process - Poisson process – Random telegraph process.		
Unit IV	CORRELATION AND SPECTRAL DENSITIES	9
Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density – Properties.		
Unit V	LINEAR SYSTEMS WITH RANDOM INPUTS	9
Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output.		
Total Periods :45 PERIODS		
Text Books:		
1. Ibe, O.C., "Fundamentals of Applied Probability and Random Processes ", 1st Indian Reprint, Elsevier, 2007.		
2. Peebles, P.Z., "Probability, Random Variables and Random Signal Principles ", Tata McGraw Hill, 4th Edition, New Delhi, 2002.		
References:		
1. Cooper. G.R., McGillem. C.D., "Probabilistic Methods of Signal and System Analysis", Oxford University Press, New Delhi, 3rd Indian Edition, 2012.		
2. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes ", Tata McGraw Hill Edition, New Delhi, 2004.		

3. Miller. S.L. and Childers. D.G., "Probability and Random Processes with Applications to Signal Processing and Communications ", Academic Press, 2004.

4. Stark. H. and Woods. J.W., "Probability and Random Processes with Applications to Signal Processing ", Pearson Education, Asia, 3rd Edition, 2002.

5. Yates. R.D. and Goodman. D.J., "Probability and Stochastic Processes", Wiley India Pvt. Ltd., Bangalore, 2nd Edition, 2012.

Course Outcomes:													Blooms Taxonomy		
CO 1: Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.													Understand		
CO2: Apply the concept random processes in engineering disciplines.													Apply		
CO3: Understand and apply the concept of correlation and spectral densities.													Understand		
CO4: Get an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable.													Analyze		
CO5: Analyze the response of random inputs to linear time invariant systems.													Analyze		
CO-PO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-
CO2	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-
CO3	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-
CO4	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-
CO5	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-
1- Low, 2- Medium, 3- High, '-' -No correlation															

23MAO006	QUEUEING AND RELIABILITY MODELLING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Probability theory – basic understanding of probability, random variables, and distributions. • Random processes – familiarity with stationary processes, Poisson processes, and Markov chains. • Basic mathematics – calculus and linear algebra to handle system modeling and reliability calculations.					

Course Objectives:

- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
- To understand the concept of queueing models and apply in engineering.
- To provide the required mathematical support in real life problems and develop probabilistic models which can be used in several areas of science and engineering.
- To study the system reliability and hazard function for series and parallel systems.
- To implement Markovian Techniques for availability and maintainability which opens up new avenues for research.

Unit I	RANDOM PROCESSES	9
Classification – Stationary process – Markov process - Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations – Limiting distributions.		
Unit II	MARKOVIAN QUEUEING MODELS	9
Markovian queues – Birth and death processes – Single and multiple server queueing models – Little's formula - Queues with finite waiting rooms.		
Unit III	ADVANCED QUEUEING MODELS	9
M/G/1 queue – Pollaczek Khinchin formula - M/D/1 and M/EK/1 as special cases – Series queues – Open Jackson networks.		
Unit IV	SYSTEM RELIABILITY	9
Reliability and hazard functions- Exponential, Normal, Weibull and Gamma failure distribution – Time - dependent hazard models – Reliability of Series and Parallel Systems.		
Unit V	MAINTAINABILITY AND AVAILABILITY	9
Maintainability and Availability functions – Frequency of failures – Two Unit parallel system with repair – k out of m systems.		
Total Periods :45 PERIODS		
Text Books:		
1. Shortle J.F, Gross D, Thompson J.M,Harris C.M., “Fundamentals of Queueing Theory”, John Wiley and Sons, New York,2018		
2. Balagurusamy E., “Reliability Engineering”, Tata McGraw Hill Publishing Company Ltd., New Delhi,2010.		
References:		
1. Medhi J, ”Stochastic models of Queueing Theory”, Academic Press, Elsevier, Amsterdam, 2003.		
2. Taha, H.A., "Operations Research", 9th Edition, Pearson India Education Services, Delhi, 2016.		

3. Trivedi, K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 2nd Edition, John Wiley and Sons, 2002.

4. Govil A.K., "Reliability Engineering", Tata-McGraw Hill Publishing Company Ltd., New Delhi, 1983.

Course Outcomes:													Blooms Taxonomy		
CO 1: Enable the students to apply the concept of random processes in engineering disciplines.													Apply		
CO2: Students acquire skills in analyzing various queueing models.													Analyze		
CO3: Students can understand and characterize phenomenon which evolve with respect to time in a probabilistic manner.													Understand		
CO4: Students can analyze reliability of the systems for various probability distributions.													Analyze		
CO5: Students can be able to formulate problems using the maintainability and availability analyses by using theoretical approach.													Apply		
CO-PO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	0	0	0	0	0	0	2	0	0	2	-	-	-
CO2	3	3	2	0	0	0	0	0	2	0	0	2	-	-	-
CO3	3	3	0	2	0	0	0	0	2	0	0	2	-	-	-
CO4	3	3	2	0	0	0	0	0	2	0	0	2	-	-	-
CO5	3	3	3	2	0	0	0	0	2	0	0	2	-	-	-
1- Low, 2- Medium, 3- High, '-' -No correlation															

23MGO004	PRODUCTION AND OPERATIONS MANAGEMENT FOR ENTREPRENEURS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of business and management principles • Fundamentals of production processes and operations • Basic mathematics for planning and optimization					

Course Objectives:		
- To know the basic concept and function of Production and Operation Management for entrepreneurship. - To understand the Production process and planning. - To understand the Production and Operations Management Control for business owners.		
Unit I	INTRODUCTION TO PRODUCTION AND OPERATIONS MANAGEMENT	9
Functions of Production Management - Relationship between production and other functions – Production management and operations management, Characteristics of modern production and operation management, organisation of production function, recent trends in production /operations management - production as an organisational function, decision making in production Operations research		
Unit II	PRODUCTION & OPERATION SYSTEMS	9
Production Systems- principles – Models - CAD and CAM- Automation in Production - Functions and significance- Capacity and Facility Planning: Importance of capacity planning- Capacity measurement – Capacity Requirement Planning (CRP) process for manufacturing and service industry		
Unit III	PRODUCTION & OPERATIONS PLANNING	9
Facility Planning – Location of facilities – Location flexibility – Facility design process and techniques – Location break even analysis-Production Process Planning: Characteristic of production process systems – Steps for production process- Production Planning Control Functions – Planning phase- Action phase- Control phase - Aggregate production planning		
Unit IV	PRODUCTION & OPERATIONS MANAGEMENT PROCESS	9
Process selection with PLC phases- Process simulation tools- Work Study – Significance – Methods, evolution of normal/ standard time – Job design and rating - Value Analysis - Plant Layout: meaning – characters – Plant location techniques - Types- MRP and Layout Design - Optimisation and Theory of Constraints (TOC)– Critical Chain Project Management (CCPM)- REL (Relationship) Chart – Assembly line balancing- – Plant design optimisation -Forecasting methods.		
Unit V	CONTROLLING PRODUCTION & OPERATIONS MANAGEMENT	9
Material requirement planning (MRP)- Concept- Process and control - Inventory control systems and techniques – JIT and Lean manufacturing - Network techniques - Quality Management: Preventive Vs Breakdown maintenance for Quality – Techniques for measuring quality - Control Chart (X , R , p , np and C chart) - Cost of Quality, Continuous improvement (Kaizen) - Quality awards - Supply Chain Management - Total Quality Management - 6 Sigma approach and Zero Defect Manufacturing.		
Total Periods :45 PERIODS		

Text Books:															
1. K. Aswathappa & K. Shridhara Bhat, Production and Operations Management, Himalaya Publishing, 2010.															
2. R. Paneerselvam, Production and Operations Management, PHI Learning, 2010.															
References:															
1. Mikell P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, Pearson, 2007.															
2. Amitabh Raturi, Production and Inventory Management, , 2008.															
3. Adam Jr. Ebert, Production and Operations Management, PHI Publication, 1992.															
4. Muhlemann, Okland and Lockyer, Production and Operation Management, Macmillan India,1992.															
5. Chary S.N, Production and Operations Management, TMH Publications, 2010.															
6. Terry Hill ,Operation Management. Pal Grave McMillan (Case Study).2005.															
Course Outcomes:													Blooms Taxonomy		
CO 1: To understand the basics and functions of Production and Operation Management for business owners													Understand		
CO2: To learn about the Production & Operation Systems.													Understand		
CO3: To acquaint on the Production & Operations Planning Techniques followed by entrepreneurs in Industries.													Apply		
CO4: To known about the Production & Operations Management Processes in organisations.													Understand		
CO5: To comprehend the techniques of controlling, Production and Operations in industries.													Analyze		
CO-PO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	1	1	1	1	2	1	1	1	-	-	-
CO2	3	2	2	1	1	1	1	1	2	1	1	1	-	-	-
CO3	3	3	2	2	2	1	1	1	2	2	1	1	-	-	-
CO4	3	2	2	2	2	1	1	1	2	2	1	1	-	-	-
CO5	3	3	3	2	2	1	1	1	2	2	1	1	-	-	-
1- Low, 2- Medium, 3- High, ‘ - ‘-No correlation															

23MGO005	MULTIVARIATE DATA ANALYSIS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of Statistics • Fundamentals of Probability • Understanding of Data Collection and Sampling Techniques					
Course Objectives: • To know various multivariate data analysis techniques for business research					
Unit I	INTRODUCTION				9
Uni-variate, Bi-variate and Multi-variate techniques – Classification of multivariate techniques – Guidelines for multivariate analysis and interpretation					
Unit II	PREPARING FOR MULTIVARIATE ANALYSIS				9
Conceptualization of research model with variables, collection of data --Approaches for dealing with missing data Testing the assumptions of multivariate analysis					
Unit III	MULTIPLE LINEAR REGRESSION ANALYSIS, FACTOR ANALYSIS				9
Multiple Linear Regression Analysis – Inferences from the estimated regression function – Validation of the model. -Approaches to factor analysis – interpretation of results.					
Unit IV	LATENT VARIABLE TECHNIQUES				9
Confirmatory Factor Analysis, Structural equation modelling, Mediation models, Moderation models, Longitudinal studies.					
Unit V	ADVANCED MULTIVARIATE TECHNIQUES				9
Multiple Discriminant Analysis, Logistic Regression, Cluster Analysis, Conjoint Analysis, multidimensional scaling					
Total periods:45 PERIODS					
Textbook					
1. Joseph F. Hair, William C. Black, Barry J. Babin, Rolph E. Anderson, <i>Multivariate Data Analysis</i> , 8th Edition, Pearson Education, 2019.					
References:					
1. Joseph F Hair, Rolph E Anderson, Ronald L. Tatham & William C. Black, <i>Multivariate Data Analysis</i> , Pearson Educa					
2. 2. Barbara G. Tabachnick, Linda S.Fidell, <i>Using Multivariate Statistics</i> , 6th Edition, Pearson, 2012					
3. . Richard A Johnson and Dean W.Wichern, <i>Applied Multivariate Statistical Analysis</i> , Prentice Hall,					

4. . Richard A Johnson and Dean W.Wichern, Applied Multivariate Statistical Analysis, Prentice Hall,															
Course Outcomes:													Blooms Taxonomy		
CO 1: Demonstrate a sophisticated understanding of the concepts and methods; know the exact scopes and possible limitations of each method; and show capability of using multivariate techniques to provide constructive guidance in decision making.													Understand		
CO2: Use advanced techniques to conduct thorough and insightful analysis, and interpret the results correctly with detailed and useful information													Analyze		
CO3: Show substantial understanding of the real problems; conduct deep analysis using correct methods; and draw reasonable conclusions with sufficient explanation and elaboration													Understand		
CO4: Write an insightful and well-organized report for a real-world case study, including thoughtful and convincing detail													Analyze		
CO5: Make better business decisions by using advanced techniques in data analytics.													Understand		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	1	-	-	-	-	-	-	-	2	1	1
CO2	2	3	2	3	2	-	-	-	-	-	-	-	3	2	2
CO3	2	3	2	3	2	-	-	-	1	-	-	-	3	2	2
CO4	1	1	1	2	2	-	-	1	2	2	1	1	2	2	1
CO5	2	3	2	2	1	-	-	-	1	-	-	-	1	2	2
1- Low, 2- Medium, 3- High, ‘ - ‘-No correlation															

23MEO009	ADDITIVE MANUFACTURING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
- COURSE OBJECTIVES: ☐ To introduce the development, capabilities, applications, of Additive Manufacturing (AM), and its business opportunities. ☐ To be acquainted with vat polymerization and material extrusion processes ☐ To be familiar with powder bed fusion and binder jetting processes.					

☐ To gain knowledge on applications of direct energy deposition, and material jetting processes. ☐ To impart knowledge on sheet lamination and direct write technologies.		
Unit I	INTRODUCTION	9
Overview - Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping- Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. AM Process Chain - ASTM/ISO 52900 Classification - Benefits - AM Unique Capabilities - AM File formats: STL, AMF Applications: Building Printing, Bio Printing, Food Printing, Electronics Printing, Automobile, Aerospace, Healthcare. Business Opportunities in AM.		
Unit II	VAT POLYMERIZATION AND MATERIAL EXTRUSION	9
Photo polymerization: Stereolithography Apparatus (SLA)- Materials -Process - top down and bottom up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) - Process - Advantages - Applications. Material Extrusion: Fused Deposition Modeling (FDM) - Process-Materials -Applications and Limitations.		
Unit III	POWDER BED FUSION AND BINDER JETTING	9
Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications. Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits - Limitations - Applications.		
Unit IV	MATERIAL JETTING AND DIRECTED ENERGY DEPOSITION	9
Material Jetting: Multijet Modeling- Materials - Process - Benefits - Applications. Directed Energy Deposition: Laser Engineered Net Shaping (LENS) - Process - Material Delivery Materials -Benefits - Applications.		
Unit V	SHEET LAMINATION AND DIRECT WRITE TECHNOLOGY	9
Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding - Materials - Application and Limitation. Ink-Based Direct Writing (DW): Nozzle Dispensing Processes, Inkjet Printing Processes, Aerosol DW - Applications of DW.		
Total periods:45 PERIODS		
Textbook		
1. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani “Additive manufacturing technologies”. 3rd edition Springer Cham, Switzerland. (2021). ISBN: 978-3-030-56126-0		
References:		
1 Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing”, Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.		

2. Milan Brandt, “Laser Additive Manufacturing: Materials, Design, Technologies, and Applications”, Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333															
3. . Amit Bandyopadhyay and Susmita Bose, “Additive Manufacturing”, 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590.															
4. . Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, Springer., United States ,2006, ISBN: 978-1-4614-9842-1.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities													Understand		
CO2: Acquire knowledge on process vat polymerization and material extrusion processes and its applications.													Analyze		
CO3: Elaborate the process and applications of powder bed fusion and binder jetting.													Understand		
CO4: Evaluate the advantages, limitations, applications of material jetting and directed energy deposition processes.													Analyze		
CO5: Acquire knowledge on sheet lamination and direct write technology..													Understand		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	1	-	-	-	-	-	-	-	2	1	1
CO2	2	3	2	3	2	-	-	-	-	-	-	-	3	2	2
CO3	2	3	2	3	2	-	-	-	1	-	-	-	3	2	2
CO4	1	1	1	2	2	-	-	1	2	2	1	1	2	2	1
CO5	2	3	2	2	1	-	-	-	1	-	-	-	1	2	2
1- Low, 2- Medium, 3- High, ‘- ‘-No correlation															

23MEO010	NEW PRODUCT DEVELOPMENT	Category: OEC			
		L	T	P	C
		3	0	0	3
Course Objectives: - To introduce the fundamental concepts of the new product development - To develop material specifications, analysis and process.					
Unit I	FUNDAMENTALS OF NPD				9

Introduction – Reading of Drawing – Grid reading, Revisions, ECN (Engg. Change Note), Component material grade, Specifications, customer specific requirements – Basics of monitoring of NPD applying		
Unit II	MATERIAL SPECIFICATIONS, ANALYSIS & PROCESS	9
Material specification standards – ISO, DIN, JIS, ASTM, EN, etc. – Awareness on various manufacturing process like Metal castings & Forming, Machining (Conventional, 3 Axis, 4 Axis, 5 Axis,), Fabrications, Welding process. Qualifications of parts mechanical, physical & Chemical properties and their test report preparation and submission. Fundamentals of DFMEA & PFMEA, Fundamentals of FEA, Bend Analysis, Hot Distortion, Metal and Material Flow, Fill and Solidification analysis		
Unit III	ESSENTIALS OF NPD	9
RFQ (Request of Quotation) Processing – Feasibility Studies & reporting – CFT (Cross Function Team) discussion on new product and reporting – Concept design, Machine selection for tool making, Machining – Manufacturing Process selection, Machining Planning, cutting tool selection – Various Inspection methods – Manual measuring, CMM – GOM (Geometric Optical Measuring), Lay out marking and Cut section analysis. Tool Design and Detail drawings preparation, release of details to machine shop and CAM programing. Tool assembly and shop floor trials. Initial sample submission with PPAP documents.		
Unit IV	CRITERIONS OF NPD	9
New product qualification for Dimensions, Mechanical & Physical Properties, Internal Soundness proving through X-Ray, Radiography, Ultrasonic Testing, MPT, etc. Agreement with customer for testing frequencies. Market Survey on similar products, Risk analysis, validating samples with simulation 293 294 results, Lesson Learned & Horizontal deployment in NPD.		
Unit V	METROLOGY FOR MICRO SYSTEMS	9
Detailed study on PPAP with 18 elements reporting, APQP and its 5 Sections, APQP vs PPAP, Importance of SOP (Standard Operating Procedure) – Purpose & documents, deployment in shop floor. Prototyping & RPT - Concepts, Application and its advantages, 3D Printing – resin models, Sand cores for foundries; Reverse Engineering. Cloud points generation, converting cloud data to 3D model – Advantages & Limitation of RE, CE (Concurrent Engineering) – Basics, Application and its advantages in NPD (to reduce development lead time, time to Market, Improve productivity and product cost.)		
Total periods:45 PERIODS		
Text Books:		
1.Product Development – Sten Jonsson		
2. Product Design & Development – Karl T. Ulrich, Maria C. Young, Steven D. Eppinger		
References:		
1. Revolutionizing Product Development – Steven C Wheelwright & Kim B. Clark		

2. Change by Design															
3. Toyota Product Development System – James Morgan & Jeffrey K. Liker															
4. Winning at New Products – Robert Brands 3rd Edition															
Course Outcomes:													Blooms Taxonomy		
CO 1: Discuss fundamental concepts and customer specific requirements of the New Product development													Understand		
CO2: Discuss the Material specification standards, analysis and fabrication, manufacturing process.													Analyze		
CO3: Develop Feasibility Studies & reporting of New Product development													Understand		
CO4: Analyzing the New product qualification and Market Survey on similar products of new product development													Apply		
CO5: Develop Reverse Engineering. Cloud points generation, converting cloud data to 3D model													Apply		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	3	-	-	-	1	1	-	-	3	3	2
CO2	2	2	3	2	2	-	-	-	1	1	-	-	3	3	3
CO3	2	2	3	2	3	-	-	-	1	1	-	-	3	3	3
CO4	1	1	2	2	3	-	-	1	2	2	1	1	2	2	2
CO5	2	1	2	2	2	-	-	-	1	1	-	-	3	3	3

23MEO011	INDUSTRIAL DESIGN & RAPID PROTOTYPING TECHNIQUES	Category: OEC			
		L	T	P	C
		2	0	2	3
Course Objectives: The course aims to • Outline Fundamental concepts in UI & UX • Introduce the principles of Design and Building an mobile app • Illustrate the use of CAD in product design • Outline the choice and use of prototyping tools • Understanding design of electronic circuits and fabrication of electronic devices					
Unit I	UI/UX				9

Fundamental concepts in UI & UX - Tools - Fundamentals of design principles - Psychology and Human Factors for User Interface Design - Layout and composition for Web, Mobile and Devices - Typography - Information architecture - Color theory - Design process flow, wireframes, best practices in the industry -User engagement ethics - Design alternatives		
Unit II	APP DEVELOPMENT	9
SDLC - Introduction to App Development - Types of Apps - web Development - understanding Stack - Frontend - backend - Working with Databases - Introduction to API - Introduction to Cloud services - Cloud environment Setup- Reading and writing data to cloud - Embedding ML models to Apps - Deploying application.		
Unit III	INDUSTRIAL DESIGN	9
Introduction to Industrial Design - Points, lines, and planes - Sketching and concept generation - Sketch to CAD - Introduction to CAD tools - Types of 3D modeling - Basic 3D Modeling Tools - Part creation – Assembly - Product design and rendering basics - Dimensioning & Tolerancing		
Unit IV	MECHANICAL RAPID PROTOTYPING	9
Need for prototyping - Domains in prototyping - Difference between actual manufacturing and prototyping - Rapid prototyping methods - Tools used in different domains - Mechanical Prototyping; 3D Printing and classification - Laser Cutting and engraving - RD Works - Additive manufacturing		
Unit V	ELECTRONIC RAPID PROTOTYPING	9
Basics of electronic circuit design - lumped circuits - Electronic Prototyping - Working with simulation tool - simple PCB design with EDA		
Total periods:45 PERIODS		
Textbook		
1. Peter Fiell, Charlotte Fiell, Industrial Design A-Z, TASCHEN America Llc(2003).		
2. Samar Malik, Autodesk Fusion 360 - The Master Guide.		
References:		
https://www.adobe.com/products/xd/learn/get-started.html		
https://developer.android.com/guide		
Course Outcomes:		Blooms Taxonomy
CO 1: Create quick UI/UX prototypes for customer needs.		Understand
CO2: Develop web application to test product traction / product feature		Analyze
CO3: Develop 3D models for prototyping various product ideas		Understand
CO4: :Develop 3D printing models		Analyze
CO5: Built prototypes using Tools and Techniques in a quick iterative		Understand

methodology															
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	1	-	-	-	-	-	-	-	2	1	1
CO2	2	3	2	3	2	-	-	-	-	-	-	-	3	2	2
CO3	2	3	2	3	2	-	-	-	1	-	-	-	3	2	2
CO4	1	1	1	2	2	-	-	1	2	2	1	1	2	2	1
CO5	2	3	2	2	1	-	-	-	1	-	-	-	1	2	2
1- Low, 2- Medium, 3- High, '-' -No correlation															

23MEO012	MICRO AND PRECISION ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic Manufacturing Processes • Fundamentals of Machine Tools • Basics of Metrology and Measurements					
Course Objectives: • Learn about the precision machine tools • Learn about the macro and micro components. • Understand handling and operating of the precision machine tools. • Learn to work with miniature models of existing machine tools/robots and other instruments. • Learn metrology for micro system					
Unit I	INTRODUCTION TO MICROSYSTEMS				9
Design, and material selection, micro-actuators: hydraulic, pneumatic, electrostatic/ magnetic etc. for medical to general purpose applications. Micro-sensors based on Thermal, mechanical, electrical properties; micro-sensors for measurement of pressure, flow, temperature, inertia, force, acceleration, torque, vibration, and monitoring of manufacturing systems.					
Unit II	FABRICATION PROCESSES FOR MICRO-SYSTEMS				9
Additive, subtractive, forming process, microsystems-Micro-pumps, micro- turbines, micro engines, micro-robot, and miniature biomedical devices					

Unit III	INTRODUCTION TO PRECISION ENGINEERING												9		
Machine tools, holding and handling devices, positioning fixtures for fabrication/ assembly of microsystems. Precision drives: inch worm motors, ultrasonic motors, stick- slip mechanism and other piezo-based devices.															
Unit IV	PRECISION MACHINING PROCESSES												9		
Precision machining processes for macro components - Diamond turning, fixed and free abrasive processes, finishing processes															
Unit V	METROLOGY FOR MICRO SYSTEMS												9		
Metrology for micro systems - Surface integrity and its characterization															
Total periods:45 PERIODS															
Text Books:															
1. Davim, J. Paulo, ed. Microfabrication and Precision Engineering: Research and Development. Woodhead Publishing, 2017															
2. Gupta K, editor. Micro and Precision Manufacturing. Springer; 2017															
References:															
1. Dornfeld, D., and Lee, D. E., Precision Manufacturing, 2008, Springer															
2. H. Nakazawa, Principles of Precision Engineering, 1994, Oxford University Press															
3.Whitehouse, D. J., Handbook of Surface Metrology, Institute of Physics Publishing, Philadelphia PA, 1994.															
4. Murthy.R.L, —Precision Engineering in Manufacturingl, New Age International, New Delhi, 2005															
Course Outcomes:													Blooms Taxonomy		
CO 1: Select suitable precision machine tools and operates													Understand		
CO2: Apply the macro and micro components for fabrication of micro systems													Analyze		
CO3: Apply suitable machining process													Understand		
CO4: Able to work with miniature models of existing machine tools/robots and other instruments.													Apply		
CO5: Apply metrology for micro system													Apply		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	3	-	-	-	1	1	-	-	3	3	2
CO2	2	2	3	2	2	-	-	-	1	1	-	-	3	3	3
CO3	2	2	3	2	3	-	-	-	1	1	-	-	3	3	3
CO4	1	1	2	2	3	-	-	1	2	2	1	1	2	2	2

CO5	2	1	2	2	2	-	-	-	1	1	-	-	3	3	3

23MEO013	COST MANAGEMENT OF ENGINEERING PROJECTS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of Accounting and Costing • Fundamentals of Management Principles • Understanding of Engineering Economics • Basic Mathematical and Quantitative Techniques					
Course Objectives: • Summarize the costing concepts and their role in decision making • Infer the project management concepts and their various aspects in selection • Interpret costing concepts with project execution • Develop knowledge of costing techniques in service sector and various budgetary control techniques • Illustrate with quantitative techniques in cost management					
Unit I	INTRODUCTION TO COSTING CONCEPTS				9
Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control					
Unit II	INTRODUCTION TO PROJECT MANAGEMENT				9
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contract					
Unit III	PROJECT EXECUTION AND COSTING CONCEPTS				9
Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making					

problemPricing strategies: Pareto Analysis, Target costing, Life Cycle Costing															
Unit IV		COSTING OF SERVICE SECTOR AND BUDGETERY CONTRO												9	
Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets															
Unit V		QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT												9	
Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory															
Total periods:45 45 PERIODS															
Text Books:															
1. John M. Nicholas, Herman Steyn Project Management for Engineering, Business and Technology, Taylor & Francis, 2 August 2020, ISBN: 9781000092561.															
2. Albert Lester ,Project Management, Planning and Control, Elsevier/Butterworth-Heinemann, 2007, ISBN: 9780750669566, 075066956X.															
References:															
1. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher, 1991.															
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988.															
3. Charles T. Horngren et al Cost Accounting a Managerial Emphasis, Prentice Hall of India, New Delhi, 2011															
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003.															
5. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007.															
Course Outcomes:													Blooms Taxonomy		
CO1: Understand the costing concepts and their role in decision making.													Understand		
CO2: Understand the project management concepts and their various aspects in selection.													Apply		
CO3: Interpret costing concepts with project execution.													Analyze		
CO4: Gain knowledge of costing techniques in service sector and various budgetary control techniques.													Understand		
CO5: Become familiar with quantitative techniques in cost management.													Analyze		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	1	-	-	-	1	1	-	-	2	1	3

CO2	2	2	2	3	2	-	-	-	1	2	1	1	3	2	3
CO3	2	2	2	3	2	-	-	-	1	1	1	1	3	2	2
CO4	2	2	2	2	3	-	-	1	2	2	1	1	3	3	2
CO5	2	3	2	3	3	-	-	-	1	1	-	-	3	2	2

23EE0011	BATTERIES AND MANAGEMENT SYSTEM	Category: OEC			
		L	T	P	C
		3	0	0	3

Prerequisites

- Basic Electrical Engineering
- Fundamentals of Electrochemistry
- Knowledge of Electric Vehicle Powertrain Components
- Basics of Circuit Theory and Modeling
- Understanding of Sensors and Measurement Techniques

Course Objectives:

- The objective of this course is to make the students to understand the working and characteristics of different types of batteries and their management .

Unit I	ADVANCED BATTERIES	9
Li-ion Batteries-different formats, chemistry, safe operating area, efficiency, aging. Characteristics SOC,DOD, SOH. Balancing-Passive Balancing Vs Active Balancing. Other Batteries-NCM and NCA Batteries. <i>NCR18650B</i> specifications		
Unit II	BATTERY PACK	9
Battery Pack- design, sizing, calculations, flow chart, real and simulation Model.Peak power – definition, testing methods-relationships with Power, Temperature and ohmic Internal Resistance. Cloud based and Local Smart charging		
Unit III	BATTERY MODELLING	9
Battery Modelling Methods-Equivalent Circuit Models, Electrochemical Model, Neural Network Model. ECM Comparisons- Rint model, Thevenin model, PNGV model. State space Models- Introduction. Battery Modelling software/simulation frame		
Unit IV	BATTERY STATE ESTIMATION	9
SOC Estimation- Definition, importance, single cell Vs series batteries SOC. Estimation Methods- Load voltage, Electromotive force, AC impedance, Ah counting, Neural networks, Neuro-fuzzy forecast method, Kalman filter. Estimation Algorithms		

Unit V	BMS ARCHITECTURE AND REAL TIME COMPONENTS												9		
Battery Management System- need, operation, classification. BMS ASIC-bq76PL536A-Q1 Battery Monitor IC- CC2662R-Q1 Wireless BMS MCU. Communication Modules- CAN Open-Flex Ray CANedge1 package.ARBIN Battery Tester. BMS Development with Modeling software and Model Based Design.															
Total periods:45 45 PERIODS															
Text Books:															
1. Jiuchun Jiang and Caiping Zhang, “Fundamentals and applications of Lithium-Ion batteriesin Electric Drive Vehicles’’, Wiley, 2015.															
2. Davide Andrea , “Battery Management Systems for Large Lithium-Ion Battery Packs” ARTECH House, 2010															
REFERENCE															
1. Developing Battery Management Systems with Simulink and Model-Based Design-whitepaper															
2. Panasonic <i>NCR18650B- DataShee</i>															
3. bq76PL536A-Q1- IC DataSheet															
4. CC2662R-Q1- IC DataSheet															
Course Outcomes:												Blooms Taxonomy			
CO 1: Acquire knowledge of different Li-ion Batteries performance.												Understand			
CO2: Design a Battery Pack and make related calculations.												Analyze			
CO3: Demonstrate a BatteryModel or Simulation												Understand			
CO4: Estimate State-of-Charges in a Battery Pack												Analyze			
CO5: Approach different BMS architectures during real world usage												Apply			
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	2	-	-	-	1	1	-	-	3	2	3
CO2	2	3	3	2	3	-	-	-	1	1	-	-	3	3	3
CO3	2	3	3	2	3	-	-	-	1	1	-	-	3	3	3
CO4	2	3	2	3	2	-	-	1	2	2	-	1	3	2	2
CO5	2	2	2	2	3	-	-	1	2	2	-	1	3	2	2

23EE0006	SENSORS AND ACTUATORS												Category: OEC			
													L	T	P	C
													3	0	0	3

Prerequisites		
• Basic Electrical and Electronics Engineering • Fundamentals of Measurement and Instrumentation		
Course Objectives:		
• The objective of this course is to make the students to list common types of sensor and actuators used in automotive vehicles.		
Unit I	INTRODUCTION TO MEASUREMENTS AND SENSORS	9
Sensors: Functions- Classifications- Main technical requirement and trends Units and standards Calibration methods- Classification of errors- Error analysis- Limiting error- Probable error-Propagation of error- Odds and uncertainty- principle of transduction-Classification. Static characteristics mathematical model of transducers- Zero, First and Second order transducers-Dynamic characteristics of first and second order transducers for standard test inputs		
Unit II	VARIABLE RESISTANCE AND INDUTANCE SENSORS	9
Principle of operation- Construction details- Characteristics and applications of resistive potentiometer Strain gauges- Resistive thermometers- Thermistors- Piezoresistive sensors Inductive potentiometer Variable reluctance transducers:- EI pick up and LVDT		
Unit III	VARIABLE AND OTHER SPECIAL SENSORS	9
Variable air gap type, variable area type and variable permittivity type- capacitor microphone Piezoelectric, Magnetostrictive, Hall Effect, semiconductor sensor- digital transducers-Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.		
Unit IV	AUTOMOTIVE ACTUATORS	9
Electromechanical actuators- Fluid-mechanical actuators- Electrical machines- Direct-current machines- Three-phase machines- Single-phase alternating-current Machines - Duty-type ratings for electrical machines. Working principles, construction and location of actuators viz. Solenoid, relay, stepper motor etc.		
Unit V	AUTOMATIC TEMPERATURE CONTROL ACTUATORS	9
Different types of actuators used in automatic temperature control- Fixed and variable displacement temperature control- Semi Automatic- Controller design for Fixed and variable displacement type air conditioning system.		
Total periods:45 PERIODS		
Text Books:		
1. Doebelin's Measurement Systems: 7th Edition (SIE),Ernest O. Doebelin DhaneshN.Manik McGraw Hill Publishers, 2019.		

2. Robert Brandy, “ Automotive Electronics and Computer System”, Prentice Hall,2001															
3. William Kimberley,” Bosch Automotive Handbook”, 6th Edition, Robert Bosch GmbH, 2004.															
4. Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th Edition, 2007, ISBN No: 978-3-658-01783-5.															
References:															
1. James D Halderman, “ Automotive Electrical and Electronics” , Prentice Hall, USA, 2013															
2. Tom Denton, “Automotive Electrical and Electronics Systems,” Third Edition, 2004, SAE International.															
3. Patranabis.D, “ Sensors and Transducers”, 2nd Edition, Prentice Hall India Ltd,2003															
4. William Ribbens, "Understanding Automotive Electronics -An Engineering Perspective," 7th Edition, Elsevier Butterworth-Heinemann Publishers, 2012.															
Course Outcomes:													Blooms Taxonomy		
CO 1: List common types of sensor and actuators used in vehicles.													Understand		
CO2: Design measuring equipment’s for the measurement of pressure force, temperature and flow.													Analyze		
CO3: Generate new ideas in designing the sensors and actuators for automotive application													Understand		
CO4: Understand the operation of the sensors, actuators and electronic control													Apply		
CO5: Design temperature control actuators for vehicles.													UNderstand		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	-	-	-	-	1	1	2	3	2	3
CO2	2	3	1	1	2	-	-	-	-	1	2	2	3	3	2
CO3	2	3	2	2	2	-	-	-	-	1	2	3	3	3	2
CO4	3	2	2	2	2	-	-	-	-	2	3	2	3	3	3
CO5	3	3	3	2	3	-	-	-	-	2	1	2	3	2	3

23ECO005	SPACE VEHICLES	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					

• Basics of Aerodynamics • Fundamentals of Propulsion		
Course Objectives: • To interpret the missile space stations, space vs earth environment. • To explain the life support systems, mission logistics and planning. • To deploy the skills effectively in the understanding of space vehicle configuration design. • To explain Engine system and support of space vehicle • To interpret nose cone configuration of space vehicle		
Unit I	FUNDAMENTAL ASPECTS	9
Energy and Efficiencies of power plants for space vehicles – Typical Performance Values – Mission design – Structural design aspects during launch - role of launch environment on launch vehicle integrity		
Unit II	SELECTION OF ROCKET PROPULSION SYSTEMS	9
Ascent flight mechanics – Launch vehicle selection process – Criteria for Selection for different missions – selection of subsystems – types of staging – Interfaces – selection and criteria for stages and their role in launch vehicle configuration design.		
Unit III	ENGINE SYSTEMS, CONTROLS, AND INTEGRATION	9
Propellant Budget – Performance of Complete or Multiple Rocket Propulsion Systems – Engine Design – Engine Controls – Engine System Calibration – System Integration and Engine Optimization		
Unit IV	THRUST VECTOR CONTROL	9
TVC Mechanisms with a Single Nozzle – TVC with Multiple Thrust Chambers or Nozzles – Testing – Integration with Vehicle – SITVC method – other jet control methods - exhaust plume problems in space environment		
Unit V	NOSE CONE CONFIGURATION	9
Aerodynamic aspects on the selection of nose shape of a launch vehicle - design factors in the finalization of nose configuration with respect to payload - nose cone thermal protection system - separation of fairings - payload injection mechanism		
Total periods: 45 PERIODS		
Textbook		
1. R. K. Jain and Sunil S. Rao, <i>Industrial Safety, Health and Environment Management Systems</i> , Khanna Publishers, New Delhi, 2006		
2. Slote L., <i>Handbook of Occupational Safety and Health</i> , John Wiley & Sons, New York		
References		

1. Jeanne Mager Stellman , <i>Encyclopedia of Occupational Health and Safety (ILO)</i> , Ms. Irma Jourdan Publication															
2. Frank P. Lees , <i>Loss Prevention in Process Industries</i> , Vol. 1 & 2, Butterworth-Heinemann Ltd., London.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Explain exotic space propulsion concepts, such as nuclear, solar sail, and antimatter.													Understand		
CO2: Apply knowledge in selecting the appropriate rocket propulsion systems													Analyze		
CO3: interpret the air-breathing propulsion suitable for initial stages and fly-back boosters.													Understand		
CO4: Analyze aerodynamics aspect, including boost-phase lift and drag, hypersonic, and re-entry.													Analyze		
CO5: Adapt from aircraft engineers moving into launch vehicle, spacecraft, and hypersonic vehicle design.													Apply		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	-	-	-	-	1	1	2	3	2	2
CO2	3	3	3	2	2	-	-	-	-	2	2	2	3	3	3
CO3	3	3	2	2	2	-	-	-	-	2	2	2	3	3	3
CO4	2	2	3	1	2	-	-	-	-	1	1	2	3	3	3
CO5	1	3	2	1	2	-	-	-	-	2	2	2	3	3	2

23MGO006	MANAGEMENT SCIENCE	Category: OEC			
		L	T	P	C
Prerequisites • Basic knowledge of Economics • Fundamentals of Engineering Management • Basic Mathematical Skills					
Course Objectives: • To introduce fundamental concepts of management and organization to students. • To impart knowledge to students on various aspects of marketing, quality control and marketing strategies.					

- To make students familiarize with the concepts of human resources management. - To acquaint students with the concepts of project management and cost analysis. - To make students familiarize with the concepts of planning process and business strategies.		
Unit I	INTRODUCTION TO MANAGEMENT AND ORGANISATION	9
Concepts of Management and organization- nature, importance and Functions of Management, Systems Approach to Management - Taylor's Scientific Management Theory- Fayal's Principles of Management- Maslow's theory of Hierarchy of Human Needs- Douglas McGregor's TheoryX and TheoryY- HertzbergTwoFactorTheoryofMotivation-LeadershipStyles, Social responsibilities of Management, Designing Organisational Structures: Basic concepts related to Organisation - Departmentation and Decentralisation		
Unit II	OPERATIONS AND MARKETING MANAGEMENT	9
Principles and Types of Plant Layout-Methods of Production(Job, batch and Mass Production), Work Study - Basic procedure involved in Method Study and Work Measurement – Business Process Reengineering (BPR)-Statistical Quality Control:control charts for Variables and Attributes (simple Problems) and Acceptance Sampling, Objectives of Inventory control, EOQ,ABC Analysis, Purchase Procedure, Stores Management and Store Records - JIT System,Supply Chain Management, Functions of Marketing, Marketing Mix, and Marketing Strategies based on ProductLifeCycle.		
Unit III	HUMAN RESOURCES MANAGEMENT	9
Concepts of HRM, HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR, Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development, Wage and Salary Administration, Promotion, Transfer, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating –Capability Maturity Model (CMM)Levels.		
Unit IV	PROJECT MANAGEMENT	9
Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method(CPM), identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing (simple problems)		
Unit V	STRATEGIC MANAGEMENT AND CONTEMPORARY STRATEGIC ISSUES	9
Mission, Goals, Objectives, Policy, Strategy, Programmes, Elements of Corporate Planning Process, Environmental Scanning, Value Chain Analysis, SWOT Analysis, Steps in Strategy Formulation and Implementation, Generic Strategy alternatives. Bench Marking and Balanced Score Cards Contemporary Business Strategies.		
Total periods: 45 PERIODS		

Text Books:															
1. Kanishka Bedi, Production and Operations Management, Oxford University Press, 2007															
2. Stoner, Freeman, Gilbert, Management, 6th Ed, Pearson Education, New Delhi, 2004.															
3. Thomas N. Duening & John M. Ivancevich Management Principles and Guidelines, Biztantra, 2007.															
4. P. Vijay Kumar, N. Appa Rao and Ashnab, Chnalill, Cengage Learning India, 2012															
References:															
1. P. Vijay Kumar, N. Appa Rao and Ashnab, Chnalill, Cengage Learning India, 2012															
2. Koontz and Weihrich: Essentials of Management, McGraw Hill, 2012.															
3. Lawrence R. Jauch, R. Gupta and William F. Glueck: Business Policy and Strategic Management Science, McGraw Hill, 2012.															
4. Samuel C. Certo: Modern Management, 2012.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Plan an organizational structure for a given context in the organization to carry out production operations through Work-study													Understand		
CO2: Survey the markets, customers and competition better and price the given products appropriately													Analyze		
CO3: Ensure quality for a given product or service													Understand		
CO4: Plan, schedule and control projects through PERT and CPM.													Apply		
CO5: Evaluate strategy for a business or service organisation													Understand		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1	2	-	-	-	2	1	1	2	2	2	2
CO2	1	2	2	2	3	-	-	-	2	2	1	2	3	2	2
CO3	2	2	3	2	3	-	-	-	1	1	1	2	3	1	3
CO4	2	3	2	3	2	-	-	-	2	1	2	2	2	3	3
CO5	1	3	2	2	2	-	-	-	3	3	2	3	3	2	2

23MEO014	PRODUCTION PLANNING AND CONTROL	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic Industrial Engineering • Fundamentals of Production / Operations Management					

• Basic Mathematics (Statistics & Optimization concepts) • Understanding of Manufacturing Processes • Basic knowledge of Inventory and Cost Concepts		
Course Objectives: • To understand the concept of production planning and control act work study, • To apply the concept of product planning, • To analyze the production scheduling, • To apply the Inventory Control concepts. • To prepare the manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP)		
Unit I	INTRODUCTION	9
Objectives and benefits of planning and control-Functions of production control-Types of production job-batch and continuous-Product development and design-Marketing aspect - Functional aspects Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration Standardization, Simplification & specialization- Break even analysis-Economics of a new design.		
Unit II	WORK STUDY	9
Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.		
Unit III	PRODUCT PLANNING AND PROCESS PLANNING	9
Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi product system.		
Unit IV	PRODUCTION SCHEDULING	9
Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems - Line of balance – Flow production scheduling Batch production scheduling-Product sequencing – Production Control systems- Periodic batch control Material requirement planning kanban – Dispatching-Progress reporting and expediting- Manufacturing lead time- Techniques for aligning completion times and due dates.		
Unit V	INVENTORY CONTROL AND RECENT TRENDS IN PP	9

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system-Determination of Economic order quantity and economic lot size ABC analysis - Recorder procedure-Introduction to computer integrated production planning systems elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP

Total periods: 45 PERIODS

Text Books:

1. James. B. Dilworth, "Operations management – Design, Planning and Control for manufacturing and services" McGraw Hill International edition 1992.

2. Martand Telsang, "Industrial Engineering and Production Management", First edition, S. Chand and Company, 2000

References:

1. Chary. S.N., "Theory and Problems in Production & Operations Management", Tata McGraw Hill, 1995

2 Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / Operations Management", 8th Edition John Wiley and Sons, 2000.

3. Jain. K.C. & Aggarwal. L.N., "Production Planning Control and Industrial Management", Khanna Publishers, 1990

4. Kanishka Bedi, "Production and Operations management", 2nd Edition, Oxford university press, 2007

Course Outcomes:

Blooms Taxonomy

CO 1: The students can able to prepare production planning and control act work study,

Understand

CO2: The students can able to prepare product planning

Analyze

CO3: The students can able to prepare production scheduling,

Understand

CO4: :The students can able to prepare Inventory Control

Analyze

CO5: They can plan manufacturing requirements manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

Apply

CO-PO Mapping

Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	2	-	-	-	2	2	1	2	2	2	2
CO2	2	2	2	2	3	-	-	-	2	2	2	2	3	2	3
CO3	2	3	2	2	3	-	-	-	1	2	2	2	3	3	2
CO4	1	2	2	3	2	-	-	-	2	3	2	2	2	2	2

CO5	2	3	3	3	3	-	-	-	3	2	3	2	3	3	3

23MGO007	OPERATIONS MANAGEMENT	Category: OEC			
		L	T	P	C
		3	0	0	3

Prerequisites

- Basic knowledge of Management Principles
- Fundamentals of Industrial Engineering
- Basic Mathematics & Statistics
- Understanding of Manufacturing Systems
- Introductory knowledge of Supply Chain & Logistics

Course Objectives:

- Recognize and appreciate the concept of Production and Operations Management in creating and enhancing a firm's competitive advantages.
- Describe the concept and contribution of various constituents of Production and Operations Management (both manufacturing and service).
- Relate the interdependence of the operations function with the other key functional areas of a firm.
- Teach analytical skills and problem-solving tools to the analysis of the operations problems.
- Apply scheduling and Lean Concepts for improving System Performance

Unit I	INTRODUCTION TO OPERATIONS MANAGEMENT	9

Operations Management – Nature, Importance, historical development, transformation processes, differences between services and goods, a system perspective, functions, challenges, current priorities, recent trends; Operations Strategy - Strategic fit , framework; Supply Chain Management

Unit II	FORECASTING, CAPACITY AND FACILITY DESIGN	9

Demand Forecasting - Need, Types, COURSE OBJECTIVES and Steps. Overview of Qualitative And Quantitative methods. Capacity Planning - Long range, Types, Developing capacity alternatives. Overview of sales and operations planning. Overview of MRP, MRP II and ERP. Facility Location – Theories, Steps in Selection, Location Models. Facility Layout – Principles, Types, Planning tools and techniques.

Unit III	DESIGN OF PRODUCT, PROCESS AND WORK SYSTEMS	9

Product Design – Influencing factors, Approaches, Legal, Ethical and Environmental issues. Process – Planning, Selection, Strategy, Major Decisions. Work Study – COURSE OBJECTIVES,

Procedure .Method Study and Motion Study. Work Measurement and Productivity – Measuring Productivity and Methods to improve productivity.		
Unit IV	MATERIALS MANAGEMEN	9
Materials Management – COURSE OBJECTIVES, Planning, Budgeting and Control. Purchasing – COURSE OBJECTIVES, Functions, Policies, Vendor rating and Value Analysis. Stores Management – Nature, Layout, Classification and Coding. Inventory – Costs and control techniques. Overview of JIT		
Unit V	SCHEDULING AND PROJECT MANAGEMENT	9
Project Management – Scheduling Techniques, PERT, CPM; Scheduling - work centers – nature, importance; Priority rules and techniques, shopfloor control; Flow shop scheduling – Johnson’s Algorithm – Gantt charts; personnel scheduling in services.		
Total periods: 45 PERIODS		
Text Books:		
1. Richard B. Chase, Ravi Shankar, F. Robert Jacobs, Nicholas J. Aquilano, Operations and Supply Management, Tata McGraw Hill, 12th Edition, 2010		
2. Norman Gaither and Gregory Frazier, Operations Management, South Western Cengage Learning, 2002.		
References:		
1. William J Stevenson, Operations Management, Tata McGraw Hill, 9 th Edition, 2009.		
2. Russel and Taylor, Operations Management, Wiley, Fifth Edition, 2006		
3. Kanishka Bedi, Production and Operations Management, Oxford University Press, 2004		
4. . Chary S. N, Production and Operations Management, Tata McGraw Hill, Third Edition, 2008.		
5. Aswathappa K and Shridhara Bhat K, Production and Operations Management, Himalaya Publishing House, Revised Second Edition, 2008.		
6. Pannerselvam R, Production and Operations Management, Prentice Hall India, Second Edition, 2008		
Course Outcomes:		Blooms Taxonomy
CO 1: The students will appreciate the role of Production and Operations management in enabling and enhancing a firm’s competitive advantages in the dynamic business environment.		Understand
CO2: : The students will obtain sufficient knowledge and skills to forecast demand for Production and Service Systems		Analyze
CO3: The students will able to Formulate and Assess Aggregate Planning strategies and Material Requirement Plan		Understand

CO4: The students will be able to develop analytical skills to calculate capacity requirements and developing capacity alternatives													Analyze		
CO5: The students will be able to apply scheduling and Lean Concepts for improving System Performance.													Apply		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1	1	-	-	-	2	2	1	2	2	3	2
CO2	2	2	2	2	2	-	-	-	1	1	1	2	3	3	3
CO3	2	3	2	2	2	-	-	-	2	2	1	3	3	2	3
CO4	3	3	2	3	2	-	-	-	1	1	2	3	2	2	2
CO5	2	3	3	3	3	-	-	-	2	2	2	3	3	3	2

23BMO003	INDUSTRIAL HYGEINE	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: • Demonstrate an understanding of how occupational hygiene standards are set and used in work health and safety. • Compare and contrast the roles of environmental and biological monitoring in work health and safety • Outline strategies for identifying, assessing and controlling risks associated with airborne gases, vapours and particulates • Discuss how personal protective equipment can be used to reduce risks associated with workplace exposures • Provide high-level advice on managing and controlling noise and noise-related hazards					
Unit I	INTRODUCTION AND SCOPE				9
Occupational Health and Environmental Safety Management - Principles practices. Comm on Occupational diseases: Occupational Health Management Services at the work place. Pre-employment, periodic medical examination of workers, medical surveillance for control of occupational diseases and health records					
Unit II	MONITORING FOR SAFETY, HEALTH & ENVIRONMENT				9

Occupational Health and Environment Safety Management System, ILO and EPA Standards Industrial Hygiene: Definition of Industrial Hygiene, Industrial Hygiene: Control Methods, Substitution, Changing the process, Local Exhaust Ventilation, Isolation, Wet method, Personal hygiene, housekeeping and maintenance, waste disposal, special control measures		
Unit III	OCCUPATIONAL HEALTH AND ENVIRONMENTAL SAFETY EDUCATION	9
Element of training cycle, Assessment of needs. Techniques of training, design and development of training programs. Training methods and strategies types of training. Evaluation and review of training programs. Occupational Health Hazards, Promoting Safety, Safety and Health training, Stress and Safety, Exposure Limits.		
Unit IV	OCCUPATIONAL SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT	9
Bureau of Indian standards on safety and health 14489 - 1998 and 15001 – 2000, OSHA, Process Safety Management (PSM) as per OSHA, PSM principles, OHSAS – 18001, EPA Standards, Performance measurements to determine effectiveness of PSM. Importance of Industrial safety, role of safety department,		
Unit V	INDUSTRIAL HAZARDS	9
Radiation: Types and effects of radiation on human body, Measurement and detection of radiation intensity. Effects of radiation on human body, Measurement – disposal of radioactive waste, Control of radiation ii. Noise and Vibration: Sources, and its control, Effects of noise on the auditory system and health, Measurement of noise , Different air pollutants in industries, Effect of different gases and particulate matter ,acid fumes ,smoke, fog on human health, Vibration: effects.		
Total periods:45 PERIODS		
Text Books:		
1. R. K. Jain and Sunil S. Rao , Industrial Safety , Health and Environment Management Systems, Khanna publishers, New Delhi (2006)		
2. Slote. L, Handbook of Occupational Safety and Health, John Willey and Sons, New York .		
References:		
1. Jeanne MagerStellman, Encyclopedia of Occupational Health and Safety (ILO) Ms. Irma Jourdan publication		
2. Frank P Lees - Loss of prevention in Process Industries, Vol. 1 and 2		
3. ButterworthHeinemann Ltd., London (1991). 2. Industrial Safety - National Safety Council of India		

4. Frank P Lees – Loss of prevention in Process Industries , Vol. 1 and 2, Butterworth- Heinemann Ltd., London

5. R. K. Jain and Sunil S. Rao, Industrial Safety , Health and Environment Management Systems, Khanna publishers, New Delhi (2006).

Course Outcomes:													Blooms Taxonomy		
CO 1: Explain and apply human factors engineering concepts in both evaluation of existing systems and design of new systems													Understand		
CO2: Specify designs that avoid occupation related injuries													Analyze		
CO3: Define and apply the principles of work design, motion economy, and work environment design													Understand		
CO4: Identify the basic human sensory, cognitive, and physical capabilities and limitations with respect to human-machine system performance.													Analyze		
CO5: Acknowledge the impact of workplace design and environment on productivity													Understand		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	2	3	2	1	2	1	3	2	2	2
CO2	3	3	2	2	1	2	3	2	1	2	1	3	3	2	3
CO3	3	3	3	2	2	2	3	2	1	2	1	3	3	3	3
CO4	2	2	2	3	2	3	3	2	1	2	1	3	2	3	2
CO5	2	3	2	2	3	2	3	2	2	2	1	3	2	3	2

23CHO008	CHEMICAL PROCESS SAFETY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic Chemistry and Chemical Engineering Fundamentals • Thermodynamics and Process Engineering • Material & Energy Balances (recommended)					

Course Objectives:

- Teach the principles of safety applicable to the design, and operation of chemical process plants.
- Ensure that potential hazards are identified and mitigation measures are in place to prevent unwanted release of energy.
- Learn about the hazardous chemicals into locations that could expose employees and others to serious harm.
- Focuses on preventing incidents and accidents during large scale manufacturing of chemicals and pharmaceuticals.
- Ensure that the general design of the plant is capable of complying with the dose limits in force and with the radioactive releases.

Unit I	SAFETY IN THE STORAGE AND HANDLING OF CHEMICALS AND GASES	9
Types of storage-general considerations for storage layouts- atmospheric venting, pressure and temperature relief - relief valve sizing calculations - storage and handling of hazardous chemicals and industrial gases, safe disposal methods, reaction with other chemicals, hazards during transportation - pipe line transport - safety in chemical laboratories		
Unit II	CHEMICAL REACTION HAZARDS	9
Hazardous inorganic and organic reactions and processes, Reactivity as a process hazard, Detonations, Deflagrations, and Runaways, Assessment and Testing strategies, Self - heating hazards of solids, Explosive potential of chemicals, Structural groups and instability of chemicals, Thermochemical screening,		
Unit III	SAFETY IN THE DESIGN OF CHEMICAL PROCESS PLANTS	9
Design principles -Process design development -types of designs, feasibility survey, preliminary design, Flow diagrams, piping and instrumentation diagram, batch versus continuous operation, factors in equipment scale up and design, equipment specifications - reliability and safety in designing - inherent safety - engineered safety - safety during startup and shutdown - non destructive testing methods - pressure and leak testing - emergency safety devices - scrubbers and flares- new concepts in safety design and operation- Pressure vessel testing standards- Inspection techniques for boilers and reaction vessels.		
Unit IV	SAFETY IN THE OPERATION OF CHEMICAL PROCESS PLANTS	9
Properties of chemicals - Material Safety Data Sheets - the various properties and formats used - methods available for property determination. Operational activities and hazards -standards operating procedures - safe operation of pumps, compressors, heaters, column, reactors, pressure vessels, storage vessels, piping		

systems - effects of pressure, temperature, Flow rate and humidity on operations - corrosion and control measures- condition monitoring - control valves - safety valves - pressure reducing valves, drains, bypass valves, inert gases. Chemical splashes, eye irrigation and automatic showers.															
Unit V		SAFETY AND ANALYSIS												9	
Safety vs reliability- quantification of basic events, system safety quantification, Human error analysis, Accident investigation and analysis, OSHAS 18001 and OSHMS.															
Total periods: 45 PERIODS															
Text Books:															
1. David A Crowl& Joseph F Louvar,”Chemical Process safety”, Pearson publication, 3rd Edition,2014															
2. Maurice Jones .A,”Fire Protection Systems,2nd edition, Jones & Bartlett Publishers,2015															
References:															
1. Ralph King and Ron Hirst,”King’s safety in the process industries”, Arnold, London, 1998.															
2. Industrial Environment and its Evolution and Control, NIOSH Publication, 1973.															
3. National Safety Council,” Accident prevention manual for industrial operations”. Chicago, 1982.															
4. Lewis, Richard. J., Sr,“Sax’s dangerous properties of materials”. (Ninth edition). Van Nostrand Reinhold, New York, 1996.															
5. Roy E Sanders, ”Chemical Process Safety”,3rd Edition, Gulf professional publishing, 2006															
Course Outcomes:													Blooms Taxonomy		
CO1: Differentiate between inherent safety and engineered safety and recognize the importance of safety in the design of chemical process plants													Understand		
CO2: Develop thorough knowledge about safety in the operation of chemical plants.													Understand		
CO3: Apply the principles of safety in the storage and handling of gases													Apply		
CO4: Identify the conditions that lead to reaction hazards and adopt measures to prevent them.													Apply		
CO5: Develop thorough knowledge about													Understand		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	1	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-	3	2	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	2	2	-
CO5	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1

1- Low, 2- Medium, 3- High, ‘ - ‘-No correlation

23EE007	ELECTRICAL, ELECTRONIC AND MAGNETIC MATERIALS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Basic Physics (Electricity, Magnetism, and Solid-State Physics) - Materials Science fundamentals - Semiconductor devices (recommended but not mandatory)					
Course Objectives: - Understanding the importance of various materials used in electrical, electronics and magnetic applications Acquiring knowledge on the properties of electrical, electronics and magnetic materials. - Gaining knowledge on the selection of suitable materials for the given application - Knowing the fundamental concepts in Semiconducting materials - Getting equipped with the materials used in optical and optoelectronic applications.					
Unit I	DIELECTRIC MATERIALS				9
Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials					
Unit II	MAGNETIC MATERIALS				9
Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, sOECial purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and Hysteresis					
Unit III	SEMICONDUCTOR MATERIALS				9
Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale Integration techniques. Concept of superconductivity; theories and examples for high temperature superconductivity; discussion on sOECific superconducting materials; comments on fabrication and engineering applications					
Unit IV	MATERIALS FOR ELECTRICAL APPLICATIONS				9
Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetals fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation.					

Unit V	OPTICAL AND OPTOELECTRONIC MATERIALS												9		
Principles of photoconductivity - effect of impurities - principles of luminescence-laser principles - HeNe, injection lasers, LED materials - binary, ternary photoelectronic materials - LCD materials - photo detectors - applications of optoelectronic materials - optical fibres and materials - electro optic modulators - Kerr effect - Pockels effect.															
Total periods: 45 PERIODS															
Text Books:															
1. Pradeep Fulay, “Electronic, Magnetic and Optical materials”, CRC Press, taylor and Francis, 2nd illustrated edition, 2017															
2. “R K Rajput”, “A course in Electrical Engineering Materials”, Laxmi Publications, 2009.															
References:															
1. T K Basak, “A course in Electrical Engineering Materials”, New Age Science Publications, 2009															
2. TTTI Madras, “Electrical Engineering Materials”, McGraw Hill Education, 2004.															
3. Adrianus J. Dekker, “Electrical Engineering Materials”, PHI Publication, 2006.															
4. S. P. Seth, P. V. Gupta “A course in Electrical Engineering Materials”, Dhanpat Rai & amp; Sons, 2011															
5. C. Kittel, “Introduction to Solid State Physics”, 7th Edition, John Wiley & Sons,Singapore, (2006)															
Course Outcomes:													Blooms Taxonomy		
CO1: Understand various types of dielectric materials, their properties in various conditions.													Understand		
CO2: Evaluate magnetic materials and their behavior.													Analyze		
CO3: Evaluate semiconductor materials and technologies.													Analyze		
CO4: Select suitable materials for electrical engineering applications.													Apply		
CO5: Identify right material for optical and optoelectronic applications													Apply		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	2	2	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	2	2	1
CO5	3	2	2	-	-	-	-	-	-	-	-	-	2	2	1
1- Low, 2- Medium, 3- High, ‘-’ -No correlation															

23CHO009	NANOMATERIALS AND APPLICATIONS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic Materials Science • Solid-State Physics • Fundamentals of Chemistry (esOEcially physical chemistry)					
Course Objectives: • Understanding the evolution of nanomaterials in the scientific era and make them to understand different types of nanomaterials for the future engineering applications • Gaining knowledge on dimensionality effects on different properties of nanomaterials • Getting acquainted with the different processing techniques employed for fabricating nanomaterials					
Unit I	NANOMATERIALS				9
Introduction, Classification: 0D, 1D, 2D, 3D nanomaterials and nano-composites, their mechanical, electrical, optical, magnetic properties; Nanomaterials versus bulk materials.					
Unit II	THERMODYNAMICS & KINETICS OF NANOSTRUCTURED MATERIALS				9
Size and interface/interphase effects, interfacial thermodynamics, phase diagrams, diffusivity, grain growth, and thermal stability of nanomaterials.					
Unit III	PROCESSING				9
Bottom-up and top-down approaches for the synthesis of nanomaterials, mechanical alloying, chemical routes, severe plastic deformation, and electrical wire explosion technique.					
Unit IV	STRUCTURAL CHARACTERISTICS				9
Principles of emerging nanoscale X-ray techniques such as small angle X-ray scattering and X-ray absorption fine structure (XAFS), electron and neutron diffraction techniques and their application to nanomaterials; SPM, Nanoindentation, Grain size, phase formation, texture, stress analysis					
Unit V	APPLICATIONS				9
Applications of nanoparticles, quantum dots, nanotubes, nanowires, nanocoatings; applications in electronic, electrical and medical industries					
Total periods: 45 PERIODS					
Text Books:					
1. Bhusan, Bharat (Ed), “Springer Handbook of Nanotechnology”, 2nd edition, 2007					
2. Carl C. Koch (ed.), NANOSTRUCTURED MATERIALS, Processing, Properties and Potential					

Applications, NOYES PUBLICATIONS, Norwich, New York, U.S.A.															
References:															
1. Poole C.P, and Owens F.J., Introduction to Nanotechnology, John Wiley 2003															
2. Nalwa H.S., Encyclopedia of Nanoscience and Nanotechnology, American Scientific Publishers 2004															
3. Zehetbauer M.J. and Zhu Y.T., Bulk Nanostructured Materials, Wiley 2008															
4. Wang Z.L., Characterization of Nanophase Materials, Wiley 2000															
5. Gutkin Y., Ovid'ko I.A. and Gutkin M., Plastic Deformation in Nanocrystalline Materials, Springer 2004															
Course Outcomes:													Blooms Taxonomy		
CO1: Evaluate nanomaterials and understand the different types of nanomaterials													Understand		
CO2: Recognise the effects of dimensionality of materials on the properties.													Analyze		
CO3: Process different nanomaterials and use them in engineering applications													Apply		
CO4: Use appropriate techniques for characterising nanomaterials													Apply		
CO5: . Identify and use different nanomaterials for applications in different engineering fields.													Apply		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	2	2	1
CO4	3	2	2	-	-	-	-	-	-	-	-	-	2	2	1
CO5	3	2	2	-	-	-	-	-	-	-	-	-	2	2	1
	2	1	-	-	-	-	-	-	-	-	-	-	2	1	-
1- Low, 2- Medium, 3- High, '-' -No correlation															

23CEO010	HYDRAULICS AND PNEUMATICS	Category: OEC			
		L	T	P	L
		3	0	0	3
Prerequisites • Engineering Physics – basic fluid properties and pressure concepts • Fluid Mechanics – Bernoulli equation, laminar/turbulent flow, losses • Engineering Mathematics – basic calculus for flow/pressure calculations • Basic Mechanical Engineering – understanding of mechanical components					

Engineering Drawing – reading and interpreting hydraulic/pneumatic symbols		
Course Objectives: - To provide the knowledge on the working principles of fluid power systems. - To study the fluids and components used in modern industrial fluid power system. - To develop the design, construction and operation of fluid power circuits. - To learn the working principles of pneumatic power system and its components. To provide the knowledge of trouble shooting methods in fluid power systems.		
Unit I	FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS	6
Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal’s Law – Principles of flow - Friction loss – Work, Power and Torque Problems, Sources of Hydraulic power: Pumping Theory— Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of pumps – Fixed and Variable displacement pumps – Problems		
Unit II	HYDRAULIC ACTUATORS AND CONTROL COMPONENTS	6
Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Rotary Actuators Hydraulic motors - Control Components: Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Accessories: Reservoirs, Pressure Switches – Filters –types and selection- Applications – Fluid Power ANSI Symbols – Problems		
Unit III	HYDRAULIC CIRCUITS AND SYSTEMS	6
Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Deceleration circuits, Sizing of hydraulic systems, Hydrostatic transmission, Electro hydraulic circuits, – Servo and Proportional valves – Applications- Mechanical, hydraulic servo systems.		
Unit IV	PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS	6
Properties of air –Air preparation and distribution – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit –classification- single cylinder and multi cylinder circuits-Cascade method –Integration of fringe circuits, Electro Pneumatic System – Elements – Ladder diagram – timer circuits-Problems, Introduction to fluidics and pneumatic logic circuits		
Unit V	TROUBLE SHOOTING AND APPLICATIONS	6
Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Conditioning of hydraulic fluids Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications- mobile hydraulics; Design of Pneumatic circuits for metal		

working, handling, clamping counter and timer circuits. – Low-cost Automation – Hydraulic and Pneumatic power packs, IOT in Hydraulics and pneumatics Note: (Use of standard Design Data Book is permitted in the University examination)

Total periods: 45

Text Books:

1. Anthony Esposito, “Fluid Power with Applications”, Prentice Hall, 2009.
2. James A. Sullivan, “Fluid Power Theory and Applications”, Fourth Edition, Prentice Hall, 1997

References:

1. Jagadeesha. T., “Pneumatics Concepts, Design and Applications “, Universities Press, 2015
2. Joshi.P., Pneumatic Control”, Wiley India, 2008.
3. Majumdar, S.R., “Oil Hydraulics Systems – Principles and Maintenance”, TataMcGraw Hill, 2001.
4. Shanmugasundaram.K., “Hydraulic and Pneumatic Controls”. Chand & Co, 2006.
5. Srinivasan.R., “Hydraulic and Pneumatic Controls”, Vijay Nicole Imprints, 3rd edition, 2019.

Course Outcomes:

Blooms Taxonomy

CO1:Apply the working principles of fluid power systems and hydraulic pumps.

Apply (K3)

CO2:Apply the working principles of hydraulic actuators and control components.

Apply (K3)

CO3:Design and develop hydraulic circuits and systems.

Create (K6)

CO4:Apply the working principles of pneumatic circuits and power system and its components

Apply (K3)

CO5: Identify various troubles shooting methods in fluid power systems.

Analyze (K4)

CO-PO Mapping

Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2						1		2	3	2	
CO2	3	2	2	2						1		2	3	2	
CO3	3	2	3	3						2		3	3	3	
CO4	3	2	2	2						1		2	3	2	
CO5	2	2	2	2						1		2	2	2	1

1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation

23EEO008	SENSORS	Category: OEC

		L	T	P	C
		3	0	0	3
Prerequisites • Basic Electrical and Electronics Engineering • Fundamentals of Measurement and Instrumentation					
Course Objectives: • To learn the various types of sensors, transducers, sensor output signal types, calibration techniques, formulation of system equation and its characteristics. • To understand basic working principle, construction, Application and characteristics of displacement, speed and ranging sensors. • To understand and analyze the working principle, construction, application and characteristics of force, magnetic and heading sensors. • To learn and analyze the working principle, construction, application and characteristics of optical, pressure, temperature and other sensors. • To familiarize students with different signal conditioning circuits design and data acquisition system.					
Unit I	SENSOR CLASSIFICATION, CHARACTERISTICS AND SIGNAL TYPES				9
Basics of Measurement – Classification of Errors – Error Analysis – Static and Dynamic Characteristics of Transducers – Performance Measures of Sensors – Classification of Sensors – Sensor Calibration Techniques – Sensor Outputs - Signal Types - Analog and Digital Signals, PWM and PPM.					
Unit II	DISPLACEMENT, PROXIMITY AND RANGING SENSORS				9
Displacement Sensors – Brush Encoders - Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – Range Sensors - Ultrasonic Ranging - Reflective Beacons - Laser Range Sensor (LIDAR) – GPS - RF Beacons.					
Unit III	FORCE, MAGNETIC AND HEADING SENSORS				9
Strain Gage – Types, Working, Advantage, Limitation, and Applications: Load Measurement – Force and Torque Measurement - Magnetic Sensors – Types, Principle, Advantage, Limitation, and Applications - Magneto Resistive – Hall Effect, Eddy Current Sensor - Heading Sensors – Compass, Gyroscope and Inclinometers					
Unit IV	OPTICAL, PRESSURE, TEMPERATURE AND OTHER SENSORS				9
Photo Conductive Cell, Photo Voltaic, Photo Resistive, LDR – Fiber Optic Sensors – Pressure – Diaphragm – Bellows - Piezoelectric - Piezo-resistive - Acoustic, Temperature – IC, Thermistor, RTD, Thermocouple – Non Contact Sensor - Chemical Sensors - MEMS Sensors - Smart Sensors.					

Unit V	SIGNAL CONDITIONING													9		
Need for Signal Conditioning – Resistive, Inductive and Capacitive Bridges for Measurement - DC and AC Signal Conditioning - Voltage, Current, Power and Instrumentation Amplifiers – Filter and Isolation Circuits – Fundamentals of Data Acquisition System																
Total periods: 45 PERIODS																
Text Books:																
1. Bolton W., “Mechatronics”, Pearson Education, 6th Edition, 2015.																
2. Ramesh S Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, Penram International Publishing Private Limited, 6th Edition, 2013.																
References:																
1. Bradley D.A., Dawson D., Buru N.C. and Loader A.J., “Mechatronics”, Chapman and Hall, 1993.																
2. Davis G. Alciatore and Michael B. Histan, “Introduction to Mechatronics and Measurement systems”, McGraw Hill Education, 2011.																
3. Devadas Shetty and Richard A. Kolk, “Mechatronics Systems Design”, Cengage Learning, 2010.																
4. Nitaigour Premchand Mahalik, “Mechatronics Principles, Concepts and Applications”, McGraw Hill Education, 2015.																
5. Smaili. A and Mrad. F, “Mechatronics Integrated Technologies for Intelligent Machines”, Oxford University Press, 2007.																
Course Outcomes:														Blooms Taxonomy		
CO1: Understand various sensor effects, sensor characteristics, signal types, calibration methods and obtain transfer function and empirical relation of sensors. They can also analyze the sensor response.														Understand		
CO2: Analyze and select suitable sensor for displacement, proximity and range measurement..														Analyze		
CO3:Analyze and select suitable sensor for force, magnetic field, speed, position and direction measurement														Analyze		
CO4:Analyze and Select suitable sensor for light detection, pressure and temperature measurement and also familiar with other miniaturized smart sensors.														Analyze		
CO5: Select and design suitable signal conditioning circuit with proper compensation and linearizing element based on sensor output signal.														Apply		
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	-	

CO2	3	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	2	2	1
CO4	3	2	2	-	-	-	-	-	-	-	-	-	2	2	1
CO5	3	2	3	-	-	-	-	-	-	-	-	-	2	2	2

1- Low, 2- Medium, 3- High, '-' -No correlation

23MEO005	FOUNDATION OF ROBOTICS	Category: OEC			
		L	T	P	C
		3	0	0	3

Prerequisites

- Basic knowledge of Engineering Mathematics
- Basic knowledge of Mechanics / Kinematics
- Fundamentals of Electronics & Sensors
- Basics of Programming (C / Python)

Course Objectives:

- To study the kinematics, drive systems and programming of robots.
- To study the basics of robot laws and transmission systems.
- To familiarize students with the concepts and techniques of robot manipulator, its kinematics.
- To familiarize students with the various Programming and Machine Vision application in robots.

Unit I	FUNDAMENTALS OF ROBOT	9

Robot – Definition – Robot Anatomy – Co-ordinate systems, Work Envelope, types and classification – specifications – Pitch, yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and their functions – Need for Robots – Different Applications.

Unit II	ROBOT KINEMATICS	9

Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices.

Unit III	ROBOT DRIVE SYSTEMS AND END EFFECTORS	9

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of All These Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic grippers, vacuum

grippers, internal grippers and external grippers, selection and design considerations of a gripper		
Unit IV	SENSORS IN ROBOTICS	9
Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion, image storage, lighting techniques, image processing and analysis – data reduction, segmentation, feature extraction, object recognition, other algorithms, applications – Inspection, identification, visual serving and navigation.		
Unit V	PROGRAMMING AND APPLICATIONS OF ROBOT	9
Teach pendant programming, lead through programming, robot programming languages – VAL programming – Motion Commands, Sensors commands, End-Effector Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields.		
Total periods:45 PERIODS		
Text Books:		
1.Ganesh.S.Hedge,"A textbook of Industrial Robotics", Lakshmi Publications, 2006.		
2.Mikell.P.Groover , "Industrial Robotics – Technology, Programming and applications" McGraw Hill 2ND edition 2012.		
References:		
1.Fu K.S. Gonalz R.C. and ice C.S.G."Robotics Control, Sensing, Vision and Intelligence", McGraw Hill book 2007.		
2.YoramKoren, "Robotics for Engineers", McGraw Hill Book, Co., 2002.		
3.Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill 2005.		
4.John. J.Craig, "Introduction to Robotics: Mechanics and Control" 2nd Edition, 2002.		

23ECO006	CONCEPTS IN MOBILE ROBOTS	Category: OEC

		L	T	P	C
		3	0	0	3
Prerequisites - Basics of Robotics and Control Systems - Elementary knowledge of Sensors and Signal Processing					
Course Objectives: - To introduce mobile robotic technology and its types in detail. - To learn the kinematics of wheeled and legged robot. - To familiarize the intelligence into the mobile robots using various sensors. - To acquaint the localization strategies and mapping technique for mobile robot. - To aware the collaborative mobile robotics in task planning, navigation and intelligence.					
Unit I	INTRODUCTION TO MOBILE ROBOTICS				9
Introduction – Locomotion of the Robots – Key Issues on Locomotion – Legged Mobile Robots – Configurations and Stability – Wheeled Mobile Robots – Design Space and Mobility Issues – Unmanned Aerial and Underwater Vehicles					
Unit II	KINEMATICS				9
Kinematic Models – Representation of Robot – Forward Kinematics – Wheel and Robot Constraints – Degree of Mobility and Steerability – Manoeuvrability – Workspace – Degrees of Freedom – Path and Trajectory Considerations – Motion Controls - Holonomic Robots					
Unit III	PERCEPTION				9
Sensor for Mobile Robots – Classification and Performance Characterization – Wheel/Motor Sensors – Heading Sensors - Ground-Based Beacons - Active Ranging - Motion/Speed Sensors – Camera - Visual Appearance based Feature Extraction.					
Unit IV	LOCALIZATION				9
Localization Based Navigation Versus Programmed Solutions - Map Representation - Continuous Representations - Decomposition Strategies - Probabilistic Map-Based Localization - Landmark-Based Navigation - Globally Unique Localization - Positioning Beacon Systems - Route-Based Localization - Autonomous Map Building - Simultaneous Localization and Mapping (SLAM).					
Unit V	PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS				9
Introduction - Competences for Navigation: Planning and Reacting - Path Planning - Obstacle Avoidance - Navigation Architectures - Control Localization - Techniques for Decomposition - Case Studies – Collaborative Robots – Swarm Robots.					
Total periods: 45 PERIODS					

Text Books:															
1. Roland Siegwart and IllahR.Nourbakish, “Introduction to Autonomous Mobile Robots” MIT Press, Cambridge, 2004.															
References:															
1. Dragomir N. Nenchev, Atsushi Konno, TeppeiTsuchita, “Humanoid Robots: Modelling and Control”, Butterworth-Heinemann, 2018															
2. MohantaJagadish Chandra, “Introduction to Mobile Robots Navigation”, LAP Lambert Academic Publishing, 2015.															
3. Peter Corke, “Robotics, Vision and Control”, Springer, 2017															
4. Ulrich Nehmzow, “Mobile Robotics: A Practical Introduction”, Springer, 2003.															
5. Xiao Qi Chen, Y.Q. Chen and J.G. Chase, “Mobile Robots - State of the Art in Land, Sea, Air, and Collaborative Missions”, Intec Press, 2009.															
6. Alonzo Kelly, Mobile Robotics: Mathematics, Models, and Methods, Cambridge University Press, 2013, ISBN: 978-1107031159.															
Course Outcomes:													Blooms Taxonomy		
CO1: Evaluate the appropriate mobile robots for the desired application.													Evaluate		
CO2: Create the kinematics for given wheeled and legged robot.													Create		
CO3: Analyse the sensors for the intelligence of mobile robotics.													Analyze		
CO4: Create the localization strategies and mapping technique for mobile robot.													Create		
CO5: Create the collaborative mobile robotics for planning, navigation and intelligence for desired applications.													Create		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	-	2	2	1
CO2	3	2	2	-	-	-	-	-	-	-	-	-	2	2	1
CO3	3	2	2	-	-	-	-	-	-	-	-	-	2	2	1
CO4	3	2	3	-	-	-	-	-	-	-	-	-	2	2	2
CO5	3	2	3	-	-	-	-	-	-	-	-	-	2	2	2
1- Low, 2- Medium, 3- High, ‘-’ -No correlation															

23MEO015	MARINE PROPULSION	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Fundamentals of fluid mechanics - Basics of thermodynamics (thermodynamic cycles, energy conversion) - Basic engineering mechanics (forces, moments, motion)					
Course Objectives: - To impart knowledge on basics of propulsion system and ship dynamic movements - To educate them on basic layout and propulsion equipment's - To impart basic knowledge on performance of the ship - To impart basic knowledge on Ship propeller and its types - To impart knowledge on ship rudder and its types					
Unit I	BASICS SHIP PROPULSION SYSTEM AND EQUIPMENTS				9
law of floatation - Basics principle of propulsion- Earlier methods of propulsion- ship propulsion machinery- boiler, Marine steam engine, diesel engine, ship power transmission system, ship dynamic structure, Marine propulsion equipment - shaft tunnel, Intermediate shaft and bearing, stern tube, stern tube sealing etc. degree of freedom, Modern propelling methods- water jet propulsion , screw propulsion.					
Unit II	SHIPS MOVEMENTS AND SHIP STABILIZATION				9
Thrust augmented devices, Ship hull, modern ship propulsion design, bow thruster – Advantages, various methods to stabilize the ship- passive and active stabilizer, fin stabilizer, bilge keel - stabilizing and securing ship in port- effect of tides on ship – effect of river water and sea water sailing vessel, Load line and load line of marking- draught markings.					
Unit III	SHIPS SPEED AND ITS PERFORMANCE				9
Ship propulsion factors, factors affecting ships speed, various velocities of ship, hull drag, effects of fouling on ships hull, ship wake, relation between powers, Fuel consumption of ship, cavitations - effects of cavitation's, ship turning radius.					
Unit IV	BASICS OF PROPELLER				9
Propeller dimension, Propeller and its types – fixed propeller, control pitch propeller, kort nozzle, ducted propeller, voith schneider, Parts of propeller, 3 blade - 5 blade - 6 blade propellers and its advantages, propeller boss hub, crown nut, propeller skew, pitch of propeller - Thrust creation by propeller. Propeller Material – Propeller balancing- static and dynamic.					
Unit V	BASICS OF RUDDER				9

Rudder dimension, Area of rudder and its design, Rudder arrangements, Rudder fittings- Rudder pintle - Rudder types- Balanced rudder, semi balanced rudder, Spade rudder, merits and demerits of various types of rudders, Propeller and rudder interaction, Rudder stopper, movement of rudders, Basic construction of Rudder															
Total periods: 45 PERIODS															
Text Books:															
1.GP. Ghose, “Basic Ship propulsion”,2015															
2.E.A. Stokoe “Reeds Ship construction for marine engineers”, Vol. 5,2010															
3.E.A. Stokoe, “Reeds Naval architecture for the marine engineers”,4th Edition,2009															
References:															
1.DJ Eyers and GJ Bruse, “Ship Construction”, 7th Edition, 2006.															
2.KJ Rawson and EC Tupper, “Basic Ship theory I” Vol. 1,5th Edition,2001.															
Course Outcomes:													Blooms Taxonomy		
CO1: Explain the basics of propulsion system and ship dynamic movements													Understand		
CO2: Familiarize with various components assisting ship stabilization													Understand		
CO3: Demonstrate the performance of the ship.													Analyze		
CO4: Classify the Propeller and its types, Materials etc.													Understand		
CO5: Categories the Rudder and its types, design criteria of rudder.													Understand		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	–	1	–	–	–	–	–	–	2	3	2	–
CO2	2	2	1	–	–	–	2	1	–	–	–	2	2	1	–
CO3	3	3	2	2	2	–	–	–	–	–	–	3	3	2	1
CO4	2	2	1	–	1	–	–	–	–	–	–	2	2	2	–
CO5	2	2	1	–	1	–	–	–	–	–	–	2	2	2	–
1- Low, 2- Medium, 3- High, ‘-’-No correlation															

23MEO016	MARINE MERCHANT VESSELS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Engineering Physics (fundamentals of forces, pressure, fluids) • Basic Mechanics (equilibrium, centre of gravity) • Basic Engineering Materials • Introductory knowledge of transportation systems (optional but useful)					
Course Objectives: • Knowledge on basics of Hydrostatics • Familiarization on types of merchant ships • Knowledge on Shipbuilding Materials • Knowledge on marine propeller and rudder • Awareness on governing bodies in shipping industry					
Unit I	INTRODUCTION TO HYDROSTATICS				9
Archimedes Principle- Laws of floatation– Meta centre – stability of floating and submerged bodies- Density, relative density - Displacement –Pressure –centre of pressure.					
Unit II	TYPES OF SHIP				9
General cargo ship - Refrigerated cargo ships - Container ships - Roll-on Roll-off ships – Oil tankers- Bulk carriers - Liquefied Natural Gas carriers - Liquefied Petroleum Gas carriers - Chemical tankers - Passenger ships					
Unit III	SHIPBUILDING MATERIALS				9
Types of Steels used in Shipbuilding - High tensile steels, Corrosion resistant steels, Steel sandwich panels, Steel castings, Steel forgings - Other shipbuilding materials, Aluminium alloys, Aluminium alloy sandwich panels, Fire protection especially for Aluminium Alloys, Fiber Reinforced Composites					
Unit IV	MARINE PROPELLER AND RUDDER				9
Types of rudder, construction of Rudder-Types of Propeller, Propeller material-Cavitations and its effects on propeller					
Unit V	GOVERNING BODIES FOR SHIPPING INDUSTRY				9
Role of IMO (International Maritime Organization), SOLAS (International Convention for the Safety of Life at Sea), MARPOL (International Convention for the Prevention of Pollution from Ships) , MLC (Maritime Labour Convention), STCW 2010 (International Convention on Standards of Training, Certification and Watch keeping for Seafarers), Classification societies Administration authorities					

Total periods: 45 PERIODS															
Text Books:															
1.D.J.Eyres, “Ship Constructions”, Seventh Edition, Butter Worth Heinemann Publishing, USA, 2015															
2.Dr.DA Taylor, “Merchant Ship Naval Architecture” I. Mar EST publications, 2006															
3.EA Stokoe, E.A, “Naval Architecture for Marine Engineers”, Vol.4, Reeds Publications,2000															
References:															
1.Kemp & Young “Ship Construction Sketches & Notes”, Butter Worth Heinemann Publishing, USA, 2011															
2.MARPOL Consolidated Edition , Bhandakar Publications, 2018															
3.SOLAS Consolidated Edition , Bhandakar Publications, 2016															
Course Outcomes:													Blooms Taxonomy		
CO1: Acquire Knowledge on floatation of ships													Remember		
CO2: Acquire Knowledge on features of various ships													Remember		
CO3: Acquire Knowledge of Shipbuilding Materials													Remember		
CO4: Acquire Knowledge to identify the different types of marine propeller and rudder													Remember		
CO5: Understand the Roles and responsibilities of governing bodies													Remember		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	1	-	-	-	-	-	3	2	-
CO2	3	-	-	-	-	-	2	-	-	-	-	-	3	2	-
CO3	3	3	2	-	-	-	1	-	-	-	-	-	3	3	2
CO4	3	2	2	-	-	-	1	-	-	-	-	-	3	3	2
CO5	-	-	-	-	-	3	3	2	-	-	-	2	2	2	-
1- Low, 2- Medium, 3- High, ‘-’ -No correlation															

23MEO017	ELEMENTS OF MARINE ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of mechanics and thermodynamics • Basic understanding of IC engines • Familiarity with engineering materials					

Fundamentals of fluid mechanics (helpful but not mandatory)		
Course Objectives: - Understand the role of Marine machinery systems - Be familiar with Marine propulsion machinery system		
Unit I	ELEMENTARY KNOWLEDGE ON MARINE MACHINERY SYSTEMS	9
Marine Engineering Terminologies, Parts of Ship, Introduction to Machinery systems on board ships – Propulsion Machinery system, Electricity Generator system, Steering gear system, Air compressors & Air reservoirs, Fuel oil and Lubricating Oil Purifiers, Marine Boiler systems		
Unit II	MARINE PROPULSION MACHINERY SYSTEM	9
Two stroke Large Marine slow speed Diesel Engine – General Construction, Basic knowledge of Air starting and reversing mechanism, Cylinder lubrication oil system, Main lubricating oil system and cooling water system		
Unit III	MARINE AUXILIARY MACHINERY SYSTEM	9
Four stroke medium speed Diesel engine – General Construction, Inline, V-type arrangement of engine, Difference between slow speed and medium speed engines – advantages, limitations and applications		
Unit IV	MARINE BOILER SYSTEM	9
Types of Boiler – Difference between Water tube boiler and Fire tube boiler, Need for boiler on board ships, Uses of steam, Advantages of using steam as working medium, Boiler mountings and accessories – importance of mountings, need for accessories		
Unit V	SHIP PROPELLERS AND STEERING MECHANISM	9
Importance of Propellor and Steering gear, Types of propellers - Fixed pitch propellers, Controllable pitch propellers, Water jet propellers, Steering gear systems - 2-Ram and 4 Ram steering gear, Electric steering gear		
Total periods: 45 PERIODS		
Text Books:		
1. Taylor, “Introduction to Marine engineering”, Revised Second Edition, Butterworth Heinemann, London, 2011		
2. J.K.Dhar, “Basic Marine Engineering”, Tenth Edition, G-Maritime Publications, Mumbai, 2011		
3. K.Ramaraj, “Text book on Marine Engineering”, Eswar Press, Chennai, 2018		
References:		
1. Alan L.Rowen, “Introduction to Practical Marine Engineering, Volume 1&2, The Institute of Marine Engineers (India), Mumbai, 2006		
2. A.S.Tambwekar, “Naval Architecture and Ship Construction”, The Institute of Marine Engineers (India),		

Mumbai, 2015															
Course Outcomes:													Blooms Taxonomy		
CO1: Distinguish the role of various marine machinery systems													Understand		
CO2: Relate the components of marine propulsion machinery system													Understand		
CO3: Explain the importance of marine auxiliary machinery system													Understand		
CO4: Acquire knowledge of marine boiler system													Understand		
CO5: Understand the importance of ship propellers and steering system													Understand		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	2	-	-	-	-	-	3	2	-
CO2	3	2	2	-	-	-	1	-	-	-	-	-	3	3	2
CO3	3	3	-	-	-	-	1	-	-	-	-	-	3	2	-
CO4	3	2	-	-	-	-	2	-	-	-	-	-	3	2	1
CO5	3	2	2	-	-	-	2	-	-	-	-	2	3	3	2
1- Low, 2- Medium, 3- High, ‘- ‘-No correlation															

3ECO007	DRONE TECHNOLOGIES	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of physics (forces, motion, energy) • Basic programming exposure (C / Python preferred) • Understanding of electronics fundamentals (sensors, actuators, batteries) • Familiarity with aerodynamics (advantageous, not mandatory)					
Course Objectives: • To understand the basics of drone concepts • To learn and understand the fundaments of design, fabrication and programming of drone					
Unit I	INTRODUCTION TO DRONE TECHNOLOGY				9
Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability					
Unit II	DRONE DESIGN, FABRICATION AND PROGRAMMING				9

Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts - Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program -Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.		
Unit III	DRONE FLYING AND OPERATION	9
Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity -Removable storage devices- Linked mobile devices and applications		
Unit IV	DRONE COMMERCIAL APPLICATIONS	9
Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing		
Unit V	FUTURE DRONES AND SAFETY	9
The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms		
Total periods: 45 PERIODS		
Text Books:		
1. Daniel Tal and John Altschuld, “Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation”, 2021 John Wiley & Sons, Inc.		
2.Terry Kilby and Belinda Kilby, “Make:Getting Started with Drones “,Maker Media, Inc, 2016		
References:		
1. John Baichtal, “Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs”, Que Publishing, 2016		
2. Završnik, “Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance”, Springer, 2018.		
Course Outcomes:		Blooms Taxonomy
CO1: Know about a various type of drone technology, drone fabrication and programming		Understand
CO2: Execute the suitable operating procedures for functioning a drone		Apply
CO3: Select appropriate sensors and actuators for Drones		Apply
CO4: Develop a drone mechanism for specific applications		Apply
CO5: Create the programs for various drones		Create

CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Apply CO1	3	2	-	-	-	-	2	-	-	-	-	-	3	2	-
CO2	-	3	3	-	2	-	-	-	2	-	-	-	2	3	2
CO3	3	3	-	2	2	-	-	-	-	-	-	-	3	3	2
CO4	-	-	3	3	2	-	-	-	-	-	-	2	2	3	3
CO5	-	3	3	-	3	-	-	-	-	-	-	3	3	2	3
1- Low, 2- Medium, 3- High, ‘- ‘-No correlation															

23CEO005	GEOGRAPHICAL INFORMATION SYSTEM	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of maps and spatial concepts • Basic knowledge of computer applications • Familiarity with data handling / database concepts (advantageous, not mandatory)					
Course Objectives: • To impart the knowledge on basic components, data preparation and implementation of Geographical Information System.					
Unit I	FUNDAMENTALS OF GIS				9
Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software - Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements.					
Unit II	SPATIAL DATA MODELS				9
Database Structures – Relational, Object Oriented – Entities – ER diagram - data models - conceptual, logical and physical models - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector Models- TIN and GRID data models.					
Unit III	DATA INPUT AND TOPOLOGY				9
Scanner - Raster Data Input – Raster Data File Formats – Georeferencing – Vector Data Input –Digitizer – Datum Projection and reprojection -Coordinate Transformation – Topology - Adjacency, connectivity and containment – Topological Consistency – Non topological file formats - Attribute Data linking – Linking External Databases – GPS Data Integration					

Unit IV	DATA QUALITY AND STANDARDS												9		
Data quality - Basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards –Interoperability - OGC - Spatial Data Infrastructure															
Unit V	DATA MANAGEMENT AND OUTPUT												9		
Import/Export – Data Management functions- Raster to Vector and Vector to Raster Conversion - Data Output - Map Compilation – Chart/Graphs – Multimedia – Enterprise Vs. Desktop GIS- distributed GIS.															
Total periods: 45 PERIODS															
Text Books:															
1. Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition, 2011.															
2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, “An Introduction Geographical Information Systems, Pearson Education, 2nd Edition,2007.															
References:															
1.Lo. C. P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers, 2006.															
Course Outcomes:													Blooms Taxonomy		
CO1: Have basic idea about the fundamentals of GIS.													Remember		
CO2: Understand the types of data models.													Understand		
CO3: Get knowledge about data input and topology													Apply		
CO4: Gain knowledge on data quality and standards													Understand		
CO5: Understand data management functions and data output													Apply		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	2	-
CO2	3	3	-	2	-	-	-	-	-	-	-	-	3	2	-
CO3	3	3	2	-	2	-	-	-	-	-	-	-	3	3	2
CO4	-	3	-	2	-	-	2	-	-	-	-	2	2	3	-
CO5	-	3	2	-	3	-	-	-	-	-	-	3	3	3	2

23CEO006	AGRICULTURE ENTREPRENEURSHIP DEVELOPMENT												Category: OEC			
													L	T	P	C
													3	0	0	3

Prerequisites		
• Basic understanding of agriculture practices • Fundamental knowledge of economics and business concepts		
Course Objectives:		
• To introduce the importance of Agri-business management, its characteristics and principles • To impart knowledge on the functional areas of Agri-business like Marketing management, Product pricing methods and Market potential assessment.		
Unit I	ENTREPRENEURIAL ENVIRONMENT IN INDIAN CONTEXT	9
Entrepreneur Development(ED): Concept of entrepreneur and entrepreneurship assessing overall business environment in Indian economy- Entrepreneurial and managerial characteristics- Entrepreneurship development programmes (EDP)-Generation incubation and commercialization of ideas and innovations- Motivation and entrepreneurship development- Globalization and the emerging business entrepreneurial environment.		
Unit II	AGRICULTURE IN GLOBAL ARENA: LEGAL PERSPECTIVE	9
Importance of agribusiness in Indian economy - International trade-WTO agreements- Provisions related to agreements in agricultural and food commodities - Agreements on Agriculture (AOA)- Domestic supply, market access, export subsidies agreements on sanitary and phyto-sanitary (SPS) measures, Trade related intellectual property rights (TRIPS).		
Unit III	ENTREPRENEURSHIP MANAGEMENT: FINANCIAL PERSPECTIVE	9
Entrepreneurship - Essence of managerial Knowledge -Management functions- Planning-organizing-Directing-Motivation-ordering-leading-supervision- communication and control-Understanding Financial Aspects of Business - Importance of financial statements-liquidity ratios-leverage ratios, coverage ratios-turnover ratios-Profitability ratios. Agro-based industries-Project-Project cycle-Project appraisal and evaluation techniques-undiscounted measures-Payback period-proceeds per rupee of outlay, Discounted measures-Net Present Value (NPV)-Benefit-Cost Ratio(BCR)-Internal Rate of Return(IRR)-Net benefit investment ratio(N/K ratio)-sensitivity analysis.		
Unit IV	ENTREPRENEURIAL OPPORTUNITIES: ECONOMIC GROWTH PERSPECTIVE	9
Managing an enterprise: Importance of planning, budgeting, monitoring evaluation and follow-up managing competition. Role of ED in economic development of a country- Overview of Indian social, political system and their implications for decision making by individual entrepreneurs- Economic system and its implication for decision making by individual entrepreneurs.		

Unit V	ENTREPRENEURIAL PROMOTION MEASURES AND GOVERNMENT SUPPORT												9		
Social responsibility of business. Morals and ethics in enterprise management- SWOT analysis- Government schemes and incentives for promotions of entrepreneurship. Government policy on small and medium enterprises (SMEs)/SSIs/MSME sectors- Venture capital (VC), contract framing (CF) and Joint Venture (JV), public-private partnerships (PPP) - overview of agricultural engineering industry characteristics of Indian farm machinery industry.															
Total periods: 45 PERIODS															
Text Books:															
1. Joseph L. Massie, 1995, “Essentials of Management”, prentice Hall of India Pvt limited, New Delhi															
2. Khanka S, 1999, Entrepreneurial Development, S, Chand and Co, New Delhi															
3. Mohanty S K, 2007, Fundamentals of Entrepreneurship, Prentice Hall India, New Delhi															
References:															
1. Harih S B, Conner U J and Schwab G D, 1981, Management of the Farm Business, Prentice Hall Inc, New Jersey															
2. Omri Ralins, N.1980, Introduction to Agricultural: Prentice Hall Inc, New Jersey															
3. Gittenger Price, 1989, Economic Analysis of Agricultural project, John Hopkins University, Press, London.															
4. Thomas W Zimmer and Norman M Scarborough, 1996, Entrepreneurship, Prentice Hall, New Jersey.															
5. Mar J Dollinger, 1999, Entrepreneurship strategies and resources, Prentice –Hall, Upper Saddal Rover, New Jersey.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Judge about agricultural finance, banking and cooperation													Evaluate (K5)		
CO 2: Evaluate basic concepts, principles and functions of financial management													Understand (K2)		
CO 3: Improve the skills on basic banking and insurance schemes available to customers													Apply (K3)		
CO 4:Analyze various financial data for efficient farm management													Analyze (K4)		
CO 5: Identify the financial institutions													Remember (K1)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	2	-	-	-	-	-	-	1	2	2	-
CO2	2	3	2	2	2	-	-	-	-	-	-	1	2	2	-

CO3	2	2	3	2	2	-	-	-	-	-	-	1	2	2	-
CO4	3	3	2	3	2	-	-	-	-	-	-	1	2	2	-
CO5	2	2	1	1	2	-	-	-	-	-	-	1	2	2	-

1- Low, 2- Medium, 3- High, '-' -No correlation

23CEO009	BIODIVERSITY CONSERVATION	Category: OEC			
		L	T	P	C
		3	0	0	3

Prerequisites

- Basic understanding of biology
- General knowledge of ecosystems and environmental science
- Familiarity with plant and animal classification at school level

Course Objectives:

- The identification of different aspects of biological diversity and conservation techniques

Unit I	INTRODUCTION	9

Concept of Species, Variation; Introduction to Major Plant Groups; Evolutionary relationships between Plant Groups; Nomenclature and History of plant taxonomy; Systems of Classification and them Application; Study of Plant Groups; Study of Identification Characters; Study of important families of Angiosperms; Plant Diversity Application.

Unit II	INTRODUCTION TO ANIMAL DIVERSITY AND TAXONOMY	9

Principles and Rules of Taxonomy; ICZN Rules, Animal Study Techniques; Concepts of Taxon, Categories, Holotype, Paratype, Topotype etc; Classification of Animal kingdom, Invertebrates, Vertebrates, Evolutionary relationships between Animal Groups.

Unit III	MICROBIAL DIVERSITY	9

Microbes and Earth History, Magnitude, Occurrence and Distribution. Concept of Species, Criteria for Classification, Outline Classification of Microorganisms (Bacteria, Viruses and Protozoa); Criteria for Classification and Identification of Fungi; Chemical and Biochemical Methods of Microbial Diversity Analysis

Unit IV	MEGA DIVERSITY	9

Biodiversity Hot-spots, Floristic and Faunal Regions in India and World; IUCN Red List; Factors affecting Diversity, Impact of Exotic Species and Human Disturbance on Diversity, Dispersal, Diversity-Stability Relationship; Socio- economic Issues of Biodiversity; Sustainable Utilization of Bioresources; National Movements and International Convention/Treaties on Biodiversity.

Unit V	CONSERVATIONS OF BIODIVERSITY	9

In-Situ Conservation- National parks, Wildlife sanctuaries, Biosphere reserves; Ex-situ conservation- Gene bank, Cryopreservation, Tissue culture bank; Long term captive breeding, Botanical gardens, Animal Translocation, Zoological Gardens; Concept of Keystone Species, Endangered Species, Threatened Species, Rare Species, Extinct Species															
Total periods:45 PERIODS															
Textbooks:															
1. A textbook of Botany: Angiosperms- Taxonomy, Anatomy, Economic Botany & Embryology. S. Chand, Limited, Pandey, B. P. January 2001															
2. Principles of Systematic Zoology, McGraw-Hill College, Ashlock, P.D., Latest Edition.															
3. Microbiology, MacGraw Hill Companies Inc, Prescott, L.M., Harley, J.P., and Klein D.A. (2022).															
4. Microbiology, Pearson Publisher, Gerard J. Tortora, Berdell R. Funke, Christine LaCasse, 13th Edition 2019.															
References:															
1. Ecological Census Technique: A Handbook, Cambridge University Press, Sutherland, W.															
2. Encyclopaedia of Biodiversity, Academic Press, Simonson Asher Levin.															
Course Outcomes:												Blooms Taxonomy			
CO1: An insight into the structure and function of diversity for ecosystem stability.												Understand (K2)			
CO2: Understand the concept of animal diversity and taxonomy												Understand (K2)			
CO3: Understand socio-economic issues pertaining to biodiversity												analyses (K4)			
CO4: An understanding of biodiversity in community resource management.												Apply (K3)			
CO5: Student can apply fundamental knowledge of biodiversity conservation to solve problems associated with infrastructure development.												Apply (K3)			
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1		2	2	1				1	2	2	
CO2	2	2	1	1		1	2	-				1	2	2	
CO3	2	2	1	2		2	3	1				2	2	2	
CO4	2	2	2	2		2	3	2				2	2	3	
CO5	2	2	3	3		2	3	2				2	3	3	
1- Low, 2- Medium, 3- High, - -No correlation															

23EE0009	INTRODUCTION TO CONTROL SYSTEMS											Category: OEC			
												L	T	P	C

		3	0	0	3
Prerequisites • Basic knowledge of differential equations • Fundamental concepts of physics • Basic electrical engineering principles • Understanding of Laplace transform • Basic mathematical modeling concepts					
Course Objectives: • To impart knowledge on various representations of systems. • To familiarize time response analysis of LTI systems and steady state error.					
Unit I	MATHEMATICAL MODELS OF PHYSICAL SYSTEMS				9
Definition & classification of system – terminology & structure of feedback control theory –Analogous systems - Physical system representation by Differential equations – Block diagram reduction–Signal flow graphs.					
Unit II	TIME RESPONSE ANALYSIS & ROOT LOCUS TECHNIQUE				9
Standard test signals – Steady state error & error constants – Time Response of I and II order system–Root locus–Rules for sketching root loci.					
Unit III	FREQUENCY RESPONSE ANALYSIS				9
Correlation between Time & Frequency response – Polar plots – Bode Plots – Determination of Transfer Function from Bode plot.					
Unit IV	STABILITY CONCEPTS & ANALYSIS				9
Concept of stability – Necessary condition – RH criterion – Relative stability – Nyquist stability criterion – Stability from Bode plot – Relative stability from Nyquist & Bode – Closed loop frequency response					
Unit V	STATE VARIABLE ANALYSIS				9
Concept of state – State Variable & State Model – State models for linear & continuous time systems– Solution of state & output equation–controllability & observability					
Total periods: 45 PERIODS					
Text Books:					
1. Farid Golnarghi , Benjamin C. Kuo, Automatic Control Systems Paper back McGraw Hill Education, 2018.					
2. Katsuhiko Ogata, ‘Modern Control Engineering’, Pearson, 5th Edition 2015.					
3. J. Nagrath and M. Gopal, Control Systems Engineering (Multi Colour Edition), New Age International, 2018.					

References:															
1. Richard C. Dorf and Robert H. Bishop, Modern Control Systems, Pearson Education, 2010.															
2. Control System Dynamics" by Robert Clark, Cambridge University Press, 1996 USA.															
3. John J. D'Azzo, Constantine H. Houpis and Stuart N. Sheldon, Linear Control System Analysis and Design, 5th Edition, CRC PRESS, 2003.															
4. S. Palani, Control System Engineering, McGraw-Hill Education Private Limited, 2009.															
5. Yaduvir Singh and S. Janardhanan, Modern Control, Cengage Learning, First Impression 2010.															
Course Outcomes:													Blooms Taxonomy		
CO1: Design the basic mathematical model of physical System.													Apply (K3)		
CO2: Analyze the time response analysis and techniques.													Apply (K3)		
CO3: Analyze the transfer function from different plots.													Apply (K3)		
CO4: Apply the stability concept in various criterion.													Apply (K3)		
CO5: Assess the state models for linear and continuous Systems.													Apply (K3)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	0	0	0	1	1	0	2	3	2	0
CO2	3	3	2	2	1	0	0	0	1	1	0	2	3	2	0
CO3	3	3	2	2	2	0	0	0	1	1	0	2	3	2	0
CO4	3	3	2	2	1	0	0	0	1	1	0	2	3	2	0
CO5	3	3	2	3	2	0	0	0	1	1	0	2	3	3	0
1- Low, 2- Medium, 3- High, '-' -No correlation															

23EE0010	ENERGY TECHNOLOGY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of physics and chemistry • Fundamentals of thermodynamics					

- Awareness of energy sources and environmental issues - Basic mathematical skills - Elementary understanding of power plants and industrial processes		
Course Objectives: - To provide basic knowledge on various forms of energy and their global/Indian availability. - To impart understanding of conventional energy systems such as thermal, hydel, and nuclear power plants.		
Unit I	INTRODUCTION	9
Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources		
Unit II	CONVENTIONAL ENERGY	9
Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.		
Unit III	NON-CONVENTIONAL ENERGY	9
Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.		
Unit IV	BIOMASS ENERGY	9
Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.		
Unit V	ENERGY CONSERVATION	9
Energy conservation in chemical process plants, energy audit, energy saving in heat exchangers, distillation		

columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation.															
Total periods: 45 PERIODS															
Text Books:															
1. Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005.															
2. Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi, 1984.															
3. Bansal, N.K., Kleeman, M. and Meliss, M., Renewable Energy Sources and Conversion Technology, Tata McGraw Hill, 1990.															
4. Nagpal, G.R., Power Plant Engineering, Khanna Publishers, 2008.															
References:															
1. Nejat Vezirog, Alternate Energy Sources, IT, McGraw Hill, New York.															
2. El. Wakil, Power Plant Technology, Tata McGraw Hill, New York, 2002.															
3. Sukhatme. S.P., Solar Energy - Thermal Collection and Storage, Tata McGraw hill, New Delhi, 1981.															
Course Outcomes:													Blooms Taxonomy		
CO1: Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.													Understand (K2)		
CO2: Students will excel as professionals in the various fields of energy engineering													Apply (K3)		
CO3: Compare different renewable energy technologies and choose the most appropriate based on local conditions.													Analyze (K4)		
CO4: Explain the technological basis for harnessing renewable energy sources.													Understand (K2)		
CO5: Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level.													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	2	3	2	1	1	1	3	3	2	1
CO2	3	3	2	2	2	2	3	2	1	1	1	3	3	3	1
CO3	3	3	3	2	2	2	3	2	1	1	1	3	3	3	2
CO4	3	2	2	2	2	2	3	2	1	1	1	3	3	2	1
CO5	3	3	3	2	2	3	3	3	1	1	1	3	3	3	2
1- Low, 2- Medium, 3- High, '-' -No correlation															
23MEO021	INTRODUCTION TO INDUSTRIAL AUTOMATION												Category: OEC		

	SYSTEMS	L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of sensors and actuators • Fundamentals of electrical circuits and power electronics • Basic programming and logic concepts • Elementary control systems and instrumentation concepts • Familiarity with communication/network basics					
Course Objectives: • To educate on design of signal conditioning circuits for various applications. • To Introduce signal transmission techniques and their design. • Study of components used in data acquisition systems interface techniques • To educate on the components used in distributed control systems • To introduce the communication buses used in automation industries.					
Unit I	INTRODUCTION				9
Automation overview, Requirement of automation systems, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA). Industrial bus systems : Modbus & Profibus					
Unit II	AUTOMATION COMPONENTS				9
Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.					
Unit III	COMPUTER AIDED MEASUREMENT AND CONTROL SYSTEMS				9
Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation.					
Unit IV	PROGRAMMABLE LOGIC CONTROLLERS				9
Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.					

Unit V	DISTRIBUTED CONTROL SYSTEM												9		
Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.															
Total periods: 45 PERIODS															
Text Books:															
1. S.K.Singh, “Industrial Instrumentation”, Tata Mcgraw Hill, 2nd edition companies,2003.															
2. C D Johnson, “Process Control Instrumentation Technology”, Prentice Hall India,8th Edition, 2006.															
3. E.A.Parr, Newnes ,NewDelhi,“Industrial Control Handbook”,3rd Edition, 2000.															
References:															
1. John W. Webb and Ronald A. Reis, “Programmable Logic Controllers: Principles and Applications”, 5th Edition, Prentice Hall Inc., New Jersey, 2003.															
2. Frank D. Petruzella, “Programmable Logic Controllers”, 5th Edition, McGraw- Hill, New York, 2016.															
3. Krishna Kant, “Computer - Based Industrial Control”, 2nd Edition, Prentice Hall, New Delhi, 2011.															
4. Gary Dunning, Thomson Delmar,“Programmable Logic Controller”, CeneageLearning, 3 rd Edition,2005.															
Course Outcomes:													Blooms Taxonomy		
CO1: Design a signal conditioning circuits for various application (L3).													Apply (K3)		
CO2: Acquire a detail knowledge on data acquisition system interface and DCS system (L2).													Understand (K2)		
CO3: Understand the basics and Importance of communication buses in applied automation Engineering (L2).													Understand (K2)		
CO4: Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function BIoek.(L3)													Apply (K3)		
CO5: Able to develop a PLC logic for a specific application on real world problem. (L5)													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	2	1	-	-	-	1	-	-	3	2	-
CO2	3	2	2	-	2	1	-	-	-	1	-	-	3	2	-
CO3	2	3	2	-	3	1	-	-	-	1	-	-	2	2	-
CO4	2	3	3	2	2	1	2	-	-	2	-	-	3	3	-

CO5	2	3	3	3	3	2	2	-	-	3	-	-	3	3	-
1- Low, 2- Medium, 3- High, ‘- ‘-No correlation															

23BTO004	FUNDAMENTALS OF FOOD ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of Physics (mechanics, heat transfer) • Basic Chemistry (properties of materials) • Fundamentals of Mathematics					
Course Objectives: • Acquaint and equip the students with different techniques of measurement of engineering properties. • Make the students understand the nature of food constituents in the design of processing equipment					
Unit I					9
Engineering properties of food materials: physical, thermal, aerodynamic, mechanical, optical and electromagnetic properties					
Unit II					9
Drying and dehydration: Basic drying theory, heat and mass transfer in drying, drying rate curves, calculation of drying times, dryer efficiencies; classification and selection of dryers; tray, vacuum, osmotic, fluidized bed, pneumatic, rotary, tunnel, trough, bin, belt, microwave, IR, heat pump and freeze dryers; dryers for liquid: Drum or roller dryer, spray dryer and foam mat dryers					
Unit III					9
Size reduction: Benefits, classification, determination and designation of the fineness of ground material, sieve/screen analysis, principle and mechanisms of comminution of food, Rittinger’s, Kick’s and Bond’s equations, work index, energy utilization; Size reduction equipment: Principal types, crushers (jaw crushers, gyratory, smooth roll), hammer mills and impactors, attrition mills, buhr mill, tumbling mills, tumbling mills, ultra fine grinders, fluid jet pulveriser, colloid mill, cutting machines (slicing, dicing, shredding, pulping)					
Unit IV					9

Mixing: theory of solids mixing, criteria of mixer effectiveness and mixing indices, rate of mixing, theory of liquid mixing, power requirement for liquids mixing; Mixing equipment: Mixers for low- or medium-viscosity liquids (paddle agitators, impeller agitators, powder-liquid contacting devices, other mixers), mixers for high viscosity liquids and pastes, mixers for dry powders and particulate solids		
Unit V		9
Mechanical Separations: Theory, centrifugation, liquid-liquid centrifugation, liquid-solid centrifugation, clarifiers, desludging and decanting machine, Filtration: Theory of filtration, rate of filtration, pressure drop during filtration, applications, constant-rate filtration and constant-pressure filtration, derivation of equation; Filtration equipment; plate and frame filter press, rotary filters, centrifugal filters and air filters, filter aids, Membrane separation: General considerations, materials for membrane construction, ultra-filtration, microfiltration, concentration, polarization, processing variables, membrane fouling, applications of ultra-filtration in food processing, reverse osmosis, mode of operation, and applications; Membrane separation methods, demineralization by electro-dialysis, gel filtration, ion exchange, per-evaporation and osmotic dehydration.		
Total periods: 45 PERIODS		
Textbooks:		
1.R.L. Earle. 2004. Unit Operations in Food Processing. The New Zealand Institute of Food Science & Technology, Nze. Warren L. McCabe, Julian Smith, Peter Harriott. 2004		
2.Unit Operations of Chemical Engineering, 7th Ed. McGraw-Hill, Inc., NY, USA. Christie John Geankoplis. 2003		
3.Transport Processes and Separation Process Principles (Includes Unit Operations), 4th Ed. Prentice-Hall, NY, USA		
4.George D. Saravacos and Athanasios E. Kostaropoulos. 2002. Handbook of Food Processing Equipment. Springer Science Business Media, New York, USA.		
References:		
1. R. L. Earle (2004) – <i>Unit Operations in Food Processing</i> , The New Zealand Institute of Food Science & Technology, New Zealand.		
2. Warren L. McCabe, Julian Smith & Peter Harriott (2004) – <i>Unit Operations of Chemical Engineering</i> , 7th Ed., McGraw-Hill, New York, USA.		
3. Christie John Geankoplis (2003) – <i>Transport Processes and Separation Process Principles (Includes Unit Operations)</i> , 4th Ed., Prentice-Hall, New York, USA.		
Course Outcomes:	Blooms Taxonomy	
CO 1: understand the importance of food polymers		

CO2: understand the effect of various methods of processing on the structure and texture of food materials													Understand (K2)		
CO3: understand the interaction of food constituents with respect to thermal and electrical properties to develop new technologies for processing and preservation.													Understand (K2)		
CO4: Explain the physical, thermal, mechanical, optical, and electromagnetic properties of food materials and their significance in designing food processing operations.													Understand (K2)		
CO5: Analyses drying and dehydration mechanisms, interprets drying rate curves, and select appropriate dryers for various food materials.													analyses (K4)		
CO-PO Mapping															
CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1								1			2	1	
CO2	2	2	1							1			2	2	
CO3	3	2	2	1	1					1		1	3	2	1
CO4	3	2	2	2	2					1		1	3	3	1
CO5	3	3	2	2	2					1		1	3	3	2
1- Low, 2- Medium, 3- High, - 'No correlation															

23BTO005	FOOD SAFETY AND QUALITY REGULATIONS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of food chemistry • Basic understanding of microbiology • Familiarity with food processing operations					
Course Objectives: • To characterize different type of food hazards, physical, chemical and biological in the industry and food service establishments • To help become skilled in systems for food safety surveillance • To be aware of the regulatory and statutory bodies in India and the world • To ensure processed food meets global standards					
Unit I					9

Introduction to food safety and security: Hygienic design of food plants and equipment's, Food Contaminants (Microbial, Chemical, Physical), Food Adulteration (Common adulterants), Food Additives (functional role, safety issues), Food Packaging & labelling. Sanitation in warehousing, storage, shipping, receiving, containers and packaging materials. Control of rats, rodents, mice, birds, insects and microbes. Cleaning and Disinfection, ISO 22000 – Importance and Implementation		
Unit II		9
Food quality: Various Quality attributes of food, Instrumental, chemical and microbial Quality control. Sensory evaluation of food and statistical analysis. Water quality and other utilities		
Unit III		9
Critical Quality control point in different stages of production including raw materials and processing materials. Food Quality and Quality control including the HACCP system. Food inspection and Food Law, Risk assessment – microbial risk assessment, dose response and exposure response modelling, risk management, implementation of food surveillance system to monitor food safety, risk communication		
Unit IV		9
Indian and global regulations: FAO in India, Technical Cooperation programmes, Biosecurity in Food and Agriculture, World Health Organization (WHO), World Animal Health Organization (OIE), International Plant Protection Convention (IPPC)		
Unit V		9
Codex Alimentarius Commission - Codex India – Role of Codex Contact point, National Codex contact point (NCCP), National Codex Committee of India – Tor, Functions, Shadow Committees etc.		
Total periods: 45 PERIODS		
Textbooks:		
1. S. S. Deshpande (2002) – <i>Handbook of Food Toxicology</i> .		
2. Cynthia A. Roberts (2009) – <i>The Food Safety Information Handbook</i> .		
3. Tannenbaum S. R. (1979) – <i>Nutritional and Safety Aspects of Food Processing</i> , Marcel Dekker Inc., New York.		
4. Hobbs B. C. (1973) – <i>Microbiological Safety of Food</i> .		
References:		
1. Handbook of food toxicology by S. S. Deshpande, 2002		
2. The food safety information handbook by Cynthia A. Robert, 2009		
3. Nutritional and safety aspects of food processing by Tannenbaum SR, Marcel Dekker Inc., New York 1979		
4. Microbiological safety of Food by Hobbs BC, 1973		

5.Food Safety Handbook by Ronald H. Schmidt, Gary E. Rodrick, A John Wiley & Sons Publication, 2003															
Course Outcomes:												Blooms Taxonomy			
CO 1: Identify and evaluate physical, chemical, and biological food hazards and apply hygienic design, sanitation, and contamination control measures in food industries and service establishments.												Understand (K2)			
CO2: Explain food quality attributes and use instrumental, chemical, microbial, and sensory evaluation methods for assessing food quality.												Understand (K2)			
CO3: Apply HACCP principles, identify critical control points, and use risk assessment models (microbial risk, dose–response, exposure assessment) for ensuring food safety across processing stages.												Apply (K3)			
CO4: Understand the roles of Indian and international regulatory bodies such as FAO, WHO, OIE, and IPPC in global food safety and biosecurity.												Remember (K1)			
CO5: Interpret and apply Codex Alimentarius standards, understand the structure of Codex India, and the functioning of NCCP and national codex committees in setting and maintaining food safety standards.												Understand (K2)			
CO-PO Mapping															
CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	2	2	1	2		2	3	2	1
CO2	2	2	1	2	2	1			1	2		1	2	2	
CO3	3	3	3	3	2	2	2	2		2		3	3	3	2
CO4	2	2	1	1	1	2	3	3		1		2	2	3	1
CO5	2	2	2	1	1	2	3	3		1		2	3	3	2
1- Low, 2- Medium, 3- High, - 'No correlation															

23BTO006	NUTRACEUTICALS	Category: OEC			
		L	T	P	C
		3	0	0	3

Prerequisites		
- Basics of food science and chemistry - Fundamentals of human nutrition and biochemistry		
Course Objectives:		
- To understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction. - To understand the role of Nutraceuticals and functional food in health and disease.		
Unit I	INTRODUCTION AND SIGNIFICANCE	9
Introduction to Nutraceuticals and functional foods; importance, history, definition, classification, list of functional foods and their benefits, Phytochemicals, zoo chemicals and microbes in food, plants, animals and microbes.		
Unit II	PHYTOCHEMICALS AS NUTRACEUTICALS	9
Phytoestrogens in plants; isoflavones; flavanols, polyphenols, tannins, saponins, lignans, lycopene, chitin, carotenoids. Manufacturing practice of selected nutraceuticals such as lycopene, is flavonoids, glucosamine, phytosterols. Formulation of functional foods containing nutraceuticals - stability, analytical and labelling issues		
Unit III	ASSESSMENT OF ANTIOXIDANT ACTIVITY	9
In vitro and in vivo methods for the assessment of antioxidant activity, Comparison of different <i>in vitro</i> methods to evaluate the antioxidant, antioxidant mechanism, Prediction of the antioxidant activity of natural phenolics from electrotopological state indices, Optimising phytochemical release by process technology; Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources		
Unit IV	ROLE IN HEALTH AND DISEASE	9
The health benefit of - Soy protein, Spirulina, Tea, Olive oil, plant sterols, Broccoli, omega3 fatty acid and eicosanoids. Nutraceuticals and Functional foods in Gastrointestinal disorder, Cancer, CVD, Diabetic Mellitus, HIV and Dental disease; Importance and function of probiotic, prebiotic and synbiotic and their applications, Functional foods and immune competence; role and use in obesity and nervous system disorders.		
Unit V	SAFETY ISSUES	9
Health Claims, Adverse effects and toxicity of nutraceuticals, regulations and safety issues International and national		
Total periods:45 PERIODS		
Textbooks:		

1.Bisset, Normal Grainger and Max Wich H “Herbal Drugs and Phytopharmaceuticals”, 2nd Edition, CRC, 2001.															
2.Handbook of Nutraceuticals and Functional Foods: Robert Wildman, CRC, Publications. 2006															
3.WEBB, PP, Dietary Supplements and Functional Foods Blackwell Publishing Ltd (United Kingdom), 2006															
4.Ikan, Raphael “Natural Products: A Laboratory Guide”, 2nd Edition, Academic Press / Elsevier, 2005.															
References:															
1.Asian Functional Foods (Nutraceutical Science and Technology) by John Shi (Editor), Fereidoon Shahidi (Editor), Chi-Tang Ho (Editor), CRC Publications, Taylor & Francis, 2007															
2.Functional Foods and Nutraceuticals in Cancer Prevention by Ronald Ross Watson (Author), Blackwell Publishing, 2007															
3.Marketing Nutrition: Soy, Functional Foods, Biotechnology, and Obesity by Brian Wansink.															
4.Functional foods: Concept to Product: Edited by G R Gibson and C M Williams, Wood head Publ., 2000															
5.Hanson, James R. “Natural Products: The Secondary Metabolites”, Royal Society of Chemistry, 2003															
Course Outcomes:													Blooms Taxonomy		
CO 1: Acquire knowledge about nutraceuticals and functional foods, their classification and benefits.													Remember (K1)		
CO2: Acquire knowledge of phytochemicals, zoochemicals and microbes in food, plants, animals and microbes													Remember (K1)		
CO3: Attain the knowledge of the manufacturing practices of selected nutraceutical components and formulation considerations of functional foods.													Understand (K2)		
CO4: Distinguish the various <i>in vitro</i> and <i>in vivo</i> assessment of antioxidant activity of compounds from plant sources.													Understand (K2)		
CO5: Gain information about the health benefits of various functional foods and nutraceuticals in the prevention and treatment of various lifestyle diseases													Understand (K2)		
CO-PO Mapping															
CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	2	1	1	1		1	1	3	2	1
CO2	3	2	1	1	1	2	1	1	1		1	1	3	2	1
CO3	2	2	2	2	2	2	2	2	2		2	2	3	3	2
CO4	2	3	2	3	2	2	2	2	2		2	2	3	3	2

CO5	2	3	3	2	2	2	2	2	2	2	2	2	3	3	3
1- Low, 2- Medium, 3- High, - 'No correlation															

23CHO010	BASICS OF DYEING AND PRINTING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Basics of textile fibers and fabric structures - Elementary knowledge of chemistry of dyes and textile processing					
Course Objectives: To enable the students to learn about the basics of Pretreatment, dyeing, printing and machinery in textile processing.					
Unit I	INTRODUCTION				9
Impurities present in different fibres, Inspection of grey goods and lot preparation. Shearing,					
Unit II	PRE TREATMENT				9
Desizing-Objective of Desizing- types of Desizing- Objective of Scouring- Mechanism of Scouring– Degumming of Silk, Scouring of wool - Bio Scouring. Bleaching -Objective of Bleaching: Bleaching mechanism of Hydrogen Peroxide, Hypo chlorites. Objective of Mercerizing - Physical and Chemical changes of Mercerizing.					
Unit III	DYEING				9
Dye - Affinity, Substantively, Reactivity, Exhaustion and Fixation. Classification of dyes. Direct dyes: General properties, principles and method of application on cellulosic materials. Reactive dyes – principles and method of application on cellulosic materials hot brand, cold brand					
Unit IV	PRINTING				9
Definition of printing – Difference between printing and dying- Classification thickeners – Requirements to be good thickener, printing paste Preparation - different styles of printing					
Unit V	MACHINERIES				9
Fabric Processing - winch, jigger and soft flow machines. Beam dyeing machines: Printing -flat bed screen - Rotary screen. Thermo transfer printing machinery. Garment dyeing machines					
Total periods: 45 PERIODS					
Text Books:					

1.Trotman, E.R., Textile Scouring and Bleaching, Charless Griffins, Com. Ltd., London 1990.															
2.Shenai V.A. “Technology of Textile Processing Vol. IV” 1998, Sevak Publications, Mumbai.															
References:															
1.Trotman E. R., “Dyeing and Chemical Technology of Textile Fibres”, Charles Griffin & Co. Ltd., U.K., 1984, ISBN : 0 85264 165 6.															
2.Dr. N N Mahapatra., “Textile dyeing”, Wood head publishing India, 2018															
3.Mathews Kolanjikombil., ”Dyeing of Textile substrates III –Fibres, Yarns and Knitted fabrics”, Wood head publishing India , 2021															
4.Bleaching & Mercerizing – BTRA Silver Jubilee Monograph series															
5.Chakraborty, J.N, "Fundamentals and Practices in colouration of Textiles", Wood head Publishing India, 2009, ISBN-13:978-81-908001-4-															
Course Outcomes:													Blooms Taxonomy		
CO 1: Basics of grey fabric													Remember (K1)		
CO2: Basics of pre treatment													Understand (K2)		
CO3: Concept of Dyeing													Understand (K2)		
CO4: Concept of Printing													Understand (K2)		
CO5: Machinery in processing industry													Understand (K2)		
CO-PO Mapping															
CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1	1	1	1	—	1	1	3	1	1
CO2	3	2	2	2	2	2	1	1	1	—	1	1	3	2	1
CO3	2	2	2	2	2	2	1	1	1	—	1	1	3	2	2
CO4	2	2	2	2	2	2	1	1	1	—	1	1	3	2	2
CO5	2	2	3	2	2	2	2	1	1	—	1	1	3	2	2

23CHO011	FIBRE SCIENCE	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Basic knowledge of polymers and chemistry of materials - Understanding of fundamental textile terms and processes					
Course Objectives: To enable the students to learn about the types of fibre and its properties					
Unit I	INTRODUCTION TO TEXTILE FIBRES				9
Definition of various forms of textile fibres - staple fibre, filament, bicomponent fibres. Classification of Natural and Man-made fibres, essential and desirable properties of Fibres. Production and cultivation of Natural Fibers: Cotton, Silk, Wool -Physical and chemical structure of the above fibres.					
Unit II	DESIGN OF CYLINDER AND PISTON COMPONENTS				9
Production Sequence of Regenerated Cellulosic fibres: Viscose Rayon, Acetate rayon – High wet modulus fibres: Modal and Lyocel ,Tencel					
Unit III	SYNTHEITC FIBRES				9
Production Sequence of Synthetic Fibers: polymer-Polyester, Nylon, Acrylic and polypropylene. Mineral fibres: fibre glass ,carbon .Introduction to spin finishes and texturization					
Unit IV	SOECIALITY FIBRES				9
Properties and end uses of high tenacity and high modulus fibres, high temperature and flame retardant fibres, Chemical resistant fibres					
Unit V	FUNCTIONAL SOECIALITY FIBRES				9
Properties and end uses : Fibres for medical application – Biodegradable fibres based on PLA ,Super absorbent fibres elastomeric fibres, ultra-fine fibres, electrospun nano fibres, metallic fibres – Gold and Silver coated.					
Total periods: 45					
Text Books:					
1. Morton W. E., and Hearle J. W. S., “Physical Properties of Textile Fibres”, The Textile Institute, Washington D.C., 2008, ISBN 978-1-84569-220-95					
2. Meredith R., and Hearle J. W. S., “Physical Methods of Investigation of Textiles”, Wiley Publication, New York, 1989, ISBN: B00JCV6ZWU ISBN-13:					
3. Mukhopadhyay S. K., “Advances in Fibre Science”, The Textile Institute,1992, ISBN: 1870812379					
References:					

1. Meredith R., “Mechanical Properties of Textile Fibres”, North Holland, Amsterdam, 1986, ISBN: 1114790699, ISBN-13: 9781114790698															
2. Hearle J. W. S., Lomas B., and Cooke W. D., “Atlas of Fibre Fracture and Damage to Textiles”, The Textile Institute, 2nd Edition, 1998, ISBN: 1855733196.															
3. Raheel M. (ed.), “Modern Textile Characterization Methods”, Marcel Dekker, 1995, ISBN:0824794737															
4. Mukhopadhyay. S. K., “The Structure and Properties of Typical Melt Spun Fibres”, Textile Progress, Vol. 18, No. 4, Textile Institute, 1989, ISBN: 1870812115															
5. Hearle J.W.S., “Polymers and Their Properties: Fundamentals of Structures and Mechanics Vol 1”, Ellis Horwood, England, 1982, ISBN: 047027302X ISBN-13: 9780470273029 36															
Course Outcomes:													Blooms Taxonomy		
CO 1: Understand the process sequence of various fibres													Understand (K2)		
CO 2: Understand the properties of various fibres													Understand (K2)		
CO 3: Apply fibre science concepts to identify fibres and interpret their structural characteristics.													Apply (K3)		
CO 4: Analyse the performance behaviour of sOECiality fibres under different conditions.													Analyse (K4)		
CO 5: Evaluate the suitability of functional sOECiality fibres for sOECific technical and medical applications.													Evaluate (K5)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	–	–	–	–	–	–	–	1	–	–	3	2	–
CO2	3	2	–	–	–	–	–	–	–	1	–	–	3	3	–
CO3	2	2	2	1	–	–	–	–	–	1	–	–	2	3	2
CO4	2	3	2	3	–	–	–	–	–	1	–	–	3	3	3
CO5	1	3	2	3	–	–	–	–	–	1	–	–	3	3	3
1- Low, 2- Medium, 3- High, ‘-’-No correlation															

23CHO012	GARMENT MANUFACTURING TECHNOLOGY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of textiles and garment components • Understanding of fabric structure and properties					

Course Objectives:		
- To enable the students to understand the basics of pattern making, cutting and sewing. - To expose the students to various problems & remedies during garment manufacturing		
Unit I	PATTERN MAKING, MARKER PLANNING, CUTTING	9
Anthropometry, sOECification sheet, pattern making – principles, basic pattern set drafting, grading, marker planning, spreading & cutting		
Unit II	TYPES OF SEAMS, STITCHES AND FUNCTIONS OF NEEDLES	9
Different types of seams and stitches; single needle lock stitch machine – mechanism and accessories; needle – functions, sOECial needles, needlepoint		
Unit III	COMPONENTS AND TRIMS USED IN GARMENT	9
Sewing thread-construction, material, thread size, packages, accessories – labels, linings, interlinings, wadding, lace, braid, elastic, hook and loop fastening, shoulder pads, eyelets and laces, zip fasteners, buttons		
Unit IV	GARMENT INSOECTION AND DIMENSIONAL CHANGES	9
Raw material, in process and final insOEction; needle cutting; sewability of fabrics; strength properties of apparel; dimensional changes in apparel due to laundering, dry-cleaning, steaming and pressing.		
Unit V	GARMENT PRESSING, PACKING AND CARE LABELING	9
Garment pressing – categories and equipment, packing; care 68abelling of apparels		
Total periods: 45		
Text Books:		
1. Carr H., and Latham B., “The Technology of Clothing Manufacture”, Blackwell Science Ltd., Oxford, 1994.		
2. Gerry Cooklin, “Introduction to Clothing Manufacture” Blackwell Science Ltd., 1995. 64		
3. Harrison.P.W Garment Dyeing, The Textile Institute Publication, Textile Progress, Vol .19 No.2,1988.		
References:		
1. Winifred Aldrich., “Metric Pattern Cutting”, Blackwell Science Ltd., Oxford, 1994		
2. Peggall H., “The Complete Dress Maker”, Marshall Caverdish, London, 1985		
3. Jai Prakash and Gaur R.K., “Sewing Thread”, NITRA, 1994		
4. Ruth Glock, Grace I. Kunz, “Apparel Manufacturing”, Dorling Kindersley Publishing Inc., New Jersey, 1995.		
5. Pradip V.Mehta, “An Introduction to Quality Control for the Apparel Industry”, J.S.N. Internationals, 1992.		
Course Outcomes:		Blooms Taxonomy

CO 1: Pattern making, marker planning, cutting													Understand (K2)		
CO 2: Types of seams, stitches and functions of needles													Understand (K2)		
CO 3: Components and trims used in garment													Apply (K3)		
CO 4: Garment inspection and dimensional changes													Analyse (K4)		
CO 5: Garment pressing, packing and care labelling													Understand (K2)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	-	2	-	1	1	-	2	3	1	2	3	1
CO2	2	2	1	1	1	-	1	1	-	2	2	1	2	2	1
CO3	1	1	1	1	1	1	1	1	-	1	2	1	1	3	1
CO4	2	1	1	1	2	2	2	1	1	2	3	1	2	3	1
CO5	2	2	1	1	1	1	2	1	-	2	2	1	2	2	1
1- Low, 2- Medium, 3- High, '-' -No correlation															

23CEO008	INDUSTRIAL SAFETY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of workplace environment and industrial operations • Understanding of fundamental science (Physics & Chemistry) related to safety hazards					
Course Objectives: • To educate about the health hazards and the safety measures to be followed in the industrial environment. • Describe industrial legislations (Factories Acts, Workmen's Compensation and other laws) enacted for the protection of employees health at work settings • Describe methods of prevention and control of Occupational Health diseases, accidents / emergencies and other hazards					
Unit I	INTRODUCTION				9
Need for developing Environment, Health and Safety systems in work places - Accident Case Studies - Status and relationship of Acts - Regulations and Codes of Practice - Role of trade union safety representatives. International initiatives - Ergonomics and work place.					
Unit II	OCCUPATIONAL HEALTH AND HYGIENE				9

Definition of the term occupational health and hygiene - Categories of health hazards - Exposure pathways and human responses to hazardous and toxic substances - Advantages and limitations of environmental monitoring and occupational exposure limits - Hierarchy of control measures for occupational health risks - Role of personal protective equipment and the selection criteria - Effects on humans - control methods and reduction strategies for noise, radiation and excessive stress.		
Unit III	WORKPLACE SAFETY AND SAFETY SYSTEMS	9
Features of Satisfactory and Safe design of work premises – good housekeeping - lighting and colour, Ventilation and Heat Control – Electrical Safety – Fire Safety – Safe Systems of work for manual handling operations – Machine guarding – Working at different levels – Process and System Safety.		
Unit IV	HAZARDS AND RISK MANAGEMENT	9
Safety appraisal - analysis and control techniques – plant safety inspection – Accident investigation - Analysis and Reporting – Hazard and Risk Management Techniques – major accident hazard control – Onsite and Offsite emergency Plans.		
Unit V	ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT	9
Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and methods of its effective implementation and review – Elements of Management Principles – Education and Training – Employee Participation.		
Total periods: 45		
Text Books:		
1. Morton W. E., and Hearle J. W. S., “Physical Properties of Textile Fibres”, The Textile Institute, Washington D.C., 2008, ISBN 978-1-84569-220-95		
2. Meredith R., and Hearle J. W. S., “Physical Methods of Investigation of Textiles”, Wiley Publication, New York, 1989, ISBN: B00JCV6ZWU ISBN-13:		
3. Mukhopadhyay S. K., “Advances in Fibre Science”, The Textile Institute, 1992, ISBN: 1870812379		
References:		
1. Meredith R., “Mechanical Properties of Textile Fibres”, North Holland, Amsterdam, 1986, ISBN: 1114790699, ISBN-13: 9781114790698		
2. Hearle J. W. S., Lomas B., and Cooke W. D., “Atlas of Fibre Fracture and Damage to Textiles”, The Textile Institute, 2nd Edition, 1998, ISBN: 1855733196.		
3. Raheel M. (ed.), “Modern Textile Characterization Methods”, Marcel Dekker, 1995, ISBN: 0824794737		
4. Mukhopadhyay S. K., “The Structure and Properties of Typical Melt Spun Fibres”, Textile Progress, Vol. 18, No. 4, Textile Institute, 1989, ISBN: 1870812115		
5. Hearle J.W.S., “Polymers and Their Properties: Fundamentals of Structures and Mechanics Vol 1”, Ellis		

Horwood, England, 1982, ISBN: 047027302X ISBN-13: 9780470273029 36															
Course Outcomes:													Blooms Taxonomy		
CO 1: Describe, with example, the common work-related diseases and accidents in occupational setting													Understand (K2)		
CO 2: Name essential members of the Occupational Health team													Understand (K2)		
CO 3: What roles can a community health practitioners play in an Occupational setting to ensure the protection, promotion and maintenance of the health of the employee													Understand (K2)		
CO 4: Analyse workplace hazards and apply suitable risk management and accident prevention strategies.													Analyse (K4)		
CO 5: Evaluate and propose effective Environmental Health & Safety (EHS) management systems for an industry.													Evaluate (K5)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	–	1	–	2	3	1	–	2	–	1	2	2	–
CO2	2	2	–	1	–	2	2	1	–	1	–	1	2	1	–
CO3	2	2	1	2	–	2	3	2	1	2	2	1	3	2	1
CO4	3	3	2	3	2	3	3	2	2	3	2	2	3	3	2
CO5	3	3	2	3	2	3	3	2	2	3	3	2	3	3	3
1- Low, 2- Medium, 3- High, ‘- ‘-No correlation															
23CHO013	UNIT OPERATIONS IN PETRO CHEMICAL INDUSTRIES											Category: OEC			
												L	T	P	C
												3	0	0	3
Prerequisites															
• Basic knowledge of Physics and Chemistry • Fundamentals of Mathematics (Calculus, Differential equations) • Introductory knowledge of Chemical process principles															
Course Objectives:															
• To impart to the student basic knowledge on fluid mechanics, mechanical operations, heat transfer operations and mass transfer operations.															
Unit I	FLUID MECHANICS CONCEPTS													9	
Fluid definition and classification of fluids, types of fluids, Rheological behaviour of fluids & Newton’s Law of viscosity. Fluid statics-Pascal's law, Hydrostatic equilibrium, Barometric equation and pressure															

measurement(problems),Basic equations of fluid flow - Continuity equation, Euler's equation and Bernoulli equation; Types of flow - laminar and turbulent; Reynolds experiment; Flow through circular and non-circular conduits - Hagen Poiseuille equation (no derivation). Flow through stagnant fluids – theory of Settling and Sedimentation – Equipment (cyclones, thickeners) Conceptual numericals.		
Unit II	FLOW MEASUREMENTS & MECHANICAL OPERATIONS	9
Different types of flow measuring devices (Orifice meter, Venturimeter, Rotameter) with derivations, flow measurements –. Pumps – types of pumps (Centrifugal & Reciprocating pumps), Energy calculations and characteristics of pumps. Size reduction–characteristics of comminute products, sieve analysis, Properties and handling of particulate solids – characterization of solid particles, average particle size, screen analysis- Conceptual numerical of differential and cumulative analysis. Size reduction, crushing laws, working principle of ball mill. Filtration & types, filtration equipments (plate and frame, rotary drum). Conceptual numericals.		
Unit III	CONDUCTIVE & CONVECTIVE HEAT TRANSFER	9
Modes of heat transfer; Conduction – steady state heat conduction through unilayer and multilayer walls, cylinders; Insulation, critical thickness of insulation. Convection- Forced and Natural convection, principles of heat transfer co-efficient, log mean temperature difference, individual and overall heat transfer co-efficient, fouling factor; Condensation – film wise and drop wise (no derivation). Heat transfer equipments – double pipe heat exchanger, shell and tube heat exchanger (with working principle and construction with applications).		
Unit IV	BASICS OF MASS TRANSFER	9
Diffusion-Fick's law of diffusion. Types of diffusion. Steady state molecular diffusion in fluids at rest and laminar flow (stagnant / unidirection and bi direction). Measurement of diffusivity, Mass transfer coefficients and their correlations. Conceptual numerical.		
Unit V	MASS TRANSFER OPERATIONS	9
Basic concepts of Liquid-liquid extraction – equilibrium, stage type extractors (belt extraction and basket extraction).Distillation – Methods of distillation, distillation of binary mixtures using McCabe Thiele method.Drying- drying operations, batch and continuous drying. Conceptual numerical.		
Total periods: 45		
Text Books:		
1. Unit operations in Chemical Engineering Warren L. McCabe, Julian C. Smith & Peter Harriot McGraw-Hill Education (India) Edition 2014		
2. Fluid Mechanics K L Kumar S Chand & Company Ltd 2008		
3. Introduction to Chemical Engineering Badger W.I. and Banchero, J.T., Tata McGraw Hill New York		

1997															
References:															
1. Principles of Unit Operations Alan S Foust, L.A. Wenzel, C.W. Clump, L. Maus, and L.B. Anderson John Wiley & Sons 2nd edition 2008															
2. Unit Operations of Chemical Engineering, Vol I &II Chattopadhyaya Khanna Publishers, Delhi-6 1996															
3. Heat Transfer J P Holman McGraw Hill International Ed															
Course Outcomes:													Blooms Taxonomy		
CO 1: State and describe the nature and properties of the fluids.													Understand (K2)		
CO 2: Study the different flow measuring instruments, the principles of various size reductions, conveying equipment's, sedimentation and mixing tanks.													Understand (K2)		
CO 3: Comprehend the laws governing the heat and mass transfer operations to solve the problems.													Apply (K3)		
CO 4: Design the heat transfer equipment suitable for sOECific requirement.													Analyse (K4)		
CO 5: Apply mass transfer principles in distillation, extraction and drying operations to solve chemical engineering problems.													Apply (K3)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	–	–	–	–	–	1	–	1	3	2	–
CO2	3	2	2	2	–	–	–	1	–	1	–	1	3	3	1
CO3	3	3	2	3	1	–	–	1	–	1	–	2	3	3	2
CO4	3	3	3	3	2	–	–	1	–	2	1	2	3	3	3
CO5	3	3	2	3	1	–	–	1	–	1	–	2	3	3	2
1- Low, 2- Medium, 3- High, '–' -No correlation															

23MEO018	PLASTIC MATERIALS FOR ENGINEERS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of polymer chemistry • Fundamentals of material science • Understanding of molecular structures and material behavior					
Course Objectives:					

- Understand the advantages, disadvantages and general classification of plastic materials - To know the manufacturing, sources, and applications of engineering thermoplastics - Understand the basics as well as the advanced applications of various plastic materials in the industry		
Unit I	INTRODUCTION TO PLASTIC MATERIALS	9
Introduction to Plastics – Brief history of plastics, advantages and disadvantages, thermoplastic and thermosetting behavior, amorphous polymers, crystalline polymers and cross-linked structures. General purpose thermoplastics/ Commodity plastics: manufacture, structure, properties and applications of polyethylene (PE), cross-linked PE, chlorinated PE, polypropylene, polyvinyl chloride-compounding, formulation, polypropylene (PP)		
Unit II	ENGINEERING THERMOPLASTICS AND APPLICATIONS	9
Engineering thermoplastics – Aliphatic polyamides: structure, properties, manufacture and applications of Nylon 6, Nylon 66. Polyesters: manufacture, structure, properties and uses of PET, PBT. Manufacture, structure, properties and uses of Polycarbonates, acetal resins, polyimides, PMMA, polyphenylene oxide, thermoplastic polyurethane (PU)		
Unit III	THERMOSETTING PLASTICS	9
Thermosetting Plastics – Manufacture, curing, moulding powder, laminates, properties and uses of phenol formaldehyde resins, urea formaldehyde, melamine formaldehyde, unsaturated polyester resin, epoxy resin, silicone resins, polyurethane resins.		
Unit IV	MISCELLANEOUS PLASTICS FOR END APPLICATIONS	9
Miscellaneous plastics- Manufacture, properties and uses of polystyrene, HIPS, ABS, SAN, poly(tetrafluoroethylene) (PTFE), TFE and copolymers, PVDF, PVA, poly (vinyl acetate), poly (vinyl carbazole), cellulose acetate, PEEK, High energy absorbing polymers, super absorbent polymers- their synthesis, properties and applications		
Unit V	PLASTICS MATERIALS FOR BIOMEDICAL APPLICATIONS	9
Sources, raw materials, methods of manufacturing, properties and applications of bio-based polymers- poly lactic acid (PLA), poly hydroxy alkanoates (PHA), PBAT, bioplastics- bio-PE, bio-PP, bio-PET, polymers for biomedical applications		
Total periods: 45		
Text Books:		
1. Premamoy Ghosh, Polymer Science and Technology: Plastics, Rubbers, Blends and Composites, 3rd Edition, McGraw Hill Education, 2011.		
2. V.R. Gowariker, N.V. Viswanathan, Jayadev Sreedhar, Polymer Science, New Age International		

Publishers, 2017.															
3. R.K. Roy, Polymer Chemistry, New Age International Publishers, 2003.															
References:															
1. Marianne Gilbert (Ed.), Brydson's Plastics Materials, 8th Edn., Elsevier (2017).															
2. J.A.Brydson, Plastics Materials, 7th Edn., Butterworth Heinemann (1999).															
3. Manas Chanda, Salil K. Roy, Plastics Technology Handbook, 4th Edn., CRC press (2006).															
4. A. Brent Strong, Plastics: Materials and Processing, 3rd Edn., Pearson Prentice Hall (2006).															
5. Olagoke Olabisi, Kolapo Adewale (Eds.), Handbook of Thermoplastics 2nd Edn., CRC press (2016).															
6. Charles A. Harper, Modern Plastics Handbook, McGraw-Hill, New York, 1999.															
7. H. Dominighaus, Plastics for Engineers, Hanser Publishers, Munich, 1988.															
Course Outcomes:													Blooms Taxonomy		
CO 1: To study the importance, advantages and classification of plastic materials													Understand (K2)		
CO 2: Summarize the raw materials, sources, production, properties and applications of various engineering thermoplastics													Understand (K2)		
CO 3: To understand the application of polyamides, polyesters and other engineering thermoplastics, thermosetting resins													Analyze (K2)		
CO 4: Know the manufacture, properties and uses of thermosetting resins based on polyester, epoxy, silicone and PU													Understand (K2)		
CO 5: To understand the engineering applications of various polymers in miscellaneous areas and applications of different biopolymers													Evaluate (K2)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	–	–	–	–	1	–	–	–	–	1	3	1	–
CO2	3	2	–	–	–	–	1	–	–	–	–	1	3	2	–
CO3	3	3	2	2	–	–	–	–	–	–	–	2	3	3	2
CO4	3	2	–	–	–	–	1	–	–	–	–	1	3	2	–
CO5	3	2	1	2	–	–	2	1	–	–	–	2	3	3	2
1- Low, 2- Medium, 3- High, '–' -No correlation															

23MEO019	PROPERTIES AND TESTING OF PLASTICS	Category: OEC

		L	T	P	C
		3	0	0	3
Prerequisites - Fundamentals of polymer science – structure, types of polymers, and polymerization basics - Basic chemistry – chemical bonding, molecular structure, physical properties - Basic material science concepts – stress–strain, mechanical behavior, thermal behavior - Introductory plastics processing – molding, extrusion, shaping methods (at basic level)					
Course Objectives: - To understand the relevance of standards and sOECifications as well as the sOECimen preparation for polymer testing. - To study the mechanical properties and testing of polymer materials and their structural property relationships. - To understand the thermal properties of polymers and their testing methods.					
Unit I	INTRODUCTION TO CHARACTERIZATION AND TESTING OF POLYMERS				9
Introduction- Standard organizations: BIS, ASTM, ISO, BS, DIN etc. Standards and sOECifications. Importance of standards in the quality control of polymers and polymer products. Preparation of test pieces, conditioning and test atmospheres. Tests on elastomers: processability parameters of rubbers – plasticity, Mooney viscosity, scorch time, cure time, cure rate index, Processability tests carried out on thermoplastics and thermosets: MFI, cup flow index, gel time, bulk density, bulk factor.					
Unit II	MECHANICAL PROPERTIES				9
Mechanical properties: Tensile, compression, flexural, shear, tear strength, hardness, impact strength, resilience, abrasion resistance, creep and stress relaxation, compression set, dynamic fatigue, ageing properties, Basic concepts of stress and strain, short term tests: Viscoelastic behavior (simple models: Kelvin model for creep and stress relaxation, Maxwell-Voigt model, strain recovery and dynamic response), Effect of structure and composition on mechanical properties, Behavior of reinforced polymers					
Unit III	THERMAL RHEOLOGICAL PROPERTIES				9
Thermal properties: Transition temperatures, sOECific heat, thermal conductivity, co-efficient of thermal expansion, heat deflection temperature, Vicat softening point, shrinkage, brittleness temperature, thermal stability and flammability. Product testing: Plastic films, sheeting, pipes, laminates, foams, containers, cables and tubes.					
Unit IV	ELECTRICAL AND OPTICAL PROPERTIES				9
Electrical properties: volume and surface resistivity, dielectric strength, dielectric constant and power					

factor, arc resistance, tracking resistance, dielectric behavior of polymers (dielectric co-efficient, dielectric polarization), dissipation factor and its importance. Optical properties: transparency, refractive index, haze, gloss, clarity, birefringence.															
Unit V		ENVIRONMENTAL AND CHEMICAL RESISTANCE												9	
Environmental stress crack resistance (ESCR), water absorption, weathering, aging, ozone resistance, permeability and adhesion. Tests for chemical resistance. Acids, alkalies, Flammability tests- oxygen index test.															
Total periods: 45															
Text Books:															
1. Vishu Shah, Handbook of Plastic Testing Technology, 3rd Edition, John Wiley & Sons, 2007.															
2. A. B. Mathur & I. S. Bharadwaj, Testing and Evaluation of Plastics, Allied Publishers Pvt. Ltd., 2003.															
3. R. P. Brown, Plastic Test Methods, 2nd Edition, Harlond, Longman Scientific, 1981.															
References:															
1. F.Majewska, H.Zowall, Handbook of analysis of synthetic polymers and plastics, Ellis Horwood Limited Publisher 1977.															
2. J.F.Rabek, Experimental Methods in Polymer Chemistry, John Wiley and Sons 1980.															
3. R.P.Brown, Plastic test methods, 2nd Edn., Harlond, Longman Scientific, 1981.															
4. A. B. Mathur, I. S. Bharadwaj, Testing and Evaluation of Plastcis, Allied Publishers Pvt. Ltd., New Delhi, 2003.															
5. Vishu Shah, Handbook of Plastic Testing Technology, 3rd Edn., John Wiley & Sons 2007.															
S. K. Nayak, S. N. Yadav, S. Mohanty, Fundamentals of Plastic Testing, Springer, 2010.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Understand the relevance of standards and sOECifications.													Understand (K2)		
CO 2: Summarize the various test methods for evaluating the mechanical properties of the polymers.													Understand (K2)		
CO 3: To know the thermal, electrical & optical properties of polymers.													Understand (K2)		
CO 4: Identify various techniques used for characterizing polymers.													Apply (K3)		
CO 5: Distinguish the processability tests used for thermoplastics, thermosets and elastomers.													Analyze (K4)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	–	–	–	–	–	–	–	–	–	1	2	1	–
CO2	2	2	1	–	–	–	–	–	–	–	–	1	2	1	–

CO3	2	1	–	–	–	–	–	–	–	–	–	1	2	1	–
CO4	2	2	2	1	–	–	–	–	–	–	–	1	3	2	1
CO5	2	2	1	–	–	–	–	–	–	–	–	1	2	2	1
1- Low, 2- Medium, 3- High, ‘- ‘-No correlation															

23ECO008	VLSI DESIGN	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basics of Digital Electronics • Fundamentals of Semiconductor Devices • Basic Knowledge of Logic Circuits					
Course Objectives: • Understand the fundamentals of IC technology components and their characteristics. • Understand combinational logic circuits and design principles. • Understand sequential logic circuits and clocking strategies.					
Unit I	MOS TRANSISTOR PRINCIPLES				9
MOS logic families (NMOS and CMOS), Ideal and Non Ideal IV Characteristics, CMOS devices. MOS(FET) Transistor DC transfer Characteristics ,small signal analysis of MOSFET					
Unit II	COMBINATIONAL LOGIC CIRCUITS				9
Propagation Delays, stick diagram, Layout diagrams, Examples of combinational logic design, Elmore’s constant, Static Logic Gates, Dynamic Logic Gates, Pass Transistor Logic, Power Dissipation.					
Unit III	SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES				9
Static Latches and Registers, Dynamic Latches and Registers, Pipelines, Timing classification of Digital Systems, Synchronous Design, Self-Timed Circuit Design .					
Unit IV	INTERCONNECT, MEMORY ARCHITECTURE				9
Interconnect Parameters – Capacitance, Resistance, and Inductance, Logic Implementation using Programmable Devices (ROM, PLA, FPGA), Memory Architecture and Building Blocks.					
Unit V	DESIGN OF ARITHMETIC BUILDING BLOCKS				9
Arithmetic Building Blocks: Data Paths, Adders-Ripple Carry Adder, Carry-Bypass Adder, Carry Select Adder, Carry-Look Ahead Adder, Multipliers, Barrel Shifter, power and speed tradeoffs.					
Total periods: 45 PERIODS					
Text Books:					

1. Jan D Rabaey, Anantha Chandrakasan, “Digital Integrated Circuits: A Design Perspective”, PHI, 2016.(Units II, III IV and V).

2. Neil H E Weste, Kamran Eshraghian, “Principles of CMOS VLSI Design: A System Perspective,” Addison Wesley, 2009.(Units - I)

References:

1. . D.A. Hodges and H.G. Jackson, Analysis and Design of Digital Integrated Circuits, International Student Edition, McGraw Hill 1983

2. . P. Rashinkar, Paterson and L. Singh, "System-on-a-Chip Verification-Methodology and Techniques", Kluwer Academic Publishers,2001

3. Samiha Mourad and Yervant Zorian, “Principles of Testing Electronic Systems”, Wiley 2000

4. M. Bushnell and V. D. Agarwal, "Essentials of Electronic Testing for Digital, Memory and MixedSignal VLSI Circuits", Kluwer Academic Publishers,2000

Course Outcomes:

Blooms Taxonomy

CO 1: Understand the working principle and characteristics of MOSFET

Understand (K2)

CO2: : Design Combinational Logic Circuits

Understand (K2)

CO3: : Design Sequential Logic Circuits and Clocking systems

Apply (K3)

CO4: : Understand Memory architecture and interconnects

Apply (K3)

CO5: Design of arithmetic building blocks.

Analyze (K4)

CO-PO Mapping

Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	-	-	-	-	-	-	1	3	2	1
CO2	3	3	3	2	2	-	-	-	-	-	-	1	3	3	2
CO3	3	2	3	2	2	-	-	-	-	-	-	1	3	3	2
CO4	2	2	2	2	2	-	-	-	-	-	-	1	2	2	2
CO5	3	2	3	2	2	-	-	-	-	-	-	1	3	3	3

1- Low, 2- Medium, 3- High, ‘- ‘-No correlation

23ECO009	WEARABLE DEVICES	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basics of Electronics and Sensors • Fundamentals of Wireless Communication					

• Basic Knowledge of Biomedical Engineering		
Course Objectives: To know the hardware requirement of wearable systems		
Unit I	INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS	9
Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Impedance plethysmography, Wearable ground reaction force sensor		
Unit II	SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES	9
Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.		
Unit III	WIRELESS HEALTH SYSTEMS	9
Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques.		
Unit IV	SMART TEXTILE	9
Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques- Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks. Case study- smart fabric for monitoring biological parameters - ECG, respiration.		
Unit V	APPLICATIONS OF WEARABLE SYSTEMS	9
Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine		
Total periods: 45 PERIODS		
Text Books:		
1. Annalisa Bonfiglio and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011		
2. . Zhang and Yuan-Ting, Wearable Medical Sensors and Systems, Springer, 2013		
3. Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014		
4. Mehmet R. Yuce and Jamil Y. Khan, Wireless Body Area Networks Technology, Implementation		

applications, Pan Stanford Publishing Pte.Ltd, Singapore, 2012															
References:															
1. . Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.															
2. Guang-Zhong Yang, Body Sensor Networks, Springer, 2006															
Course Outcomes:													Blooms Taxonomy		
CO 1: Describe the concepts of wearable system.													Understand (K2)		
CO2: Explain the energy harvestings in wearable device.													Understand (K2)		
CO3: Use the concepts of BAN in health care.													Analyze (K4)		
CO4: Illustrate the concept of smart textile													Apply (K3)		
CO5: Compare the various wearable devices in healthcare system													Understand (K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	2	-	-	-	-	-	-	1	2	1	-
CO2	3	2	2	2	2	-	-	-	-	-	-	1	3	2	1
CO3	3	2	3	2	2	-	-	-	-	-	-	1	3	3	1
CO4	3	2	2	2	2	-	-	-	-	-	-	1	2	2	1
CO5	3	2	2	2	2	-	-	-	-	-	-	1	3	2	2
1- Low, 2- Medium, 3- High, ‘- ‘-No correlation															

23BMO004	MEDICAL INFORMATICS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basics of Computer Science • Fundamentals of Biology and Healthcare Systems • Basic Knowledge of Information Technology					
Course Objectives: • To study the applications of information technology in health care management.					
Unit I	INTRODUCTION TO MEDICAL INFORMATICS.				9
Introduction - Structure of Medical Informatics –Internet and Medicine -Security issues, Computer based medical information retrieval, Hospital management and information system, Functional capabilities of					

a computerized HIS, Health Informatics – Medical Informatics, Bioinformatics		
Unit II	COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING	9
Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computer assisted medical imaging- nuclear medicine, ultrasound imaging, computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance		
Unit III	COMPUTERISED PATIENT RECORD	9
Introduction - conventional patient record, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients		
Unit IV	COMPUTER ASSISTED MEDICAL DECISION-MAKING	9
Neuro computers and Artificial Neural Networks application, Expert system-General model of CMD, Computer-assisted decision support system-production rule system cognitive model, semantic networks, decisions analysis in clinical medicine-computers in the care of critically ill patients, Computer aids for the handicapped		
Unit V	RECENT TRENDS IN MEDICAL INFORMATICS	9
Virtual reality applications in medicine, Virtual endoscopy, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery, Computer assisted patient education and health- Medical education and healthcare information, computer assisted instruction in medicine.		
Total periods: 45 PERIODS		
Text Books:		
1. Mohan Bansal, “Medical informatics”, Tata McGraw Hill Publishing Ltd, 2003		
2. R.D.Lele, “Computers in medicine progress in medical informatics”, Tata Mcgraw Hill,2005		
References:		
1. 1. Kathryn J. Hannah, Marion J Ball, “Health Informatics”, 3rd Edition, Springer, 2006.		
Course Outcomes:		Blooms Taxonomy
CO 1: Explain the structure and functional capabilities of Hospital Information System.		Understand (K2)
CO2: Describe the need of computers in medical imaging and automated clinical laboratory		Apply (K3)
CO3: Articulate the functioning of information storage and retrieval in computerized patient record system.		Understand (K2)
CO4: Apply the suitable decision support system for automated clinical diagnosis		Understand (K2)
CO5: Discuss the application of virtual reality and telehealth technology in medical		Understand (K2)

industry.															
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	2	2	-	-	-	-	-	-	1	2	1	-
CO2	3	2	2	2	2	-	-	-	-	-	-	1	2	2	1
CO3	3	2	2	2	2	-	-	-	-	-	-	1	2	2	1
CO4	3	3	3	2	2	-	-	-	-	-	-	1	3	3	2
CO5	2	3	2	2	2	-	-	-	-	-	-	1	3	2	2
1- Low, 2- Medium, 3- High, '-' -No correlation															

MINOR DEGREE

VERTICAL I : FINTECH AND BLOCK CHAIN

23CMG001	FINANCIAL MANAGEMENT	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of commerce or accounting • Understanding of fundamental business concepts • Ability to perform simple mathematical and analytical calculations					
Course Objectives: • To acquire the knowledge of the decision areas in finance. • To learn the various sources of Finance					
Unit I	INTRODUCTION TO FINANCIAL MANGEMENT				9
Definition and Scope of Finance Functions - Objectives of Financial Management - Profit Maximization and Wealth Maximization- Time Value of money- Risk and return concepts.					
Unit II	SOURCES OF FINANCE				9
Long term sources of Finance -Equity Shares – Debentures - Preferred Stock – Features – Merits and Demerits. Short term sources - Bank Sources, Trade Credit, Overdrafts, Commercial Papers, Certificate of Deposits, Money market mutual funds etc					
Unit III	INVESTMENT DECISIONS				9

Investment Decisions: capital budgeting – Need and Importance – Techniques of Capital Budgeting – Payback -ARR – NPV – IRR –Profitability Index. Cost of Capital - Cost of Specific Sources of Capital - Equity -Preferred Stock- Debt - Reserves - Concept and measurement of cost of capital - Weighted Average Cost of Capital.																
Unit IV		FINANCING AND DIVIDEND DECISION													9	
Operating Leverage and Financial Leverage- EBIT-EPS analysis. Capital Structure – determinants of Capital structure- Designing an Optimum capital structure. Dividend policy - Aspects of dividend policy - practical consideration - forms of dividend policy - - Determinants of Dividend Policy																
Unit V		WORKING CAPITAL DECISION													9	
Working Capital Management: Working Capital Management - concepts - importance -Determinants of Working capital. Cash Management: Motives for holding cash – Objectives and Strategies of Cash Management. Receivables Management: Objectives - Credit policies.																
Total periods: 45																
Text Books:																
1. M.Y. Khan and P.K.Jain Financial management, Text, Tata McGraw Hill																
2. M. Pandey Financial Management, Vikas Publishing House Pvt. Ltd																
References:																
1. James C. Vanhorne –Fundamentals of Financial Management– PHI Learning,.																
2. Prasanna Chandra, Financial Management,																
Course Outcomes:													Blooms Taxonomy			
CO 1: To acquire knowledge of major financial decision areas in organizations													Understand (K2)			
CO2: To understand various long-term and short-term sources of finance													Understand (K2)			
CO3: To learn capital budgeting techniques and cost of capital													Apply (K3)			
CO4: To understand capital structure and dividend policy decisions													Analyze (K4)			
CO5: To develop skills in working capital management tools and techniques													Evaluate (K5)			
CO-PO Mapping																
CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	2	1	1						2		2	3			
CO2	3	2	1	1						2		2	2			
CO3	3	3	2	3						2		3	3			
CO4	3	3	2	3						3		3	3			
CO5	3	3	2	3						2		3	3			
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation																

23CMG002	FUNDAMENTALS OF INVESTMENT	Category:PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of financial terms • Fundamental knowledge of markets and economics • Ability to perform simple mathematical calculations					
Course Objectives: • Describe the investment environment in which investment decisions are taken. • Explain how to Value bonds and equities • Explain the various approaches to value securities • Describe how to create efficient portfolios through diversification • Discuss the mechanism of investor protection in India.					
Unit I	THE INVESTMENT ENVIRONMENT				9
The investment decision process, Types of Investments – Commodities, Real Estate and FinancialAssets, the Indian securities market, the market participants and trading of securities, securitymarket indices, sources of financial information, Concept of return and risk, Impact of Taxes andInflationonreturn.					
Unit II	FIXED INCOME SECURITIES				9
Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, defaultrisk andcreditrating.					
Unit III	APPROACHES TOEQUITYANALYSIS				9
Introduction to Fundamental Analysis, Technical Analysis and Efficient Market Hypothesis, dividend capitalisation models, and price-earnings multiple approach to equity valuation.					
Unit IV	PORTFOLIO ANALYSIS AND FINANCIAL DERIVATIVES				9
Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India					
Unit V	INVESTOR PROTECTION				9
Role of SEBI and stock exchanges in investor protection; Investor grievances and their redressal system, insider trading, investors’ awareness andactivism					
Total periods:45					

Text Books:															
1.Charles P. Jones – <i>Investments: Analysis and Management</i> , Wiley, 14th Edition, 2019															
2. Prasanna Chandra – <i>Investment Analysis and Portfolio Management</i> , McGraw Hill, 5th Edition, 2017															
3. R. P. Rustagi – <i>Investment Management: Theory and Practice</i> , Sultan Chand & Sons, 2021															
References:															
1. Charles P. Jones, Gerald R. Jensen. Investments: analysis and management. Wiley, 14TH Edition, 2019.															
2. Chandra, Prasanna. Investment analysis and portfolio management. McGraw-hill education, 5th, Edition, 2017															
3. Rustagi, R. P. Investment Management Theory and Practice. Sultan Chand & Sons, 2021.															
4. ZviBodie, Alex Kane, Alan J Marcus, PitabusMohanty, Investments, McGraw Hill Education (India), 11 Edition(SIE), 2019															
Course Outcomes:												Blooms Taxonomy			
CO 1: Explain the investment environment, types of investments, and functioning of securities markets												Understand (K2)			
CO2: Apply valuation methods for fixed-income securities and understand bond risks												Apply (K3)			
CO3: Analyze equity valuation using fundamental, technical, and EMH approaches												Analyze (K4)			
CO4: Evaluate portfolio construction, diversification, mutual funds, and derivatives												Evaluate (K5)			
CO5: Explain investor protection mechanisms, SEBI regulations, and grievance redressal												Understand (K2)			
CO-PO Mapping															
CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1						2		2	3		
CO2	3	3	2	2						2		2	3		
CO3	3	3	2	3						2		3	3		
CO4	3	3	2	3						3		3	3		
CO5	2	2	1	2						2		2	2		
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CMG003	BANKING, FINANCIAL SERVICES AND INSURANCE	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of money and financial systems • Fundamental knowledge of markets and financial institutions					
Course Objectives: • Understand the Banking system in India • Grasp how banks raise their sources and how they deploy it • Understand the development in banking technology • Understand the financial services in India • Understand the insurance Industry in India					
Unit I	INTRODUCTION TO INDIAN BANKING SYSTEM				9
Overview of Banking system – Structure – Functions –Banking system in India - Key Regulations in Indian Banking sector –RBI. Relationship between Banker and Customer - Retail & Wholesale Banking – types of Accounts - Opening and operation of Accounts.					
Unit II	MANAGING BANK FUNDS/ PRODUCTS				9
Liquid Assets - Investment in securities - Advances - Loans.Negotiable Instruments – Cheques, Bills of Exchange & Promissory Notes.Designing deposit schemes– Asset and Liability Management – NPA’s – Current issues on NPA’s – M&A’s of banks into securities market					
Unit III	DEVELOPMENT IN BANKING TECHNOLOGY				9
Payment system in India – paper based – e payment –electronic banking –plastic money – e-money forecasting of cash demand at ATM’s –The Information Technology Act, 2000 in India – RBI’s Financial Sector Technology vision document – security threats in e-banking & RBI’s Initiative.					
Unit IV	FINANCIAL SERVICES				9
Introduction – Need for Financial Services – Financial Services Market in India – NBFC — Leasing and Hire Purchase — mutual funds. Venture Capital Financing –Bill discounting –factoring – Merchant Banking					
Unit V	INSURANCE				9
Insurance –Concept - Need - History of Insurance industry in India. Insurance Act, 1938 –IRDA – Regulations – Life Insurance - Annuities and Unit Linked Policies - Lapse of the Policy – revival – settlement of claim					
Total periods:45					
Text Books:					

1. Padmalatha Suresh & Justin Paul — <i>Management of Banking and Financial Services</i> , Pearson, 2017															
2. Meera Sharma — <i>Management of Financial Institutions with Emphasis on Bank and Risk Management</i> , PHI Learning, 2010															
3. Peter S. Rose & Sylvia C. Hudgins — <i>Bank Management and Financial Services</i> , Tata McGraw Hill, 2017															
References:															
1. . Padmalatha Suresh and Justin Paul, “Management of Banking and Financial Services, Pearson, Delhi, 2017.															
2. Meera Sharma, “Management of Financial Institutions – with emphasis on Bank and Risk Management”, PHI Learning Pvt. Ltd., New Delhi 2010															
3. Peter S. Rose and Sylvia C. and Hudgins, “Bank Management and Financial Services”, Tata McGraw Hill, New Delhi, 2017															
Course Outcomes:												Blooms Taxonomy			
CO 1: Explain the Indian banking system, structure, functions, and customer–banker relationship												Understand (K2)			
CO2: Apply knowledge of bank fund management, negotiable instruments, ALM, and NPAs												Apply (K3)			
CO3: Analyze developments in banking technology, e-payments, IT Act, and security issues												Analyze (K4)			
CO4: Understand major financial services such as NBFCs, leasing, factoring, mutual funds, merchant banking, and venture capital												Understand (K2)			
CO5: Explain the concepts of insurance, regulations, IRDA, policy lapse, revival, and settlement												Understand (K2)			
CO-PO Mapping															
CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1						2		2	3		
CO2	3	3	2	2						2		2	3		
CO3	3	3	2	3						3		3	3		
CO4	2	2	1	2						2		2	2		
CO5	2	2	1	2						2		2	2		
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

3CMG004	INTRODUCTION TO BLOCKCHAIN AND ITS APPLICATIONS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of computer networks • Understanding of cryptography fundamentals (helpful but not mandatory) • Familiarity with programming concepts					
Course Objectives: • Understand the fundamentals, architecture, and evolution of blockchain. • Explain decentralization, consensus mechanisms, and blockchain components. • Learn cryptocurrency concepts including Bitcoin, altcoins, mining, and wallets. • Explore Ethereum architecture, EVM, and smart contract development. • Understand Web3, Hyperledger frameworks, and emerging blockchain trends.					
Unit I	INTRODUCTION TO BLOCKCHAIN				9
Blockchain: The growth of blockchain technology - Distributed systems - The history of blockchain and Bitcoin - Features of a blockchain - Types of blockchain, Consensus: Consensus mechanism - Types of consensus mechanisms - Consensus in blockchain. Decentralization: Decentralization using blockchain - Methods of decentralization - Routes to decentralization- Blockchain and full ecosystem decentralization - Smart contracts - Decentralized Organizations- Platforms for decentralization.					
Unit II	INTRODUCTION TO CRYPTOCURRENCY				9
Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations – Name coin – Prime coin – Zcash – Smart Contracts – Ricardian Contracts- Deploying smart contracts on a blockchain					
Unit III	ETHEREUM				9
Introduction - The Ethereum network - Components of the Ethereum ecosystem - Transactions and messages - Ether cryptocurrency / tokens (ETC and ETH) - The Ethereum Virtual Machine (EVM), Ethereum Development Environment: Test networks - Setting up a private net - Starting up the private network					
Unit IV	WEB3 AND HYPERLEDGE				9
Introduction to Web3 – Contract Deployment – POST Requests – Development Frameworks – Hyperledger as a Protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger – Corda.					

Unit V	EMERGING TRENDS												9		
Kadena – Ripple – Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous Tools.															
Total periods: 45															
Text Books:															
1. Imran Bashir, <i>Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained</i> , Packt Publishing, 2nd Edition, 2018															
2. Peter Borovykh, <i>Blockchain Applications in Finance</i> , Blockchain Driven, 2nd Edition, 2018															
3. Arshdeep Bahga, Vijay Madiseti, <i>Blockchain Applications: A Hands-On Approach</i> , VPT, 2017															
References:															
1. Imran. Bashir. Mastering block chain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained. Packt Publishing, 2nd Edition, 2018															
2. Peter Borovykh , Blockchain Application in Finance, Blockchain Driven, 2nd Edition, 2018															
3. ArshdeepBahga, Vijay Madiseti, “Blockchain Applications: A Hands On Approach”, VPT, 2017.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Explain the fundamentals and architecture of blockchain systems													Understand (K2)		
CO2: Analyze cryptocurrencies, Bitcoin mechanics, and alternative coins													Analyze (K4)		
CO3: Develop and deploy smart contracts on Ethereum													Apply (K3)		
CO4: Utilize Web3 and Hyperledger tools for decentralized applications													Apply (K3)		
CO5: Evaluate emerging blockchain technologies, scalability, and privacy challenges													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1					2			3	2	1
CO2	3	3	2	2	1					2		1	3	2	1
CO3	2	2	3	3	2	1				3	1		3	3	2
CO4	2	2	3	3	3	1				3	1	1	3	3	2
CO5	3	3	2	3	3	1				3	1	2	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CMG005	FINTECH PERSONAL FINANCE AND PAYMENTS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of finance concepts • Familiarity with digital payments • Knowledge of basic computer and internet usage					
Course Objectives: • Understand cryptocurrencies, digital wallets, and modern payment systems • Learn the evolution and impact of digital and alternative finance • Understand InsureTech innovations using AI/ML and IoT • Explore peer-to-peer lending, crowdfunding, and marketplace lending • Study regulatory frameworks, RegTech, and fraud detection technologies					
Unit I	CURRENCY EXCHANGE AND PAYMENT				9
Understand the concept of Crypto currency- Bitcoin and Applications -Cryptocurrencies and Digital Crypto Wallets -Types of Cryptocurrencies - Cryptocurrencies and Applications, block chain, Artificial Intelligence, machine learning. Fintech users, Individual Payments, RTGS Systems, Immediate Page 54 of 90 Payment Service (IMPS), Unified Payments Interface (UPI).Legal and Regulatory Implications of Crypto currencies, Payment systems and their regulations.Digital Payments Smart Cards, Stored-Value Cards, EC Micropayments, Payment Gateways, Mobile Payments, Digital and Virtual Currencies, Security, Ethical, Legal, Privacy, and Technology Issues					
Unit II	DIGITAL FINANCE AND ALTERNATIVE FINANCE				9
A Brief History of Financial Innovation, Digitization of Financial Services, Crowd funding, Charity and Equity,. Introduction to the concept of Initial Coin Offering					
Unit III	INSURETECH				9
InsurTech Introduction , Business model disruption AI/ML in InsurTech IoT and InsurTech ,Risk Modeling ,Fraud Detection Processing claims and Underwriting Innovations in Insurance Services					
Unit IV	PEER TO PEER LENDING				9
P2P and Marketplace Lending, New Models and New Products in market place lending P2P Infrastructure and technologies, Concept of Crowdfunding Crowdfunding Architecture and Technology ,P2P and Crowdfunding unicorns and business models , SME/MSME Lending: Unique opportunities and Challenges, Solutions and Innovations					

Unit V	REGULATORY ISSUES												9		
FinTech Regulations: Global Regulations and Domestic Regulations, Evolution of RegTech, RegTech Ecosystem: Financial Institutions, RegTech Ecosystem: StartupsRegTech, Startups: Challenges, RegTech Ecosystem: Regulators, Use of AI in regulation and Fraud detection															
Total periods:45															
Text Books:															
1. Swanson Seth, <i>Fintech for Beginners: Understanding and Utilizing the Power of Technology</i> , 2016															
2. Tanda & Models, <i>Fintech BigTech and Banks</i> , Springer, 2019															
3. Henning Diedrich, <i>Ethereum: Blockchains, Digital Assets, Smart Contracts</i> , 2016															
4. Jacob William, <i>FinTech: The Beginner’s Guide to Financial Technology</i> , 2016															
References:															
1. Swanson Seth, <i>Fintech for Beginners: Understanding and Utilizing the power of technology</i> , Createspace Independent Publishing Platform,2016.															
2. Models AuTanda, <i>Fintech Bigtech And Banks Digitalization and Its Impact On Banking Business</i> , Springer, 2019															
3.Henning Diedrich, <i>Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations</i> , Wildfire Publishing, 2016															
4. Jacob William, <i>FinTech:TheBeginner’s Guide to Financial Technology</i> , Createspace Independent Publishing Platform, 2016															
5. IIBF, <i>Digital Banking</i> , Taxmann Publication, 2016															
6. Jacob William, <i>Financial Technology</i> , Create space Independent Pub, 2016															
7. Luke Sutton, <i>Financial Technology: Bitcoin & Blockchain</i> , Createspace Independent Pub, 2016															
Course Outcomes:													Blooms Taxonomy		
CO 1: Explain cryptocurrencies, digital wallets, and modern payment systems													Understand (K2)		
CO2: Analyze digital finance, alternative finance, and ICO mechanisms													Analyze (K4)		
CO3: Apply InsureTech tools such as AI, ML, and IoT in insurance operations													Apply (K3)		
CO4: Evaluate P2P lending, crowdfunding models, and SME lending innovations													Evaluate (K5)		
CO5: Examine regulatory frameworks, RegTech applications, and fraud detection systems													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	2					2			3	2	1
CO2	3	3	2	3	2					2	1	1	3	2	1

CO3	2	2	3	3	3	1				3	1		3	3	2
CO4	3	3	3	3	3	1				3	1	2	3	3	3
CO5	3	3	2	3	3	1				3	1	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CMG006	INTRODUCTION TO FINTECH	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of financial systems • Basic understanding of digital technology and internet usage					
Course Objectives: • To learn about history, importance and evolution of Fintech • To acquire the knowledge of Fintech in payment industry • To acquire the knowledge of Fintech in insurance industry					
Unit I	INTRODUCTION				9
Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.					
Unit II	PAYMENT INDUSTRY				9
FinTech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, FinTech in Lending Industry- Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.					
Unit III	INSURANCE INDUSTRY				9
FinTech in Wealth Management Industry-Financial Advice, Automated investing, Socially responsible investing, Fractional Investing, Social Investing. FinTech in Insurance Industry- P2P insurance, On-Demand Insurance, On-Demand Consultation, Customer engagement through Quote to sell, policy servicing, Claims Management, Investment linked health insurance.					
Unit IV	FINTECH AROUND THE GLOBE				9
FinTech developments - US, Europe and UK, Germany, Sweden, France, China, India, Africa, Australia, New Zealand, Brazil and Middle East, Regulatory and Policy Assessment for Growth of FinTech. FinTech as disruptors, Financial institutions collaborating with FinTech companies, The new financial world.					

Unit V	FUTURE OF FINTECH	9
How emerging technologies will change financial services, the future of financial services, banking on innovation through data, why FinTech banks will rule the world, The FinTech Supermarket, Banks partnering with FinTech start-ups, The rise of BankTech, Fintech impact on Retail Banking, A future without money, Ethics in Fintech.		
Total periods: 45		
Text Books:		
1. Arner D., Barbers J., Buckley R. The evolution of FinTech: a new post crisis paradigm, University of New South Wales Research Series, 2015		
2. Susanne Chishti, Janos Barberis. The FINTECH Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries, Wiley Publications, 2016		
3. Richard Hayen. FinTech: The Impact and Influence of Financial Technology on Banking and the Finance Industry, 2016		
4. Parag Y Arjunwadkar. FinTech: The Technology Driving Disruption in the financial service industry. CRC Press, 2018		
References:		
1. Arner D., Barbers J., Buckley R, The evolution of FinTech: a new post crisis paradigm, University of New South Wales Research Series, 2015		
2. Susanne Chishti, Janos Barberis, The FINTECH Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries, Wiley Publications, 2016		
3. Richard Hayen, FinTech: The Impact and Influence of Financial Technology on Banking and the Finance Industry, 2016		
4. Parag Y Arjunwadkar, FinTech: The Technology Driving Disruption in the financial service industry CRC Press, 2018		
5. Sanjay Phadke, Fintech Future : The Digital DNA of Finance Paperback .Sage Publications, 2020		
6. Pranay Gupta, T. Mandy Tham, Fintech: The New DNA of Financial Services Paperback, 2018		
Course Outcomes:		Blooms Taxonomy
CO 1: Explain the fundamentals of FinTech including definition, history, significance, architecture and evolution		Understand (K2)
CO2: Analyze the role of FinTech in payment and lending industries		Analyze (K4)
CO3: Apply FinTech concepts in wealth management and insurance industries		Apply (K3)
CO4: Evaluate global FinTech developments and regulatory frameworks		Evaluate (K5)
CO5: Assess the future of FinTech including emerging technologies, BankTech and		Evaluate (K5)

ethics															
CO-PO Mapping															
CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	1					1			2	1	
CO2	2	3	2	2	2					1			3	2	1
CO3	2	2	3	2	3					1			3	3	2
CO4	1	2	2	3	2	1				2		1	2	2	
CO5	1	2	3	3	3	1				2		1	3	3	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

VERTICAL II : ENTREPRENERUSHIP

23CMG007	FOUNDATIONS OF ENTREPRENERUSHIP	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of business concepts and organizational structure. • Fundamental knowledge of economics and market environment. • Awareness of innovation, creativity, and problem-solving concepts. • Basic communication and interpersonal skills. • Interest in technology-driven business and entrepreneurial thinking.					
Course Objectives: • To develop and strengthen the entrepreneurial quality and motivation of learners. • To impart the entrepreneurial skills and traits essential to become successful entrepreneurs.					
Unit I	INTRODUCTION TO ENTREPRENEURSHIP				9
Entrepreneurship- Definition, Need, Scope - Entrepreneurial Skill & Traits - Entrepreneur vs. Intrapreneur; Classification of entrepreneurs, Types of entrepreneurs -Factors affecting entrepreneurial development – Achievement Motivation – Contributions of Entrepreneurship to Economic Development.					
Unit II	BUSINESS OWNERSHIP & ENVIRONMENT				9
Types of Business Ownership – Buiness Envrionnemental Factors – Political-Economic-Sociological-Technological-Environmental-Legal aspects – Human Reosurces Mobilisation-Basics of Managing					

Finance- Essentials of Marketing Management - Production and Operations Planning – Systems Management and Administration		
Unit III	FUNDAMENTALS OF TECHNOPRENEURSHIP	9
Introduction to Technopreneurship - Definition, Need, Scope- Emerging Concepts- Principles - Characterisitcis of a technopreneur - Impacts of Technopreneurship on Society – Economy- Job Opportuinities in Technopreneurship - Recent trends		
Unit IV	APPLICATIONS OF TECHNOPRENEURSHIP	9
Technology Entrepreneurship - Local, National and Global practices - Intrapreneurship and Technology interactions, Networking of entrepreneurial activities – Launching - Managing Technology based Product / Service entrepreneurship – Success Stories of Technopreneurs - Case Studies		
Unit V	EMERGING TRENDS IN ENTREPRENERUSHIP	9
Effective Business Management Strategies For Franchising - Sub-Contracting- Leasing- Technopreneurs – Agripreneurs - Netpreneurs- Portfolio entrepreneruship - NGO Entrepreneurship – Recent Entrprernerual Develoments - Local – National – Global perspectives.		
Total periods: 45		
Text Books:		
1. S.S.Khanka, “Entrepreneurial Development” S.Chand & Co. Ltd. Ram Nagar New Delhi, 2021.		
2. Donal F Kuratko Entrepreneurship (11th Edition) Theory, Process, Practice by Published 2019 by Cengage Learning.		
References:		
1. Daniel Mankani. 2003. Technopreneurship: The successful Entrepreneur in the new Economy. Prentice Hall		
2. Edward Elgar. 2007. Entrepreneurship, Cooperation and the Firm: The Emergence and Survival of High-Technology Ventures in Europe. Edi: Jan Ulijn, Dominique Drillon, and Frank Lasch. Wiley Pub.		
Course Outcomes:		Blooms Taxonomy
CO1: Learn the basics of Entrepreneurship		Remember (K1), Understand (K2)
CO2: Understand the business ownership patterns and evnironment		Understand (K2)
CO3: Understand the Job opportunitites in Industries relating to Technopreneurship		Understand (K2), Apply (K3)
CO4: Learn about applications of tehnopreneurship and successful technopreneurs		Apply (K3), Analyze (K4)
CO5: Acquaint with the recent and emerging trends in entrepreneruship		Analyze (K4),

													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1							1	2					
CO2	2	2	1						2	2		1			
CO3	1	2	2						2	2		1			
CO4		2	3	2	1				3	3	1	1	1		
CO5		1	2	2	2				3	3	1	2	1		
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23CMG008	TEAM BUILDING AND LEADERSHIP MANAGEMENT FOR BUSINESS	Category:PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of organizational structure and communication. • Awareness of human behavior and group dynamics. • Basic knowledge of business management concepts. • Interest in leadership development and team-based activities. • Fundamental interpersonal and decision-making skills.					
Course Objectives: • To develop and strengthen the Leadership qualities and motivation of learners. • To impart the Leadership skills and traits essential to become successful entrepreneurs.					
Unit I	INTRODUCTION TO MANAGING TEAMS				9
Introduction to Team - Team Dynamics - Team Formation – Stages of Team Development - Enhancing teamwork within a group - Team Coaching - Team Decision Making - Virtual Teams - Self Directed Work Teams (SDWTs) -Multicultural Teams.					
Unit II	MANAGING AND DEVELOPING EFFECTIVE TEAMS				9
Team-based Organisations- Leadership roles in team-based organisations - Offsite training and team development - Experiential Learning - Coaching and Mentoring in team building - Building High-Performance Teams - Building Credibility and Trust - Skills for Developing Others - Team Building at the Top - Leadership in Teamwork Effectiveness.					

Unit III	INTRODUCTION TO LEADERSHIP												9		
Introduction to Leadership - Leadership Myths – Characteristics of Leader, Follower and Situation - Leadership Attributes - Personality Traits and Leadership- Intelligence Types and Leadership - Power and Leadership - Delegation and Empowerment .															
Unit IV	LEADERSHIP IN ORGANISATIONS												9		
Leadership Styles – LMX Theory- Leadership Theory and Normative Decision Model - Situational Leadership Model - Contingency Model and Path Goal Theory – Transactional and Transformational Leadership - Charismatic Leadership - Role of Ethics and Values in Organisational Leadership.															
Unit V	LEADERSHIP EFFECTIVENESS												9		
Leadership Behaviour - Assessment of Leadership Behaviors - Destructive Leadership - Motivation and Leadership - Managerial Incompetence and Derailment Conflict Management - Negotiation and Leadership - Culture and Leadership - Global Leadership – Recent Trends in Leadership.															
Total periods: 45															
Text Books:															
1. Daniel Levi, Group Dynamics for Teams ,4th Ed, (2014), Sage Publications.															
2. Dyer, W. G., Dyer, W. G., Jr., & Dyer, J. H..Team building: Proven strategies for improving team performance, 5thed, Jossey-Bass, (2013).															
References:															
1. Hughes, R.L., Ginnett, R.C., & Curphy, G.J., Leadership: Enhancing the lessons of experience, 9th Ed, McGraw Hill Education, Chennai, India. (2019).															
2. Katzenback, J.R., Smith, D.K., The Wisdom of Teams: Creating the High Performance Organisations, Harvard Business Review Press, (2015).															
3. Haldar, U.K., Leadership and Team Building, Oxford University Press, (2010).															
4. Daft, R.L., The Leadership Experience, Cengage, (2015).															
Course Outcomes:													Blooms Taxonomy		
CO1: Learn the basics of managing teams for business.													Remember (K1)		
CO2: Understand developing effective teams for business management.													Understand (K2)		
CO3: Understand the fundamentals of leadership for running a business.													Understand (K2)		
CO4: Learn about the importance of leadership for business development.													Analyze (K4)		
CO5: Acquaint with emerging trends in leadership effectiveness for entrepreneurs.													Analyze (K4),		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1						2	2		1			

CO2	1	2	2	1					2	2		1			
CO3	2	2	1						2	3		1			
CO4		2	3	2	1				3	3	1	1	1		
CO5		1	2	2	2				3	3	1	2	1		
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CMG009	CREATIVITY AND INNOVATION IN ENTREPRENEURSHIP	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of entrepreneurship and business fundamentals. • Awareness of creative thinking and problem-solving skills. • Fundamental knowledge of innovation concepts. • Interest in developing new ideas, products, or business models. • Basic analytical and decision-making skills.					
Course Objectives: • To develop the creativity skills among the learners • To impart the knowledge of creative intelligence essential for entrepreneurs					
Unit I	CREATIVITY				9
Creativity: Definition- Forms of Creativity-Essence, Elaborative and Expressive Creativities- Quality of Creativity-Existential, Entrepreneurial and Empowerment Creativities – Creative Environment- Creative Technology- - Creative Personality and Motivation.					
Unit II	CREATIVE INTELLIGENCE				9
Creative Intelligence: Convergent thinking ability – Traits Congenial to creativity – Creativity Training-- Criteria for evaluating Creativity-Credible Evaluation- Improving the quality of our creativity – Creative Tools and Techniques - Blocks to creativity- fears and Disabilities- Strategies for Unblocking- Designing Creativity Enabling Environment.					
Unit III	INNOVATION				9
Innovation: Definition- Levels of Innovation- Incremental Vs Radical Innovation-Product Innovation and Process- Technological, Organizational Innovation – Indicators- Characteristics of Innovation in Different Sectors. Theories in Innovation and Creativity- Design Thinking and Innovation- Innovation as Collective Change-Innovation as a system					

Unit IV	INNOVATION AND ENTREPRENEURSHIP												9		
Innovation and Entrepreneurship: Entrepreneurial Mindset , Motivations and Behaviours- Opportunity Analysis and Decision Making- Industry Understanding - Entrepreneurial Opportunities- Entrepreneurial Strategies – Technology Pull/Market Push – Product -Market fit															
Unit V	INNOVATIVE BUSINESS MODELS												9		
Innovative Business Models: Customer Discovery-Customer Segments-Prospect Theory and Developing Value Propositions- Developing Business Models: Elements of Business Models – Innovative Business Models: Elements, Designing Innovative Business Models- Responsible Innovation and Creativity.															
Total periods: 45															
SUGGESTED READINGS:															
1. Creativity and Inovation in Entrepreneurship, Kankha, Sultan Chand															
2. Pradip N Khandwalla, Lifelong Creativity, An Unending Quest, Tata Mc Graw Hill, 2004.															
3. Paul Trott, Innovation Management and New Product Development, 4e, Pearson, 2018.															
4. Vinnie Jauhari, Sudanshu Bhushan, Innovation Management, Oxford Higher Education, 2014.															
Course Outcomes:													Blooms Taxonomy		
CO1: Learn the basics of creativity for developing Entrepreneurship													Remember (K1)		
CO2: Understand the importance of creative intelligence for business growth													Apply (K3)		
CO3: Understand the advances through Innovation in Industries													Analyze (K4)		
CO4: Learn about applications of innovation in building successful ventures													Analyze (K4)		
CO5: Acquaint with developing innovative business models to run the business effecientlty and effectively													Analyze (K4)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1							2	2		1			
CO2	1	2	2						2	3		1			
CO3	1	2	2	1					2	3		1			
CO4		2	3	2	1				3	3	1	1	1		
CO5		1	2	2	2				3	3	1	2	1		
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CMG010	PRINCIPLES OF MARKETING MANAGEMENT FOR BUSINESS								Category: PEC			
									L	T	P	C

		3	0	0	3
Prerequisites • Basic understanding of business operations and entrepreneurship. • Awareness of customer needs and buying behavior. • Fundamental knowledge of economics and business environment. • Interest in marketing strategies, branding, and product development. • Basic analytical and communication skills.					
Course Objectives: • To provide basic knowledge of concepts, principles, tools and techniques of marketing for entrepreneurs • To provide an exposure to the students pertaining to the nature and Scope of marketing, which they are expected to possess when they enter the industry as practitioners.					
Unit I	INTRODUCTION TO MARKETING MANAGEMENT				9
Introduction - Market and Marketing – Concepts- Functions of Marketing - Importance of Marketing - Marketing Orientations - Marketing Mix-The Traditional 4Ps - The Modern Components of the Mix - The Additional 3Ps - Developing an Effective Marketing Mix.					
Unit II	MARKETING ENVIRONMENT				9
Introduction - Environmental Scanning - Analysing the Organisation’s Micro Environment and Macro Environment - Differences between Micro and Macro Environment – Techniques of Environment Scanning - Marketing organization - Marketing Research and the Marketing Information System, Types and Components.					
Unit III	PRODUCT AND PRICING MANAGEMENT				9
Product- Meaning, Classification, Levels of Products – Product Life Cycle (PLC) - Product Strategies - Product Mix - Packaging and Labelling - New Product Development - Brand and Branding - Advantages and disadvantages of branding Pricing - Factors Affecting Price Decisions - Cost Based Pricing - Value Based and Competition Based Pricing - Pricing Strategies - National and Global Pricing.					
Unit IV	PROMOTION AND DISTRIBUTION MANAGEMENT				9
Introduction to Promotion – Marketing Channels- Integrated Marketing Communications (IMC) - Introduction to Advertising and Sales Promotion – Basics of Public Relations and Publicity - Personal Selling - Process - Direct Marketing - Segmentation, Targeting and Positioning (STP)-Logistics Management- Introduction to Retailing and Wholesaling.					
Unit V	CONTEMPORARY ISSUES IN MARKETING MANAGEMENT				9

Introduction - Relationship Marketing Vs. Relationship Management - Customer Relationship Management (CRM) - Forms of Relationship Management - CRM practices - Managing Customer Loyalty and Development – Buyer-Seller Relationships- Buying Situations in Industrial / Business Market - Buying Roles in Industrial Marketing - Factors that Influence Business - Services Marketing - E-Marketing or Online Marketing.															
Total periods: 45															
Text Books:															
1. Philip Kotler, Gary Armstrong, Principles of Marketing, Pearson Education, 17th Edition, 2018.															
2. Ramaswamy V.S., Namakumari S., Marketing Management: Global Perspective – Indian Context, McGraw Hill Education, 5th Edition, 2018															
3. C.B. Gupta, Rajan Nair, Marketing Management: Text and Cases, Sultan Chand & Sons, 17th Edition, 2017.															
References:															
1. Marketing Management, Sherlekar S.A, Himalaya Publishing House, 2016.															
2. Marketing Management, Philip Kortler and Kevin Lane Keller, PHI 15th Ed, 2015.															
3. Marketing Management- An Indian perspective, Vijay Prakash Anand, Biztantra, Second edition, 2016.															
4. Marketing Management Global Perspective, Indian Context, V.S.Ramaswamy &S.Namakumari, Macmillan Publishers India,5th edition, 2015.															
5. Marketing Management, S.H.H. Kazmi, 2013, Excel Books India.															
6. Marketing Management- text and Cases, Dr. C.B.Gupta & Dr. N.Rajan Nair, 17th edition, 2016.															
Course Outcomes:													Blooms Taxonomy		
CO1: Have the awareness of marketing management process													Understand (K2)		
CO2: Understand the marketing environment													Analyze (K4)		
CO3: Acquaint about product and pricing strategies													Apply (K3)		
CO4: Knowledge of promotion and distribution in marketing management.													Analyze (K4)		
CO5: Comprehend the contemporary marketing scenairos and offer solutions to marketing issues.													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1							2	2		1			
CO2	1	2	2	1					2	3		1			
CO3	1	2	2	2	1				3	3		1	1		
CO4		2	3	2	2				3	3	1	1	1		

CO5		1	2	2	2				3	3	1	2	1		
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CMG011	HUMAN RESOURCE MANAGEMENT FOR ENTREPRENEURS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of organizational structure and management principles. • Awareness of fundamental business operations and entrepreneurial functions.					
Course Objectives: • To introduce the basic concepts, structure and functions of human resource management for entrepreneurs. • To create an awareness of the roles, functions and functioning of human resource department. • To understand the methods and techniques followed by Human Resource Management practitioners.					
Unit I	INTRODUCTION TO HRM				9
Concept, Definition, Objectives- Nature and Scope of HRM - Evolution of HRM - HR Manager Roles- Skills - Personnel Management Vs. HRM - Human Resource Policies - HR Accounting - HR Audit - Challenges in HRM.					
Unit II	HUMAN RESOURCE PLANNING				9
HR Planning - Definition - Factors- Tools - Methods and Techniques - Job analysis- Job rotation- Job Description - Career Planning - Succession Planning - HRIS - Computer Applications in HR - Recent Trends					
Unit III	RECRUITMENT AND SELECTION				9
Sources of recruitment- Internal Vs. External - Domestic Vs. Global Sources -eRecruitment - Selection Process- Selection techniques -eSelection- Interview Types- Employee Engagement.					
Unit IV	TRAINING AND EMPLOYEE DEVELOPMENT				9
Types of Training - On-The-Job, Off-The-Job - Training Needs Analysis – Induction and Socialisation Process - Employee Compensation - Wages and Salary Administration – Health and Social Security Measures- Green HRM Practices					
Unit V	CONTROLLING HUMAN RESOURCES				9

Performance Appraisal – Types - Methods - Collective Bargaining - Grievances Redressal Methods – Employee Discipline – Promotion – Demotion - Transfer – Dismissal - Retrenchment - Union Management Relationship - Recent Trends															
Total periods: 45															
Text Books:															
1. K. Aswathappa, Sadhna Dash , Human Resource Management - Text and Cases , 9th Edition, McGraw Hill, 2021.															
2. Uday Kumar Haldar, Juthika Sarkar. Human Resource management. Oxford. 2012															
References:															
1. Gary Dessler and Biju Varkkey, Human Resource Management, 14e , Pearson, 2015.															
2. Mathis and Jackson, Human Resource Management, Cengage Learning 15e, 2017.															
3. David A. Decenzo, Stephen.P.Robbins, and Susan L. Verhulst, Human Resource Management, Wiley, International Student Edition, 11th Edition, 2014															
4. R. Wayne Mondy, Human Resource Management, Pearson , 2015.															
5. Luis R.Gomez-Mejia, David B.Balkin, Robert L Cardy. Managing Human Resource. PHI Learning. 2012															
6. John M. Ivancevich, Human Resource Management,12e, McGraw Hill Irwin,2013.															
Course Outcomes:														Blooms Taxonomy	
CO1: To understand the Evolution of HRM and Challenges faced by HR Managers														Understand (K2)	
CO2: To learn about the HR Planning Methods and practices.														Apply (K3)	
CO3: To acquaint about the Recruitment and Selection Techniques followed in Industries.														Apply (K3)	
CO4: To known about the methods of Training and Employee Development.														Analyze (K4)	
CO5: To comprehend the techniques of controlling human resources in organisations.														Evaluate (K5)	
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	2	1	1	2	3	2	1	3	2	1
CO2	2	3	2	2	1	2	1	1	2	3	2	1	3	2	1
CO3	2	2	3	2	1	2	1	1	3	3	2	1	3	2	2
CO4	2	2	3	3	2	2	1	1	3	3	2	2	3	2	2
CO5	2	2	2	3	2	3	1	2	3	3	2	2	3	2	2
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CMG012	FINANCING NEW BUSINESS VENTURES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of accounting and financial statements • Understanding of fundamental business concepts • Awareness of entrepreneurship and new venture creation basics					
Course Objectives: • To develop the basics of business venture financing. • To impart the knowledge essential for entrepreneurs for financing new ventures. • To acquaint the learners with the sources of debt and equity financing. • To empower the learners towards fund raising for new ventures effectively. • To empower learners to apply effective fund-raising methods for new ventures					
Unit I	ESSENTIALS OF NEW BUSINESS VENTURE				9
Setting up new Business Ventures – Need - Scope - Franchising - Location Strategy, Registration Process - State Directorate of Industries- Financing for New Ventures - Central and State Government Agencies - Types of loans – Financial Institutions - SFC, IDBI, NSIC and SIDCO.					
Unit II	INTRODUCTION TO VENTURE FINANCING				9
Venture Finance – Definition – Historic Background - Funding New Ventures- Need – Scope – Types - Cost of Project - Means of Financing - Estimation of Working Capital - Requirement of funds – Mix of Debt and Equity - Challenges and Opportunities.					
Unit III	SOURCES OF DEBT FINANCING				9
Fund for Capital Assets - Term Loans - Leasing and Hire-Purchase - Money Market instruments – Bonds, Corporate Papers – Preference Capital- Working Capital Management- Fund based Credit Facilities - Cash Credit - Over Draft.					
Unit IV	SOURCES OF EQUITY FINANCING				9
Own Capital, Unsecured Loan - Government Subsidies , Margin Money- Equity Funding - Private Equity Fund- Schemes of Commercial banks - Angel Funding – Crowdfunding- Venture Capital.					
Unit V	METHODS OF FUND RAISING FOR NEW VENTURES				9
Investor Decision Process - Identifying the appropriate investors- Targeting investors- Developing Relationships with investors - Investor Selection Criteria- Company Creation- Raising Funds - Seed Funding- VC Selection Criteria – Process- Methods- Recent Trends					

Total periods: 45															
Text Books:															
1.Prasanna Chandra, <i>Financial Management: Theory and Practice</i> , McGraw Hill Education, Latest Edition.															
2.I.M. Pandey, <i>Financial Management</i> , Vikas Publishing House, Latest Edition.															
3.Bhabatosh Banerjee, <i>Fundamentals of Financial Management</i> , PHI Learning, Latest Edition.															
References:															
1. Principles of Corporate Finance by Brealey and Myers et al.,12TH ed, McGraw Hill Education (India) Private Limited, 2018															
2. Prasanna Chandra, Projects : Planning ,Analysis,Selection ,Financing,Implementation and Review, McGraw Hill Education India Pvt Ltd ,New Delhi , 2019.															
3. Introduction to Project Finance. Andrew Fight,Butterworth-Heinemann, 2006.															
4. Metrick, Andrew; Yasuda, Ayako. Venture Capital And The Finance Of Innovation. Venture Capital And The Finance Of Innovation, 2nd Edition, Andrew Metrick And Ayako Yasuda, Eds., John Wiley And Sons, Inc, 2010.															
5. Feld, Brad; Mendelson, Jason. Venture Deals. Wiley, 2011.															
6. May, John; Simons, Cal. Every Business Needs An Angel: Getting The Money You Need To Make Your Business Grow. Crown Business, 2001.															
7. Gompers, Paul Alan; Lerner, Joshua. The Money Of Invention: How Venture Capital Creates New Wealth. Harvard Business Press, 2001.															
8. Camp, Justin J. Venture Capital Due Diligence: A Guide To Making Smart Investment Choices And Increasing Your Portfolio Returns. John Wiley & Sons, 2002.															
9. Byers, Thomas. Technology Ventures: From Idea To Enterprise. Mcgraw2014.															
10. Lerner, Josh; Leamon, Ann; Financing Of Entrepreneurship. 2012.															
Course Outcomes:													Blooms Taxonomy		
CO1: Learn the basics of starting a new business venture.													Remember (K1)		
CO2: Understand the basics of venture financing.													Understand (K2)		
CO3: Understand the sources of debt financing.													Apply (K3)		
CO4: Understand the sources of equity financing.													Analyze (K4)		
CO5: Acquaint with the methods of fund raising for new business ventures.													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	2	1	1	2	3	2	1	3	2	1
CO2	3	3	2	2	1	2	1	1	2	3	2	1	3	2	1

CO3	2	3	3	2	1	2	1	1	3	3	2	1	3	2	2
CO4	2	3	3	3	2	2	1	1	3	3	2	2	3	2	2
CO5	2	3	3	3	2	3	1	2	3	3	2	2	3	2	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

VERTICAL III: PUBLIC ADMINISTRATION

23CMG013	PRINCIPLES OF PUBLIC ADMINISTRATION	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of social sciences (recommended, not mandatory). • No formal prerequisites.					
Course Objectives: • To Introduce the meaning, nature, scope and significance of Public Administration. • To Explain the evolution and changing trends in Public Administration including NPA and NPM. • To Familiarize students with classical, scientific, bureaucratic, human relations and ecological approaches.					
Unit I					9
1. Meaning, Nature and Scope of Public Administration 2. Importance of Public Administration 3. Evolution of Public Administration					
Unit II					9
1. New Public Administration 2. New Public Management 3. Public and Private Administration					
Unit III					9
1. Relationships with Political Science, History and Sociology 2. Classical Approach 3. Scientific Management Approach					
Unit IV					9

1. Bureaucratic Approach: Max Weber															
2. Human Relations Approach : Elton Mayo															
3. Ecological Approach : Riggs															
Unit V														9	
1. Leadership: Leadership - Styles - Approaches															
2. Communication: Communication Types - Process - Barriers															
3. Decision Making: Decision Making - Types, Techniques and Processes.															
Total periods: 45															
Text Books:															
1.Avasthi and Maheshwari, <i>Public Administration in India</i> , Lakshmi Narain Agarwal, Agra, 2013.															
2.Rumki Basu, <i>Public Administration: Concepts and Theories</i> , Sterling Publishers, New Delhi, 2013.															
References:															
1. Avasthi and Maheswari: Public Administration in India, Agra:Lakshmi Narain Agarwal,2013.															
2. Ramesh K Arora: Indian Public Administration, New Delhi: Wishwa Prakashan, 2012.															
Course Outcomes:													Blooms Taxonomy		
CO1: Analyze the meaning, nature, scope and evolution of Public Administration.													Analyze (K4)		
CO2: Analyze New Public Administration, New Public Management and compare public–private administration.													Analyze(K4)		
CO3: Evaluate classical, scientific, bureaucratic, human relations and ecological approaches.													Evaluate(K5)		
CO4: Create administrative frameworks using classical and modern administrative theories.													Create(K6)		
CO5: Apply leadership, communication and decision-making techniques in administrative contexts.													Applying(K3)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2			1					2	3			1		
CO2	2	1		2					2	3			1		
CO3	2	2	2	3					2	3			2		
CO4	1			2				1	3	3			1		
CO5								1	3	3			2	1	
1 - Low, 2 - Medium, 3 - High , ‘ ‘ No correlation															

23CMG014	CONSTITUTION OF INDIA	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of Indian history and civics (recommended but not mandatory). • No formal prerequisites.					
Course Objectives: • To provide knowledge about the constitutional developments and the making of the Indian Constitution. • To enable students to understand Fundamental Rights, Duties, and Directive Principles of State Policy. • Familiarize students with the structure and functioning of the Union Government – President, Parliament, Supreme Court.					
Unit I					9
1. Constitutional Development Since 1909 to 1947					
2. Making of the Constitution.					
3. Constituent Assembly					
Unit II					9
1. Fundamental Rights					
2. Fundamental Duties					
3. Directive Principles of State Policy					
Unit III					9
1. President					
2. Parliament					
3. Supreme Court					
Unit IV					9
1. Governor					
2. State Legislature					
3. High Court					
Unit V					9
1. Secularism					
2. Social Justice					

3. Minority Safeguards															
Total periods: 45															
Text Books:															
1.D.D. Basu – Introduction to the Constitution of India, LexisNexis / Prentice Hall of India.															
2.M. Laxmikanth – Indian Polity, McGraw Hill Education.															
References:															
1. Basu. D.D.: Introduction to Indian Constitution ; Prentice Hall; New Delhi.															
2. Kapur. A.C: Indian Government and Political System; S.Chand and Company Ltd., New Delhi.															
3. Johari J.C.: Indian Politics, Vishal Publications Ltd, New Delhi															
4. Agarwal R.C: Indian Political System; S.Chand & Co., New Delhi															
Course Outcomes:													Blooms Taxonomy		
CO1: Explain the historical evolution, constitutional development (1909–1947), and making of the Constitution.													Understand(K2)		
CO2: Describe and interpret the Fundamental Rights, Fundamental Duties, and Directive Principles of State Policy, and their significance in the Indian constitutional framework.													Understand (K2)		
CO3: Analyze the structure, powers, and functions of the President, Parliament, and Supreme Court, and evaluate their roles in the Union Government.													Analyze (K4)		
CO4: Explain the functioning of State Government institutions—Governor, State Legislature, and High Courts—and compare their roles with corresponding Union institutions.													Analyze (K4)		
CO5: Examine the concepts of secularism, social justice, and constitutional safeguards for minorities, and assess their relevance in contemporary India.													Evaluate (K5)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1					1	2		1			1		
CO2	2	2		1			2	2		1			1		
CO3	2	2	1	2			2	2		1			2	1	
CO4	1	2	1	2			2	2		1			2	1	
CO5	1	1		1			3	3		1			2	1	
1 - Low, 2 - Medium, 3 - High , ‘ ‘ No correlation															

23CMG015	PUBLIC PERSONNEL ADMINISTRATION	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites - No formal prerequisites. - Basic understanding of public administration and governance (recommended).					
Course Objectives: - To understand the meaning, scope, and significance of personnel administration in public organizations. - To familiarize students with various personnel systems and administrative structures. - To explain recruitment, training, promotion, and their role in administrative efficiency. - To analyze the relationship between civil servants, political executives, and integrity systems. - To provide insights into employer–employee relations, wage systems, and employee benefits in public administration.					
Unit I					9
1. Meaning, Scope and Importance of Personnel Administration 2. Types of Personnel Systems: Bureaucratic, Democratic and Representative systems					
Unit II					9
1. Generalist Vs Specialist 2. Civil Servants’ Relationship with Political Executive 3. Integrity in Administration.					
Unit III					9
1. Recruitment: Direct Recruitment and Recruitment from Within 2. Training: Kinds of Training 3. Promotion					
Unit IV					9
1. Governor 2. State Legislature 3. High Court					
Unit V					9
1. Employer Employee Relations 2. Wage and Salary Administration					

3. Allowances and Benefits															
Total periods: 45															
Text Books:															
1.Stahl, Glenn O. – Public Personnel Administration															
References:															
1. Stahl Glean O: Public Personnel Administration															
2. Parnandikar Pai V.A: Personnel System for Development Administration.															
3. Bhambhiru . P: Bureaucracy and Policy in India.															
4. Dwivedi O.P and Jain R.B: India's Administrative state.															
5. Muttalis M.A: Union Public Service Commission.															
6. Bhakara Rao .V: Employer Employee Relations in India.															
7. Davar R.S. Personnel Management & Industrial Relations															
Course Outcomes:												Blooms Taxonomy			
CO1: Analyze the meaning, scope, importance, and types of personnel administration systems.												Analyze (K4)			
CO2: Analyze the functions of generalists and specialists, political–administrative relationships, and integrity mechanisms.												Analyze(K4)			
CO3: Evaluate recruitment, training, and promotion processes in public personnel administration.												Evaluate(K5)			
CO4: Create effective personnel management strategies relating to Governor, State Legislature, and High Court functions in the administrative system.												Create(K6)			
CO5: Apply concepts of employer–employee relations, wage systems, allowances, and benefits in public organizational settings.												Applying(K3)			
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2			1				2	3				1		
CO2	2	1		2				2	3				1		
CO3	2	2	2	3				2	3				2	1	
CO4	1			2			1	3	3				1		
CO5								1	3	3			2	1	
1 - Low, 2 - Medium, 3 - High , ‘ ‘ No correlation															

23CMG016	ADMINISTRATIVE THEORIES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites - No formal prerequisites. - Basic understanding of public administration and management concepts (recommended).					
Course Objectives: - To understand the meaning, scope, and significance of Public Administration. - To study the evolution of Public Administration as a discipline and its identity. - To learn classical, scientific, and human relations theories of organization. - To analyze organizational behavior, design, and group dynamics. - To examine motivation and leadership theories and the contributions of eminent administrative thinkers.					
Unit I					9
Meaning, Scope and significance of Public Administration, Evolution of Public Administration as a discipline and Identity of Public Administration					
Unit II					9
Theories of Organization: Scientific Management Theory, Classical Model, Human Relations Theory					
Unit III					9
Organization goals and Behaviour, Groups in organization and group dynamics, Organizational Design.					
Unit IV					9
Motivation Theories, content, process and contemporary; Theories of Leadership: Traditional and Modern: Process and techniques of decision-making					
Unit V					9
Administrative thinkers: Kautilya, Woodrow Willson, C.I. Barnard . Peter Drucker					
Total periods: 45					
Text Books:					
1.Shum Sun Nisa Alvi – <i>Eminent Administrative Thinkers</i>					
2.Keith Davis – <i>Organization Theory</i>					
References:					
1. Crozier M : The Bureaucratic phenomenon (Chand)					
2. Blau. P.M and Scott. W : Formal Organizations (RKP)					

3. Presthus. R : The Organizational Society (MAC)															
4. Alvi, Shum Sun Nisa : Eminent Administrative Thinkers.															
5. Keith Davis : Organization Theory (MAC)															
Course Outcomes:												Blooms Taxonomy			
CO1: Explain the meaning, scope, significance, and evolution of Public Administration.												Understand(K2)			
CO2: Analyze organizational theories: Scientific Management, Classical, and Human Relations approaches.												Analyze(K4)			
CO3: Examine organizational behavior, group dynamics, and organizational design.												Analyze(K4)			
CO4: Evaluate motivation and leadership theories and apply decision-making techniques.												Evaluate(K5)			
CO5: Assess contributions of eminent administrative thinkers and their relevance to contemporary administration.												Evaluate(K5)			
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1		1				2	2				1		
CO2	2	2	1	2				2	3				1		
CO3	2	2	1	2				2	3				1	1	
CO4	2	1	1	3				2	3				2	1	
CO5	2	1	1	3				2	3				2	1	
1 - Low, 2 - Medium, 3 - High , ‘ ‘ No correlation															

23CMG017	INDIAN ADMINISTRATIVE SYSTEM	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites - No formal prerequisites. - Basic understanding of Indian polity and governance (recommended).					
Course Objectives: - To understand the evolution and constitutional context of Indian Administration. - To examine the role and functions of key constitutional authorities and administrative offices. - To analyze the role of district administration and local governance in development programmes.					

- To evaluate the impact of coalition politics, integrity, and vigilance mechanisms in administration. - To understand anti-corruption mechanisms, Ombudsman, Lok Pal, and Lok Ayuktha in India.		
Unit I		9
Evolution and Constitutional Context of Indian Administration, Constitutional Authorities: Finance Commission, Union Public Services Commission, Election Commission, Comptroller and Auditor General of India, Attorney General of India		
Unit II		9
Role & Functions of the District Collector, Relationship between the District Collector and Superintendent of Police, Role of Block Development Officer in development programmes, Local Government		
Unit III		9
Main Features of 73rd Constitutional Amendment Act 1992, Salient Features of 74th Constitutional Amendment Act 1992		
Unit IV		9
Coalition politics in India, Integrity and Vigilance in Indian Administration		
Unit V		9
Corruption – Ombudsman, Lok Pal & Lok Ayuktha		
Total periods: 45		
Text Books:		
1.S.R. Maheswari – Indian Administration.		
References:		
1. S.R. Maheswari : Indian Administration		
2. Khera. S.S : Administration in India		
3. Ramesh K. Arora : Indian Public Administration		
4. T.N. Chaturvedi : State administration in India		
5. Basu, D.D : Introduction to the Constitution of India		
Course Outcomes:		Blooms Taxonomy
CO1: Analyze the evolution and constitutional framework of Indian Administration.		Analyze (K4)
CO2: Analyze the roles and functions of district and local administrative offices.		Analyze(K4)
CO3: Evaluate the impact of 73rd & 74th Constitutional Amendments on local governance.		Evaluate(K5)
CO4: Create administrative strategies to enhance integrity, vigilance, and governance effectiveness.		Create(K6)

CO5: Apply knowledge of anti-corruption mechanisms like Ombudsman, Lok Pal & Lok Ayuktha.													Applying(K3)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1		1				2	2				1		
CO2	2	2	1	2				2	3				1		
CO3	2	2	1	3				2	3				2	1	
CO4	1	1	1	3			2	3	3				2	1	
CO5	1			2				2	3				2	1	
1 - Low, 2 - Medium, 3 - High , ‘ ‘ No correlation															

23CMG018	PUBLIC POLICY ADMINISTRATION	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites - No formal prerequisites. - Basic understanding of political science, public administration, and governance (recommended).					
Course Objectives: - To understand the meaning, nature, scope, and importance of public policy. - To examine the relationship of public policy with social sciences, political science, and public administration. - To explore approaches to policy analysis, including institutional, incremental, system, and Dror’s optimal model.					
Unit I					9
Meaning and Definition of Public Policy - Nature, Scope and Importance of public policy – Public policy relationship with social sciences especially with political science and Public Administration.					
Unit II					9
Approaches in Policy Analysis - Institutional Approach – Incremental Approach and System’s Approach – Dror’s Optimal Mode					
Unit III					9
Major stages involved in Policy making Process – Policy Formulation – Policy Implementation –Policy Evaluation.					

Unit IV													9		
Institutional Framework of Policy making – Role of Bureaucracy – Role of Interest Groups and Role of Political Parties.															
Unit V													9		
Introduction to the following Public Policies – New Economic Policy – Population Policy – Agriculture policy - Information Technology Policy.															
Total periods: 45															
Text Books:															
1.Rajesh Chakrabarti & Kaushik Sanyal – Public Policy in India, Oxford University Press, 2016															
References:															
1. Rajesh Chakrabarti & Kaushik Sanyal : Public Policy in India, Oxford University Press, 2016.															
2. Kuldeep Mathur : Public Policy and Politics in India, Oxford University Press, 2016.															
3. Bidyutv Chakrabarty: Public Policy: Concept, Theory and Practice, 2015.															
Course Outcomes:												Blooms Taxonomy			
CO1: Explain the meaning, nature, scope, and significance of public policy.												Understand(K2)			
CO2: Analyze various approaches to policy analysis, including institutional, incremental, system, and Dror’s optimal mode.												Analyze(K4)			
CO3: Evaluate the policy formulation process and assess the factors influencing effective policy design.												Evaluate(K5)			
CO4: Examine the institutional framework of policy-making and the roles of bureaucracy, political parties, and interest groups.												Analyze(K4)			
CO5: Apply knowledge of public policies in India, including economic, population, agriculture, and IT policies.												Apply(K3)			
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1		1				2	2				1		
CO2	2	2	1	2				2	3				1		
CO3	2	2	1	3				2	3				2	1	
CO4	1			2			1	3	3				1		
CO5								1	3	3			2	1	
1 - Low, 2 - Medium, 3 - High , ‘ ‘ No correlation															

VERTICAL IV : BUSINESS DATA ANALYTICS

23CMG019	STATISTICS FOR MANAGEMENT	Category: PEC			
		L	T	P	C
		3	0	0	1
Prerequisites • A strong foundational knowledge of high school level algebra and arithmetic operations is required. • Basic familiarity with using spreadsheet software applications like Microsoft Excel for data entry. • The ability to interpret and analyze basic statistical charts and graphical representations of data. • An introductory understanding of mathematical concepts such as set theory and logical reasoning. • Possession of basic analytical thinking skills to solve numerical problems effectively.					
Course Objectives: • To learn the various applications of statistical methods in modern business decision-making processes. • To understand the fundamental concepts of probability distributions and their real-world implications.					
Unit I	INTRODUCTION				9
Basic definitions and rules for probability, Baye’s theorem and random variables, Probability distributions: Binomial, Poisson, Uniform and Normal distributions.					
Unit II	SAMPLING DISTRIBUTION AND ESTIMATION				9
Introduction to sampling distributions, Central limit theorem and applications, sampling techniques, Point and nterval estimates of population parameters.					
Unit III	TESTING OF HYPOTHESIS - PARAMETIRC TESTS				9
Hypothesis testing: one sample and two sample tests for means of large samples (z-test), one sample and two sample tests for means of small samples (t-test), ANOVA one way.					
Unit IV	NON-PARAMETRIC TESTS				9
Chi-square tests for independence of attributes and goodness of fit, Kolmogorov-Smirnov – test for goodness of fit, Mann – Whitney U test and Kruskal Wallis test.					
Unit V	CORRELATION AND REGRESSION				9
Correlation –Rank Correlation – Regression – Estimation of Regression line – Method of Least Squares – Standard Error of estimate.					
Total periods: 45					

Text Books:																
1.Statistics for Management by Levin, Rubin, et al. (Pearson, 2017)																
2.Applied Business Statistics by Ken Black (Wiley, 2012)																
References:																
1. Richard I. Levin, David S. Rubin, Masood H.Siddiqui, Sanjay Rastogi, Statistics for Management, Pearson Education, 8th Edition, 2017.																
2.Prem. S. Mann, Introductory Statistics, Wiley Publications, 9th Edition, 2015																
3. T N Srivastava and Shailaja Rego, Statistics for Management, Tata McGraw Hill, 3rd Edition 2017.																
4. Ken Black, Applied Business Statistics, 7th Edition, Wiley India Edition, 2012.																
5. David R. Anderson, Dennis J. Sweeney, Thomas A.Williams, Jeffrey D.Camm, James																
6.Cochran, Statistics for business and economics, 13th edition, Thomson (South – Western) Asia, Singapore, 2016.																
7.N. D. Vohra, Business Statistics, Tata McGraw Hill, 2017.																
Course Outcomes													Blooms Taxonomy			
CO1: To facilitate objective solutions in business decision making.													Apply (K3)			
CO2: To understand and solve business problems.													Understand (K2)			
CO3: To apply statistical techniques to data sets, and correctly interpret the results.													Analyze (K4)			
CO4: To develop skill-set that is in demand in both the research and business environments.													Evaluate (K5)			
CO5: To enable the students to apply the statistical techniques in a work setting.													Create (K6)			
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	2														
CO2	3	3														
CO3	3	3	2										3			
CO4	3	3	2	2										3		
CO5	3	3	3													3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation																

23CMG020	DATAMINING FOR BUSINESS INTELLIGENCE	Category: PEC			
		L	T	P	L
		3	0	0	3
Prerequisites - A solid foundational knowledge of basic statistical concepts and probability theory is essential. - Basic understanding of database management systems and how data is structured and stored. - Familiarity with fundamental programming logic or algorithm development for data processing. - Understanding of linear algebra concepts including matrix operations and vector spaces. - Basic knowledge of core business processes and how decision-making occurs in organizations.					
Course Objectives: - To know how to derive meaningful insights from huge volumes of complex data and information. - To understand how the knowledge discovery process is utilized in effective business decision-making. - To apply advanced prediction techniques including time series analysis and data visualization methods					
Unit I	INTRODUCTION				9
Data mining, Text mining, Web mining, Data ware house.					
Unit II	DATA MINING PROCESS				9
Datamining process – KDD, CRISP-DM, SEMMA Prediction performance measures					
Unit III	PREDICTION TECHNIQUES				9
Data visualization, Time series – ARIMA, Winter Holts,					
Unit IV	CLASSIFICATION AND CLUSTERING TECHNIQUES				9
Classification, Association, Clustering.					
Unit V	MACHINE LEARNING AND AI				9
Genetic algorithms, Neural network, Fuzzy logic, Ant Colony optimization, Particle Swarm optimization					
Total periods: 45					
Text Books:					
1.Data Mining Concepts and Techniques by Han & Kamber (2006)					
2.Business Intelligence by Turban et al. (2008)					
References:					

1. Jaiwei Ham and Micheline Kamber, Data Mining concepts and techniques, Kauffmann Publishers 2006															
2. Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2008.															
3. W.H.Inmon, Building the Data Warehouse, fourth edition Wiley India pvt. Ltd. 2005.															
4. Ralph Kimball and Richard Merz, The data warehouse toolkit, John Wiley, 3rd edition, 2013.															
5. Michel Berry and Gordon Linoff, Mastering Data mining, John Wiley and Sons Inc, 2nd Edition, 2011															
6. Michel Berry and Gordon Linoff, Data mining techniques for Marketing, Sales and Customer support, John Wiley, 2011															
7. G. K. Gupta, Introduction to Data mining with Case Studies, Prentice hall of India, 2011															
8. Giudici, Applied Data mining – Statistical Methods for Business and Industry, John Wiley. 2009															
9. Elizabeth Vitt, Michael Luckevich Stacia Misner, Business Intelligence, Microsoft, 2011															
10. Michalewicz Z., Schmidt M. Michalewicz M and Chiriac C, Adaptive Business Intelligence, Springer – Verlag, 2007															
11. Galit Shmueli, Nitin R. Patel and Peter C. Bruce, Data Mining for Business Intelligence – Concepts, Techniques and Applications Wiley, India, 2010.															
Course Outcomes													Blooms Taxonomy		
CO1: Learn to apply various data mining techniques into various areas of different domains.													Apply (K3)		
CO2: Be able to interact competently on the topic of data mining for business intelligence.													Understand (K2)		
CO3: Apply various prediction techniques.													Analyze (K4)		
CO4: Learn about supervised and unsupervised learning technique.													Evaluate (K5)		
CO5: To enable the students to apply the statistical techniques in a work setting.													Create (K6)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											3		
CO2	2	2								2					
CO3	3	3	3											3	
CO4	3	3		2											
CO5	3		3												3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CMG021	HUMAN RESOURCE ANALYTICS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of the core functions and responsibilities within human resource management. • Familiarity with key organizational behavior concepts and employee performance dynamics. • Fundamental skills in statistics and the ability to interpret data patterns correctly. • Proficiency in using spreadsheet tools for performing calculations and organizing workforce data. • Understanding of strategic management principles and overall organizational business goals.					
Course Objectives: • To develop the ability of the learners to define and implement HR metrics that are aligned with the overall business strategy. • To know the different types of HR metrics and understand their respective impact and application. • To understand the impact and use of HR metrics and their connection with HR analytics.					
Unit I	INTRODUCTION TO HR ANALYTICS				9
People Analytics - stages of maturity - Human Capital in the Value Chain : impact on business – HR metrics and KPIs.					
Unit II	HR ANALYTICS I: RECRUITMENT				9
Recruitment Metrics : Fill-up ratio - Time to hire - Cost per hire - Early turnover - Employee referral hires - Agency hires - Lateral hires - Fulfillment ratio- Quality of hire.					
Unit III	HR ANALYTICS - TRAINING AND DEVELOPMENT				9
Training & Development Metrics : Percentage of employees trained- Internally and externally trained - Training hours and cost per employee - ROI.					
Unit IV	HR ANALYTICS EMPLOYEE ENGAGEMENT AND CAREER PROGRESSION				9
Employee Engagement Metrics :Talent Retention index - Voluntary and involuntary turnover- grades, performance, and service tenure - Internal hired index Career Progression Metrics: Promotion index - Rotation index - Career path index.					
Unit V	HR ANALYTICS IV: WORKFORCE DIVERSITY AND DEVELOPMENT				9
Workforce Diversity and Development Metrics : Employees per manager – Workforce age profiling - Workforce service profiling - Churnover index - Workforce diversity index - Gender mix					
Total periods: 45					

Text Books:															
1.The New HR Analytics by Jac Fitz-enz (2010)															
2.Predictive HR Analytics by Edwards & Edwards (2016)															
References:															
1. JacFitzenz , The New HR Analytics, AMACOM , 2010.															
2. Edwards M. R., & Edwards K, Predictive HR Analytics: Mastering the HR Metric.London: Kogan Page.2016.															
3. Human Resources kit for Dummies – 3 rd edition – Max Messmer, 2003															
4. Dipak Kumar Bhattacharyya, HR Analytics ,Understanding Theories and Applications, SAGE Publications India ,2017.															
5. Sesil, J. C. , Applying advanced analytics to HR management decisions: Methods fo selection, developing incentives, and improving collaboration. Upper Saddle River,New Jersey: Pearson Education,2014.															
6. Pease, G., & Beresford, B, Developing Human Capital: Using Analytics to Plan and Optimize Your Learning and Development Investments. Wiley ,2014.															
7. Phillips, J., & Phillips, P.P, Making Human Capital Analytics Work: Measuring the ROI of Human Capital Processes and OUTCOME. McGraw-Hill,2014.															
Course Outcomes													Blooms Taxonomy		
CO1: The learners will be conversant about HR metrics and ready to apply at work settings.													Understand (K2)		
CO2: The learners will be able to resolve HR issues using people analytics.													Apply (K3)		
CO3: Analyze workforce data to identify trends and patterns in employee behavior.													Analyze (K4)		
CO4: Evaluate the effectiveness of HR interventions and training programs using ROI.													Evaluate (K5)		
CO5: Create strategic HR plans based on predictive analytics models.													Create (K6)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2					2		2							
CO2	3	3											3		
CO3	3	3	2											2	
CO4	3	3		2											
CO5	3		3								2				3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CMG022	MARKETING AND SOCIAL MEDIA WEB ANALYTICS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Fundamental understanding of marketing management principles and consumer engagement strategies. - Basic knowledge of internet technologies, web architecture, and social networking platforms. - Understanding of consumer behavior models and current digital marketing trends. - Basic statistical analysis skills required for interpreting marketing performance data. - Familiarity with various digital communication channels and online community dynamics					
Course Objectives: - To showcase the opportunities that exist today to leverage the power of the web and social media. - To understand the methods for marketing budget allocation and performance measurement analysis. - To analyze the strategies for community building and understanding the viral impact of social media. - To implement effective web analytics strategies and define key performance indicators for success. - To apply search engine optimization techniques and traffic analysis to improve online visibility					
Unit I	MARKETING ANALYTICS				9
Marketing Budget and Marketing Performance Measure, Marketing - Geographical Mapping, Data Exploration, Market Basket Analysis					
Unit II	COMMUNITY BUILDING AND MANAGEMENT				9
History and Evolution of Social Media-Understanding Science of Social Media –Goals for using Social Media- Social Media Audience and Influencers - Digital PR- Promoting Social Media Pages- Linking Social Media Accounts-The Viral Impact of Social Media.					
Unit III	SOCIAL MEDIA POLICIES AND MEASUREMENTS				9
Social Media Policies-Etiquette, Privacy- ethical problems posed by emerging social media technologies - The Basics of Tracking Social Media.					
Unit IV	WEB ANALYTICS				9
Data Collection, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of a Successful Web Analytics Strategy, Proposals & Reports, Web Data Analysis.					
Unit V	SEARCH ANALYTICS				9
Search engine optimization (SEO), user engagement, user-generated content, web traffic analysis, online					

security, online ethics, data visualization.															
Total periods: 45															
Text Books:															
1.Web Analytics: An Hour a Day by Avinash Kaushik (2007)															
2.Social Media in Business and Governance by K. M. Shrivastava (2013)															
References:															
1. K. M. Shrivastava, Social Media in Business and Governance, Sterling Publishers Private Limited, 2013															
2. Christian Fuchs, Social Media a critical introduction, SAGE Publications Ltd, 2014															
3. Bittu Kumar, Social Networking, V & S Publishers, 2013															
Course Outcomes													Blooms Taxonomy		
CO1: Understand the role of web and social media in modern marketing strategies.													Understand (K2)		
CO2: Apply marketing analytics tools to measure performance and budget allocation.													Apply (K3)		
CO3: Analyze social media audiences and influencers to optimize digital PR.													Analyze (K4)		
CO4: Evaluate web traffic data and key performance indicators (KPIs) for strategy.													Evaluate (K5)		
CO5: Create comprehensive reports and proposals based on web and social data.													Create (K6)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2				3										
CO2	3	2											3		
CO3	3	3	2											3	
CO4	3			3		2									
CO5	3		3												3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CMG023	OPERATION AND SUPPLY CHAIN ANALYTICS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
- Basic understanding of operations management principles and supply chain logistics flows. - Familiarity with linear programming concepts and mathematical optimization problems.					

Course Objectives:		
- To understand various location models and layout methods for optimizing facility placement. - To analyze warehousing decisions using heuristic approaches and dynamic location models		
Unit I	INTRODUCTION	9
P-Median Methods - Guided LP Approach, Greedy Drop Heuristics, Dynamic Location Models, Space Determination and Layout Methods.		
Unit II	WAREHOUSING DECISIONS	9
P-Median Methods - Guided LP Approach, Greedy Drop Heuristics, Dynamic Location Models, Space Determination and Layout Methods.		
Unit III	INVENTORY MANAGEMENT	9
Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT, Risk Analysis in Supply Chain, Risk pooling strategies.		
Unit IV	TRANSPORTATION NETWORK MODELS	9
Minimal Spanning Tree, Shortest Path Algorithms, Maximal Flow Problems, Transportation Problems, Set covering and Set Partitioning Problems, Travelling Salesman Problem, Scheduling Algorithms.		
Unit V	MCDM MODELS	9
Analytic Hierarchy Process(AHP), Data Envelopment Analysis (DEA), Fuzzy Logic an Techniques, the analytical network process (ANP), TOPSIS.		
Total periods: 45		
Text Books:		
1.Big Data Driven Supply Chain Management by Nada R. Sanders (2014)		
2.Supply Chain Network Design by Watson et al. (2013)		
References:		
1. Nada R. Sanders, Big data driven supply chain management: A framework for implementing analytics and turning information into intelligence, Pearson Education, 2014.		
2. Michael Watson, Sara Lewis, Peter Cacioppi, Jay Jayaraman, Supply Chain Network Design: Applying Optimization and Analytics to the Global Supply Chain, Pearson Education, 2013.		
3. Anna Nagurney, Min Yu, Amir H. Masoumi, Ladimer S. Nagurney, Networks Against Time:		
Course Outcomes		Blooms Taxonomy
CO1: Apply optimization models to solve facility location and layout problems.		Apply (K3)
CO2: Analyze inventory systems and warehousing decisions using data.		Analyze (K4)
CO3: Evaluate transportation networks and risks using simulation and algorithms.		Evaluate (K5)
CO4: Create efficient supply chain strategies using multi-criteria decision models.		Create (K6)

CO5: Understand the fundamental concepts of supply chain analytics and logistics.													Understand (K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											2		
CO2	3	3	3											3	
CO3	3	3		2											
CO4	3		3												3
CO5	2				2										
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CMG024	FINANCIAL ANALYTICS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Understanding of fundamental financial accounting principles and financial reporting standards. • Knowledge of time value of money concepts and their application in finance. • Basic understanding of probability theory and statistical analysis for financial data. • Familiarity with the functioning of financial markets and various investment instruments. • Proficiency in using Excel for creating financial models and analyzing datasets.					
Course Objectives: • To apply corporate financial predictive modeling techniques for project and cash flow analysis. • To estimate and predict the risk and return associated with bond and stock investments. • To perform portfolio analysis using the capital asset pricing model and option pricing models. • To use technical analysis charts and market indicators for the prediction of share prices. • ☐ To evaluate credit risk models using techniques like logistic regression and decision trees.					
Unit I	CORPORATE FINANCE ANALYSIS				9
Basic corporate financial predictive modelling- Project analysis- cash flow analysis- cost of capital, Financial Break even modelling, Capital Budget model-Payback, NPV, IRR.					
Unit II	FINANCIAL MARKET ANALYSIS				9
Estimation and prediction of risk and return (bond investment and stock investment) –Time series-examining nature of data, Value at risk, ARMA, ARCH and GARCH.					
Unit III	PORTFOLIO ANALYSIS				9

Portfolio Analysis – capital asset pricing model, Sharpe ratio, Option pricing models- binomial model for options, Black Scholes model and Option implied volatility.															
Unit IV		TECHNICAL ANALYSIS												9	
Prediction using charts and fundamentals – RSI, ROC, MACD, moving average and candle charts, simulating trading strategies. Prediction of share prices.															
Unit V		CREDIT RISK ANALYSIS												9	
Credit Risk analysis- Data processing, Decision trees, logistic regression and evaluating credit risk model.															
Total periods: 45															
Text Books:															
1. Financial Analytics with R by Bennett & Hugen															
2.Quantitative Financial Analytics by Williams & Dobelman															
References:															
1. Financial analytics with R by Mark J. Bennett, Dirk L. Hugen, Cambridge university press.															
2. Haskell Financial Data Modeling and Predictive Analytics Paperback – Import, 25 Oct 2013 by Pavel Ryzhov.															
3. Quantitative Financial Analytics: The Path To Investment Profits Paperback – Import, 11 Sep 2017 by Edward E Williams (Author), John A Dobelman.															
Course Outcomes													Blooms Taxonomy		
CO1: Apply financial predictive modeling techniques to project and cash flow analysis.													Apply (K3)		
CO2: Analyze financial market data to estimate risk, return, and volatility.													Analyze (K4)		
CO3: Evaluate portfolio performance using CAPM and option pricing models.													Evaluate (K5)		
CO4: Create trading strategies based on technical analysis and chart patterns.													Create (K6)		
CO5: Understand the principles of credit risk analysis and decision modeling.													Understand (K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3									3		3		
CO2	3	3	3											3	
CO3	3	3		3											
CO4	3		3												3
CO5	2										2				
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

VERTICAL V : ENVIRONMENT AND SUSTAINABILITY

23CES001	SUSTAINABLE INFRASTRUCTURE DEVELOPMENT	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of civil engineering fundamentals and construction materials • Awareness of environmental studies and basic sustainable development concepts					
Course Objectives: • To impart knowledge about sustainable Infrastructure development goals, practices • To understand the concepts of sustainable planning, design, construction, maintenance and decommissioning of infrastructure projects.					
Unit I	SUSTAINABLE DEVELOPMENT GOALS				9
Definitions, principles and history of Sustainable Development - Sustainable development goals (SDG): global and Indian – Infrastructure Demand and Supply - Environment and Development linkages - societal and cultural demands– Sustainability indicators - Performance indicators of sustainability and Assessment mechanism - Policy frameworks and practices: global and Indian – Infrastructure Project finance – Infrastructure project life cycle - Constraints and barriers for sustainable development - future directions.					
Unit II	SUSTAINABLE INFRASTRUCTURE PLANNING				9
Overview of Infrastructure projects: Housing sector, Power sector, Water supply, road, rail and port transportation sector, rural and urban infrastructure. Environmental Impact Assessment (EIA), Land acquisition -Legal aspects, Resettlement &Rehabilitation and Development - Cost effectiveness Analysis - Risk Management Framework for Infrastructure Projects, Economic, demand, political, socio-environmental and cultural risks. Shaping the Planning Phase of Infrastructure Projects to mitigate risks, Designing Sustainable Contracts, Negotiating with multiple Stakeholders on Infrastructure Projects. Use of ICT tools in planning – Integrated planning - Clash detection in construction - BIM (Building Information Modelling).					
Unit III	SUSTAINABLE CONSTRUCTION PRACTICES AND TECHNIQUES				9
Sustainability through lean construction approach - Enabling lean through information technology – Lean in planning and design - IPD (Integrated Project Delivery) - Location Based Management System - Geospatial Technologies for machine control, site management, precision control and real time progress monitoring - Role of logistics in achieving sustainable construction – Data management for integrated supply chains in construction - Resource efficiency benefits of effective logistics - Sustainability in geotechnical practice – Design considerations, Design Parameters and Procedures – Quality control and					

Assurance - Use of sustainable construction techniques: Precast concrete technology, Pre-engineered buildings.		
Unit IV	SUSTAINABLE CONSTRUCTION MATERIALS	9
Construction materials: Concrete, steel, glass, aluminium, timber and FRP - No/Low cement concrete - Recycled and manufactured aggregate - Role of QC and durability - Sustainable consumption – Eco-efficiency - green consumerism - product stewardship and green engineering - Extended producer responsibility – Design for Environment Strategies, Practices, Guidelines, Methods, And Tools. Eco-design strategies –Design for Disassembly - Dematerialization, rematerialization, transmaterialization – Green procurement and green distribution - Analysis framework for reuse and recycling – Typical constraints on reuse and recycling - Communication of Life Cycle Information - Indian Eco mark scheme - Environmental product declarations – Environmental marketing- Life cycle Analysis (LCA), Advances in LCA: Hybrid LCA, Thermodynamic LCA - Extending LCA - economic dimension, social dimension - Life cycle costing (LCC) - Combining LCA and LCC – Case studies		
Unit V	SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS	9
Case Studies - Sustainable projects in developed countries and developing nations - An Integrated Framework for Successful Infrastructure Planning and Management - Information Technology and Systems for Successful Infrastructure Management, - Structural Health Monitoring for Infrastructure projects - Innovative Design and Maintenance of Infrastructure Facilities - Capacity Building and Improving the Governments Role in Infrastructure Implementation, Infrastructure Management Systems and Future Directions. – Use of Emerging Technologies – IoT, Big Data Analytics and Cloud Computing, Artificial Intelligences, Machine and Deep Learning, Fifth Generation (5G) Network services for maintenance .		
Total periods:45		
Text Books:		
1. Charles J. Kibert, Sustainable Construction: Green Building Design and Delivery, 4th Edition, Wiley Publishers, 2016.		
2. Steve Goodhew, Sustainable Construction Processes, Wiley-Blackwell, UK, 2016.		
3. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth-Heinemann, 2011.		
4. William P. Spence, Construction Materials, Methods and Techniques, Yesdee Publication Pvt. Ltd., 2016.		
References:		
1. Charles J Kibert, Sustainable Construction : Green Building Design & Delivery, 4th Edition , Wiley Publishers 2016.		

2. Steve Goodhew, Sustainable Construction Process, Wiley Blackwell,UK, 2016.															
3. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.															
4. William P Spence, Construction Materials, Methods & Techniques (3e), Yesdee Publication Pvt. Ltd, 2016.															
5. New Building Materials and Construction World magazine															
6. Kerry Turner. R, "Sustainable Environmental Management", Principles and Practice Publisher:Belhaven Press,ISBN:1852930039.															
7. Munier N, "Introduction to Sustainability", Springer2005															
8. Sharma, "Sustainable Smart Cities In India: Challenges And Future Perspectives", SPRINGER, 2022.															
Course Outcomes:													Blooms Taxonomy		
CO1: Understand the environment sustainability goals at global and Indian scenario.													Understand (K2)		
CO2: Understand risks in development of projects and suggest mitigation measures.													Understand (K2)		
CO3: Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.													Apply (K3)		
CO4: Explain Life Cycle Analysis and life cycle cost of construction materials.													Explain (K2)		
CO5: Explain the new technologies for maintenance of infrastructure projects.													Explain (K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			1		2			2		1	2		
CO2	3	3	2		2		2			2		1	3	1	
CO3	3	3	3	2	2		2	1		3		1	3	2	1
CO4	2	3	2	2	2	1	2	2		3		2	3	2	1
CO5	2	2	2	2	3	1	3	2	1	3		2	3	2	1
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CES002	SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL MANAGEMENT	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites:					

• Basic understanding of ecology and environmental science • Fundamental knowledge of agriculture and natural resource management		
Course Objectives: • To educate the students about the issues of sustainability in agroecosystems, introduce the concepts and principles of agroecology as applied to the design and management of sustainable agricultural systems for a changing world. • To develop understanding of soil, water, nutrient and pest management for sustainable farming.		
Unit I	AGROECOLOGY, AGROECOSYSTEM AND SUSTAINABLE AGRICULTURE CONCEPTS	9
Ecosystem definition - Biotic Vs. abiotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture - Problems associated with industrial agriculture/food systems - Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems		
Unit II	SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT	9
Soil health definition - Factors to consider (physical, chemical and biological) - Composition of healthy soils - Soil erosion and possible control measures - Techniques to build healthy soil - Management practices for improving soil nutrient - Ecologically sustainable strategies for pest and disease control		
Unit III	WATER MANAGEMENT	9
Soil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling - Fertigation - Advanced irrigation systems and agricultural practices for sustainable water use		
Unit IV	ENERGY AND WASTE MANAGEMENT	9
Types and sources of agricultural wastes - Composition of agricultural wastes - Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture		
Unit V	EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS	9
Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production - Goals and components of a community food system - Case studies		
Total periods:45		
Text Books:		

1. Lal, R., Sustainable Agriculture and the Environment, CRC Press, 2016.															
2. Pretty, J., Sustainable Agriculture and Food Systems, Earthscan Publications, 2008.															
3. Gliessman, S.R., Agroecology: The Ecology of Sustainable Food Systems, CRC Press, 2015.															
4. Altieri, M.A., Agroecology: The Science of Sustainable Agriculture, Westview Press, 2012.															
References:															
1. Approaches to Sustainable Agriculture – Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020															
2. Natural bioactive products in sustainable agriculture, Singh, J. & Yadav, A.N., Springer, 2020															
3. Organic Farming for Sustainable Agriculture, Nandwani, D., Springer, 2016															
4. Principles of Agronomy for Sustainable Agriculture, Villalobos, F.J. & Fereres, E., Springer, 2016															
5. Sustainable Agriculture for Food Security: A Global Perspective, Balkrishna, A., CRC Press, 2021															
6. Sustainable Energy Solutions in Agriculture, Bundschuh, J. & Chen, G., CRC Press, 2014															
Course Outcomes:													Blooms Taxonomy		
CO1: Have an in-depth knowledge about the concepts, principles and advantages of sustainable agriculture													Understand (K2)		
CO2: Discuss the sustainable ways in managing soil health, nutrients, pests and diseases													Analyze (K4)		
CO3: Suggest the ways to optimize the use of water in agriculture to promote an ecological use of resources													Apply (K3)		
CO4: Develop energy and waste management plans for promoting sustainable agriculture in non-sustainable farming areas													Create (K6)		
CO5: Assess an ecosystem for its level of sustainability and prescribe ways of converting to a sustainable system through the redesign of a conventional agroecosystem													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			1		2			2		1	2		
CO2	3	3	2		2		2			2		1	3	1	
CO3	3	3	2	1	2		2	1		3		1	3	2	1
CO4	2	3	2	2	2	1	2	2		3		2	3	2	1
CO5	2	2	2	2	3	1	3	2	1	3		2	3	2	1
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CES003	SUSTAINABLE BIO MATERIALS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites: • Basic knowledge of materials science. • Introductory understanding of chemistry and biology.					
Course Objectives: • To Impart knowledge of biomaterials and their properties • To learn about Fundamentals aspects of Biopolymers and their applications • To learn about bioceramics and biopolymers					
Unit I	INTRODUCTION TO BIOMATERIALS				9
Introduction: Definition of biomaterials, requirements & classification of biomaterials- Types of Biomaterials- Degradable and resorbable biomaterials- engineered natural materials- Biocompatibility- Hydrogels-pyrolitic carbon for long term medical implants-textured and porous materials-Bonding types-crystal structure-imperfection in crystalline structure-surface properties and adhesion of materials –strength of biological tissues-performance of implants-tissue response to implants- Impact and Future of Biomaterials					
Unit II	BIO POLYMERS				9
Molecular structure of polymers -Molecular weight - Types of polymerization techniques–Types of polymerization reactions- Physical states of polymers- Common polymeric biomaterials -Polyethylene - Polymethylmethacrylate (PMMA-Polylactic acid (PLA) and polyglycolic acid (PGA) -Polycaprolactone (PCL) - Other biodegradable polymers –Polyurethan- reactions polymers for medical purposes - Collagens-Elastin- Cellulose and derivatives-Synthetic polymeric membranes and their biological applications					
Unit III	BIO CERAMICS AND BIOCOMPOSITES				9
General properties- Bio ceramics -Silicate glass - Alumina (Al2O3) -Zirconia (ZrO2)-Carbon- Calcium phosphates (CaP)- Resorbable Ceramics- surface reactive ceramics- Biomedical Composites-Polymer Matrix Composite(PMC)-Ceramic Matrix Composite(CMC)-Metal Matrix Composite (MMC)–glass ceramics - Orthopedic implants-Tissue engineering scaffolds					
Unit IV	METALS AS BIOMATERIALS				9
Biomedical metals-types and properties-stainless steel-Cobalt chromium alloys-Titanium alloys-Tantalum-Nickel titanium alloy (Nitinol)- magnesium-based biodegradable alloys-surface properties of metal					

implants for osteointegration-medical application-corrosion of metallic implants – biological tolerance of implant metals		
Unit V	NANOBIOMATERIALS	9
Metallic nanobiomaterials–Nanopolymers-Nanoceramics- Nanocomposites -Carbon based nanobiomaterials - transport of nanoparticles- release rate-positive and negative effect of nanosize-nanofibres-Nano and micro features and their importance in implant performance-Nanosurface and coats-Applications nanoantibiotics-Nanomedicines- Biochips – Biomimetics- BioNEMs -Biosensor-Bioimaging/Molecular Imaging- challenges and future perspective.		
Total periods:45		
Text Books:		
1. Buddy D. Ratner et al., Biomaterials Science: An Introduction to Materials in Medicine, Elsevier, 2013.		
2. D. Williams, Essential Biomaterials Science, Cambridge University Press, 2014.		
3. Sujata V. Bhat, Biomaterials, Narosa Publishing House, 2002.		
4. Joon Park and R.S. Lakes, Biomaterials: An Introduction, Springer, 2007.		
References:		
1. C. Mauli Agrawal, Joo L. Ong, Mark R. Appleford, Gopinath Mani “Introduction to Biomaterials Basic Theory with Engineering Applications” Cambridge University Press, 2014.		
2. Donglu shi “Introduction to Biomaterials” Tsinghua University press, 2006.		
3. Joon Park, R.S.Lakes “Biomaterials An Introduction” third edition, Springer 2007.		
4. M.Jaffe, W.Hammond, P.Tolias and T.Arinzeh “Characterization of Biomaterials” Wood head publishing, 2013.		
5. Buddy D.Ratner and Allan S.Hoffman Biomaterials Science “An Introduction to Material in Medicine” Third Edition, 2013.		
6. VasifHasirci, NesrinHasirci “Fundamentals of Biomaterials” Springer, 2018		
7. Leopoldo Javier Rios Gonzalez. “Handbook of Research on Bioenergy and Biomaterials: Consolidated and green process” Apple academic press, 2021.		
8. Devarajan Thangadurai, Jeyabalan Sangeetha, Ram Prasad “Functional Bionanomaterials” springer, 2020.		
9. Sujata.V.Bhat Biomaterials; Narosa Publishing house, 2002.		
Course Outcomes:		Blooms Taxonomy
CO 1: Students will gain familiarity with Biomaterials and they will understand their importance.		Understand (K2)
CO2: Students will get an overview of different biopolymers and their properties		Understand (K2)

CO3: Students gain knowledge on some of the important Bioceramics and Biocomposite materials													Understand (K2)		
CO4: Students gain knowledge on metals as biomaterials													Understand (K2)		
CO5: Student gains knowledge on the importance of nanobiomaterials in biomedical applications.													Understand (K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2				1	2	2					2	1	
CO2	2	2	2		2	1	2	2					2	2	
CO3	2	3	3	2	2	1	2	2					3	2	1
CO4	2	3	3	2	2	1	2	2					3	3	1
CO5	2	3	3	3	2	2	3	2					3	3	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CES004	MATERIALS FOR ENERGY SUSTAINABILITY	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of physics and chemistry. • Fundamental knowledge of energy systems and materials.					
Course Objectives: • To familiarize the students about the challenges and demands of energy sustainability • To provide fundamental knowledge about electrochemical devices and the materials used. • To introduce the students to various types of fuel cell					
Unit I	SUSTAINABLE ENERGY SOURCES				9
Introduction to energy demand and challenges ahead – sustainable source of energy (wind, solar etc.) – electrochemical energy systems for energy harvesting and storage – materials for sustainable electrochemical systems building – India centric solutions based on locally available materials – Economics of wind and solar power generators vs. conventional coal plants – Nuclear energy					
Unit II	ELECTROCHEMICAL DEVICES				9
Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O2 battery, Nickel Cadmium, Nickel Metal Hydride) –					

Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodiaterd hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, LiCoO ₂ , LiFePO ₄ , LiMn ₂ O ₄) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based)		
Unit III	FUEL CELLS	9
Principle of operation of fuel cells – types of fuel cells (Proton exchange membrane fuel cells, alkaline fuel cell, direct methanol fuel cells, direct borohydride fuel cells, phosphoric acid fuel cells, solid oxide fuel cells, and molten carbonate fuel cells) – Thermodynamics of fuel cell – Fuel utilization – electrolyte membrane (proton conducting and anion conducting) – Catalysts (Platinum, Platinum alloys, carbon supported platinum systems and metal oxide supported platinum catalysts) – Anatomy of fuel cells (gas diffusion layer, catalyst layer, flow field plate, current conductors, bipolar plates and monopolar plates).		
Unit IV	PHOTOVOLTAICS	9
Physics of the solar cell – Theoretical limits of photovoltaic conversion – bulk crystal growth of Si and wafering for photovoltaic application - Crystalline silicon solar cells – thin film silicon solar cells – multijunction solar cells – amorphous silicon based solar cells – photovoltaic concentrators – Cu(InGa)Se ₂ solar cells – Cadmium Telluride solar cells – dye sensitized solar cells – Perovskite solar cells – Measurement and characterization of solar cells - Materials used in solar cells (metallic oxides, CNT films, graphene, OD fullerenes, single-multi walled carbon nanotubes, two-dimensional Graphene, organic or Small molecule-based solar cells materials - copper-phthalocyanine and perylenetetracarboxylicbis - benzene – fullerenes - boron subphthalocyanine- tin (II) phthalocyanine)		
Unit V	SUPERCAPACITORS	9
Supercapacitor –types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) - design of supercapacitor-three and two electrode cell-parameters of supercapacitor-Faradaic and non - Faradaic capacitance – electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbon fibres (ACF)- Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite- conductive polypyrrole hydrogels – Different types of nanocomposites for the SC electrodes (carbon–carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.		
Total periods:45		
Text Books:		

1. David S. Ginley and David Cahen, Fundamentals of Materials for Energy and Environmental Sustainability, Cambridge University Press, 2012.															
2. John A. Turner, Sustainable Hydrogen Production Processes, Wiley, 2014.															
3. Mark Z. Jacobson, Renewable Energy and the Environment, Academic Press, 2018.															
4. Vikas Mittal, Advanced Materials for Energy Conversion and Storage, Wiley, 2019.															
References:															
1. Functional materials for sustainable energy applications; John A. Kilner, Stephen J. Skinner, Stuart J. C. Irvine and Peter P. Edwards.															
2. Hand Book of Fuel Cells: Fuel Cell Technology and Applications, Wolf Vielstich, Arnold Lamm, Hubert Andreas Gasteiger, Harumi Yokokawa, Wiley, London 2003.															
3. B.E. Conway, Electrochemical supercapacitors: scientific fundamentals and technological applications, Kluwer Academic / Plenum publishers, New York, 1999.															
4. T.R. Crompton, Batteries reference book, Newners, 3rd Edition, 2002.															
5. Materials for Supercapacitor applications; B.Viswanathan. M.Aulice Scibioh															
Course Outcomes:													Blooms Taxonomy		
CO 1: Students will acquire knowledge about energy sustainability.													Understand (K2)		
CO2: Students understand the principles of different electrochemical devices.													Understand (K2)		
CO3: Students learn about the working of fuel cells and their application.													Apply (K3)		
CO4: Students will learn about various Photovoltaic applications and the materials used.													Apply (K3)		
CO5: The students gain knowledge on different types of supercapacitors and the performance of various materials													Understand (K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2				2	3	2					2	1	
CO2	2	3	2		2	2	3	2					2	2	
CO3	2	3	3	2	2	2	3	2					3	2	1
CO4	2	2	3	2	2	2	3	2					3	2	2
CO5	2	3	3	3	2	2	3	2					3	3	2
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CES005	GREEN TECHNOLOGY	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of chemistry and environmental science. • Awareness of pollution and sustainability concepts.					
Course Objectives: • To acquire knowledge on green systems and the environment, energy technology and efficiency, and sustainability. • To provide green engineering solutions to energy demand, reduced energy footprint. • To encourage sustainable design of products and industrial processes.					
Unit I	PRINCIPLES OF GREEN CHEMISTRY				9
Historical Perspectives and Basic Concepts. The twelve Principles of Green Chemistry and green engineering. Green chemistry metrics- atom economy, E factor, reaction mass efficiency, and other green chemistry metrics, application of green metrics analysis to synthetic plans.					
Unit II	POLLUTION TYPES				9
Pollution – types, causes, effects, and abatement. Waste – sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling.					
Unit III	GREEN REAGENTS AND GREEN SYNTHESIS				9
Environmentally benign processes- alternate solvents- supercritical solvents, ionic liquids, water as a reaction medium, energy-efficient design of processes- photo, electro and sono chemical methods, microwave-assisted reactions					
Unit IV	DESIGNING GREEN PROCESSES				9
Safe design, process intensification, in process monitoring. Safe product and process design – Design for degradation, Real-time Analysis for pollution prevention, inherently safer chemistry for accident prevention					
Unit V	GREEN NANOTECHNOLOGY				9
Nanomaterials for water treatment, nanotechnology for renewable energy, nanotechnology for environmental remediation and waste management, nanotechnology products as potential substitutes for harmful chemicals, environmental concerns with nanotechnology					
Total periods: 45					

Text Books:															
1. Green technology and design for the environment, Samir B. Billatos, Nadia A. Basaly, Taylor & Francis, Washington, DC, ©1997															
2. Green Chemistry – An introductory text - M. Lancaster, RSC,2016.															
3. Green chemistry metrics - Alexi Lapkin and david Constable (Eds) , Wiley publications,2008															
References:															
1. Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017															
Course Outcomes:													Blooms Taxonomy		
CO1: To understand the principles of green engineering and technology													Understand (K2)		
CO2: To learn about pollution using hazardous chemicals and solvents													Understand (K2)		
CO3: To modify processes and products to make them green and safe.													Apply (K3)		
CO4: To design processes and products using green technology													Create (K6)		
CO5: To understand advanced technology in green synthesis													Understand (K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2				3	3	2					2	1	
CO2	2	3			2	3	3	2					2	2	
CO3	2	3	3	2	2	3	3	2					3	2	1
CO4	2	2	3	3	2	3	3	2					3	2	2
CO5	2	3	3	3	2	3	3	2					3	3	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CES006	ENVIRONMENTAL QUALITY MONITORING AND ANALYSIS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of environmental science. • Knowledge of basic analytical and scientific measurement methods.					
Course Objectives: • To understand and study the complexity of the environment in relation to pollutants generated due to industrial activity. • To analyze the quality of the environmental parameters and monitor the same for the purpose of					

environmental risk assessment. - To introduce instrumental methods used in environmental quality assessment. - To analyze environmental risk and monitoring programmes. - To develop skills in interpreting environmental data for quality control.		
Unit I	ENVIRONMENTAL MONITORING AND STANDARDS	9
Introduction- Environmental Standards- Classification of Environmental Standards- Global Environmental Standards- Environmental Standards in India- Ambient air quality standards- water quality standard- Environmental Monitoring-Need for environmental monitoring- Concepts of environmental monitoring- Techniques of Environmental Monitoring.		
Unit II	MONITORING OF ENVIRONMENTAL PARAMETERS	9
Current Environmental Issues- Global Environmental monitoring programme-International conventions- Application of Environmental Monitoring- Atmospheric Monitoring - screening parameters – Significance of environmental sampling- sampling methods – water sampling - sampling of ambient air-sampling of flue gas.		
Unit III	ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING	9
Classification of Instrumental Method- Analysis of Organic Pollutants by Spectrophotometric methods - Determination of nitrogen, phosphorus and, chemical oxygen demand (COD) in sewage; Biochemical oxygen demand (BOD)- Sampling techniques for air pollution measurements; analysis of particulates and air pollutants like oxides of nitrogen, oxides of sulfur, carbon monoxide, hydrocarbon; Introduction to advanced instruments for environmental analysis		
Unit IV	ENVIRONMENTAL MONITORING PROGRAMME (EMP) & RISKASSESSMENT	9
Water quality monitoring programme- national water quality monitoring- Parameters for National Water Quality Monitoring- monitoring protocol; Process of risk assessment- hazard identification- exposure assessment- dose-response assessment; risk characterization.		
Unit V	AUTOMATED DATA ACQUISITION AND PROCESSING	9
Data Acquisition for Process Monitoring and Control - The Data Acquisition System - Online Data Acquisition, Monitoring, and Control - Implementation of a Data Management System - Review of Observational Networks -Sensors and transducers- classification of transducers- data acquisition system- types of data acquisition systems- data management and quality control; regulatory overview.		
Total periods:45		
Text Books:		
1. Environmental monitoring Handbook, Frank R. Burden, © 2002 by The McGraw-Hill Companies, Inc.		

2. Handbook of environmental analysis: chemical pollutants in the air, water, soil, and solid wastes / Pradyot Patnaik, © 1997 by CRC Press, Inc															
References:															
1. Environmental monitoring / edited by G. Bruce Wiersma, © 2004 by CRC Press LLC.															
2. H. H. Willard, L. L. Merit, J. A. Dean and F. A. Settle, Instrumental Methods of Analysis, CBP Publishers and Distributors, New Delhi, 1988.															
3. Heaslip, G. (1975) Environmental Data Handling. John Wiley & Sons. New York.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Basic concepts of environmental standards and monitoring.													Understand (K2)		
CO2: The ambient air quality and water quality standards;													Understand (K2)		
CO3: The various instrumental methods and their principles for environmental monitoring													Analyze (K4)		
CO4: The significance of environmental standards in monitoring quality and sustainability of the environment.													Evaluate (K5)		
CO5: The various ways of raising environmental awareness among the people.													Understand (K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2				3	3	2					2	1	
CO2	2	3		2	2	3	3	2					2	2	
CO3	2	3	3	2	2	3	3	2					3	2	1
CO4	2	2	3	3	2	3	3	2					3	2	2
CO5	2	2			2	3	3	2					2	1	
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CES007	INTEGRATED ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
- Fundamental knowledge of energy resources and environmental studies. - Basic awareness of sustainable development concepts.					

Course Objectives:		
- To create awareness on the energy scenario of India with respect to world - To understand the fundamentals of energy sources, energy efficiency and resulting environmental implications of energy utilisation - Familiarisation on the concept of sustainable development and its benefits - Recognize the potential of renewable energy sources and its conversion technologies for attaining sustainable development - Acquainting with energy policies and energy planning for sustainable development		
Unit I	ENERGY SCENARIO	9
Comparison of energy scenario – India and World (energy sources, generation mix, consumption pattern, T&D losses, energy demand, per capita energy consumption) – energy pricing – Energy security		
Unit II	ENERGY AND ENVIRONMENT	9
Conventional Energy Sources - Emissions from fuels – Air, Water and Land pollution – Environmental standards - measurement and controls		
Unit III	SUSTAINABLE DEVELOPMENT	9
Sustainable Development: Concepts and Stakeholders, Sustainable Development Goal (SDG) - Social development: Poverty, conceptual issues and measures, impact of poverty. Globalization and Economic growth - Economic development: Economic inequalities, Income and growth.		
Unit IV	RENEWABLE ENERGY TECHNOLOGY	9
Renewable Energy – Sources and Potential – Technologies for harnessing from Solar, Wind, Hydro, Biomass and Oceans – Principle of operation, relative merits and demerits		
Unit V	ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT	9
National & State Energy Policy - National solar mission - Framework of Central Electricity Authority - National Hydrogen Mission - Energy and climate policy - State Energy Action Plan, RE integration, Road map for ethanol blending, Energy Efficiency and Energy Mix		
Total periods:45		
Text Books:		
1. Godfrey Boyle, Renewable Energy: Power for a Sustainable Future, Oxford University Press, 2012.		
2. Virendra K. Vijay, Energy Planning and Policy for Sustainable Development, Springer, 2016.		
3. Vaclav Smil, Energy and Civilization: A History, MIT Press, 2017.		
4. R. K. Rajput, Energy Management and Conservation, Laxmi Publications, 2014.		
References:		
1. Energy Manager Training Manual (4Volumes) available at http://www.em-ea.org/gbook1.asp , a website		

administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.2004															
2. Robert Ristirer and Jack P. Kraushaar, “Energy and the environment”, Willey, 2005.															
3. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K., 2012															
4. Twidell, J.W. & Weir A., “Renewable Energy Resources”, EFNSpon Ltd., UK, 2015.															
5. Dhandapani Alagiri, Energy Security in India Current Scenario, The ICFAI University Press, 2006.															
6. M.H. Fulekar, Bhawana Pathak, R K Kale, “Environment and Sustainable Development” Springer, 2016															
7. https://www.niti.gov.in/verticals/energy															
Course Outcomes:													Blooms Taxonomy		
CO 1: Understand the world and Indian energy scenario													Understand (K2)		
CO2: Analyse energy projects, its impact on environment and suggest control strategies													Analyze (K4)		
CO3: Recognise the need of Sustainable development and its impact on human resource development													Understand (K2)		
CO4: Apply renewable energy technologies for sustainable development													Apply (K3)		
CO5: Fathom Energy policies and planning for sustainable development.													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2				2	3	2					2	1	
CO2	2	3	2	2	2	2	3	2					2	2	
CO3	2	2	3	2	2	2	3	2					3	2	1
CO4	2	2	3	3	2	2	3	2					3	2	2
CO5	2	3	3	3	2	2	3	2					3	3	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CES008	ENERGY EFFICIENCY FOR SUSTAINABLE DEVELOPMENT	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of energy systems and environmental impact. • Introductory knowledge of sustainability principles					

Course Objectives:		
- To understand the types of energy sources, energy efficiency and environmental implications of energy utilisation - To create awareness on energy audit and its impacts - To acquaint the techniques adopted for performance evaluation of thermal utilities - To familiarise on the procedures adopted for performance evaluation of electrical utilities - To learn the concept of sustainable development and the implication of energy usage		
Unit I	ENERGY AND ENVIRONMENT	9
Primary energy sources - Coal, Oil, Gas – India Vs World with respect to energy production and consumption, Climate Change, Global Warming, Ozone Depletion, UNFCCC, COP		
Unit II	ENERGY AUDITING	9
Need and types of energy audit. Energy management (audit) approach-understanding energy costs, benchmarking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments		
Unit III	ENERGY EFFICIENCY IN THERMAL UTILITIES	9
Energy conservation avenues in steam generation and utilisation, furnaces, Thermic Fluid Heaters. Insulation and Refractories - Commercial waste heat recovery devices: recuperator, regenerator, heat pipe, heat exchangers (Plate, Shell & Tube), heat pumps, and thermocompression		
Unit IV	ENERGY CONSERVATION IN ELECTRICAL UTILITIES	9
Demand side management - Power factor improvement – Energy efficient transformers - Energy conservation avenues in Motors, HVAC, fans, blowers, pumps, air compressors, illumination systems and cooling towers		
Unit V	SUSTAINABLE DEVELOPMENT	9
Sustainable Development: Concepts and Stakeholders, Sustainable Development Goal (SDG). Globalization and Economic growth. Economic development: Economic inequalities, Income and growth. Social development: Poverty, conceptual issues and measures, impact of poverty,		
Total periods: 45		
Text Books:		
1. Eastop T.D. and Croft D.R., Energy Efficiency for Engineers and Technologists, Longman Scientific & Technical, 1990.		
2. W.R. Murphy and G. McKay, Energy Management, Butterworths, London, 1987.		
3. Pramod Verma, Energy Audit and Conservation, McGraw Hill, 2015.		
4. A. Thumann and Terry Niehus, Handbook of Energy Audits, Fairmont Press, 2010.		

References:															
1. Energy Manager Training Manual (4Volumes) available at http://www.em-ea.org/gbook1.asp , a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.2004															
2. Eastop.T.D& Croft D.R, “Energy Efficiency for Engineers and Technologists”, Logman Scientific & Technical, ISBN-0-582-03184, 1990															
3. W.R. Murphy and G. McKay “Energy Management” Butterworths, London 1987															
4. Pratap Bhattacharyya, “Climate Change and Greenhouse Gas Emission”, New India Publishing Agency-Nipa,2020															
5. Matthew John Franchetti , Defne Apul “Carbon Footprint Analysis: Concepts, Methods, Implementation, and Case Studies” CRC Press,2012 6. Robert A. Ristinen, Jack J. Kraushaar, Jeffrey T. Brack, “Energy and the Environment”, 4th Edition,Wiley,2022															
7. M.H. Fulekar,Bhawana Pathak, R K Kale,“Environment and Sustainable Development” Springer,2016															
8. Sustainable development in India: Stocktaking in the run up to Rio+20: Report prepared by TERI for MoEF, 2011.															
Course Outcomes:												Blooms Taxonomy			
CO 1: Understand the prevailing energy scenario												Understand (K2)			
CO2: Familiarise on energy audits and its relevance												Understand (K2)			
CO3: Apply the concept of energy audit on thermal utilities												Apply (K3)			
CO4: Employ relevant techniques for energy improvement in electrical utilities												Apply (K3)			
CO5: Understand Sustainable development and its impact on human resource development												Understand (K2)			
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2				2	3	2					2	1	
CO2	2	3		2	2	2	3	2					2	2	
CO3	2	3	3	2	2	2	3	2					3	2	1
CO4	2	2	3	3	2	2	3	2					3	2	2
CO5	2	2			2	2	3	2					2	1	
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															