

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
Electrical and Electronics 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 create dynamic and challenging electrical engineers with social responsibilities

Mission

•	To provide technical proficiency by adopting well defined teaching learning process.
•	To create an environment to practice ethical codes.
•	To prepare the graduates to be professionally competent to meet out the industrial needs.
•	To motivate the students to pursue higher studies and research activities.

III. Program Educational Objectives(PEOs)

PEO1:	Have a successful career in core and allied engineering or associated industries or in higher education or as entrepreneurs or in research.
PEO2:	Provide the optimal solution for complex engineering problems in chosen Technical areas.
PEO3:	Exhibit continuous improvement in their profession through life-long learning.

IV. Program Outcomes(POs)

Graduates of the ELECTRICAL AND ELECTRONICS ENGINEERING will be able to

PO1:	Engineering knowledge Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2:	Problem analysis Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3:	Design/development of solutions Design solutions for complex engineering problems and design system components or 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 modeling 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 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 knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in 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 ELECTRICAL AND ELECTRONICS ENGINEERING will be able to

PSO1:	Provide optimal solution in the field of Power sector.
PSO2:	Apply suitable Electronic controllers for Power conversion, Control and Automation.
PSO3:	Make use of appropriate technique and modern tools to analyze and evaluate the performance of Electrical machines and Electronic circuits

VI. PEOs mapped with POs and PSOs

Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
PEO1	3	3	3	2	2	2	2	2	3	3	2	3	3	3	3
PEO2	3	3	3	3	2	2	2	2	2	2	2	2	2	3	2
PEO3	3	3	3	2	3	2	2	2	2	3	3	3	2	3	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	1.5	2	1.5	2	1.5	3	3	3	1.5	3	3	3			
	Matrices and Calculus	3	2	1	1								1			
	Engineering Physics	3	3	1.6	1.2	1.8	1						1			
	Engineering Chemistry	3	1			1	1	1				1	1			
	Programming in C	2	2.4	2.2	1	2.2	1	1.2	1	2		3	2.4	1.8	2.2	
	Heritage of Tamils															
	Programming in C Laboratory	1.8	2.4	2.6	1.6	1.4	1.6			2.2	1	2.4	2.4	2.4	2.4	
	Physics and Chemistry Laboratory	3	2.4	2.6	1	1										
	English Laboratory ^s	1						2	2	2	3	2	3			
II	Professional English-II	1						1	2	1	3	2	3			
	Laplace Transform and Numerical methods	3	2	2	2		1						2			
	Physics for Electrical Engineering	3	2	1			1									
	Basic Civil and Mechanical Engineering	3	2	2			1	1					2	2	2	
	Engineering Graphics	3	1	2		2					3		2	2	2	
	Electric Circuit Analysis	3	3	2.8	3	1							3	2	1.5	1.8
	NCC Credit Course Level1#															
	Tamils and Technology															
	Electric Circuits Laboratory	3	2.8	1.3			1.3	1.7	-	2.2	1.3	1.7	1	2	1.6	2
	Engineering Practices	3	2			1	1	1					2	2	1	1

Sem	Course Name	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	Laboratory															
	Communication Laboratory/ Foreign Language\$	1						2	2	2	3	2	3			
III	Transforms and Partial Differential Equations	3	3	3	3		1						1			
	Electromagnetic Fields	3	2	2	2	1	1						3	3	3	3
	Electrical Machines - I	3	3	1	2	1			1				3	3	3	3
	Electron Devices and Circuits	2	2	3	2	2						-	1	3	-	1
	Digital Logic Circuits	3	3	3	1	3						1	3		3	2
	Problem Solving and Python Programming	2.4	2.6	3.0	2.8	1.8						1.6	2		3	
	Electrical Machines Laboratory – I	3	3	1	1					3	2	1	3	2		3
	Electronic Devices and Circuits Laboratory	3	1	2	1				1	3		3	2	2	3	
	Problem Solving and Python Programming laboratory	2.6	2.6	3	3	2.2						2	2	2.8	3	
	Professional Development\$					1	1			3		1	2			
IV	Environmental Science and Engineering	3	1	1		1	1	2		2		1	1			3
	Electrical Machines - II	3	3	2	2	1	1						3	2	2	3
	Transmission and Distribution	2.8	1.8	1	1		1	-	1.8					3	2.4	3
	Control System	3	3	3	3	3			1				3	3	3	3
	Linear Integrated Circuits	3	3	3	2	2	1					2	2	1	2	3
	Measurements and	3	3	3	1	2	2		2	2			3	3	3	3

Sem	Course Name	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	Instrumentation															
	NCC Credit Course Level 2#															
	Electrical Machines Laboratory - II	3	3	1	2					2			3	3	3	3
	Control and Instrumentation Laboratory	3	3	3	2	3	2		2	3	2		3	2	2	2
	Linear and Digital Circuits Laboratory	3	3	2.8	3	3				2	1.6	2	3		3	3
V	Power System Analysis	3	3	3	1.8	1.4	1			2			3	3	1	3
	Power Electronics	3	3	3	3			1.5	1			2.2	3	3	3	3
	Microprocessor and Micro controller	2	1	2	3				1				3	3	1	3
	Power Electronics Laboratory	3	3	3	2	2.5	2		2	3	3	2	2	1	3	2
	Microprocessor and Micro controller laboratory	2	1	2			1		1	3	3	3	3	1	2	2
VI	Protection and Switchgear	3	1	1	2	1.2	2	1	1	1	1	2	-	3	1.4	1
	Power System Operation and Control	2.8	1.8	1.7 5	2	2	2					2.2	1.8	3	2.2	2
	Power System Laboratory	3	3	1.8	1.8	3				3	2.6	2.6	2	3	1.6	3
	Mini project	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
VII	Renewable Energy Systems	1.8	2.2	2.6	2.6	1.8	-	2.8					1.6	2.6	1.2	
	Human Values and Ethics						2.4	2	3		1	-	1.6			
	Project Work I	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
VIII	Project Work II	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. ELECTRICAL AND ELECTRONICS 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 Contact s 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	HSM C	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	27	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.	23MAT202	Laplace Transform and Numerical methods	BSC	40/60	3	1	0	4	4
3.	23PHT203	Physics for Electrical Engineering	BSC	40/60	3	0	0	3	3
4.	23BET201	Basic Civil and Mechanical Engineering	ESC	40/60	3	0	0	3	3
5.	23GET201	Engineering Graphics	ESC	40/60	2	0	4	6	4
6.	23EET201	Electric Circuit Analysis	PCC	40/60	3	1	0	4	4
7.		NCC Credit Course Level1#	-	40/60	2	0	0	2	2#
8.	23GET202	தமிழரும் தொழில்நுட்பம் / Tamils and Technology	HSMC	40/60	1	0	0	1	1
PRACTICALS									
9.	23EEP201	Electric Circuits Laboratory	PCC	60/40	0	0	4	4	2
10.	23GEP201	Engineering Practices Laboratory	ESC	60/40	0	0	4	4	2
11.	23GEP202	Communication Laboratory/ Foreign Language\$	EEC	60/40	0	0	4	4	2
TOTAL				-	17	2	16	35	27

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.	23EET301	Electromagnetic Fields	PCC	40/60	3	0	0	3	3
3.	23EET302	Electrical Machines-I	PCC	40/60	3	1	0	4	4
4.	23EET303	Electron Devices and Circuits	PCC	40/60	3	0	0	3	3
5.	23EET304	Digital Logic Circuits	PCC	40/60	3	0	0	3	3
6.	23CST201	Problem Solving and Python Programming	PCC	40/60	3	0	0	3	3
	PRACTICALS								
7.	23EEP301	Electrical Machines Laboratory– I	PCC	60/40	0	0	3	3	1.5
8..	23EEP302	Electronic Devices and Circuits Laboratory	PCC	60/40	0	0	3	3	1.5
9.	23CSP201	Problem Solving and Python Programming laboratory	PCC	60/40	0	0	3	3	1.5
10.	23GEP301	Professional Development ^{\$}	EEC	100	0	0	2	2	1
TOTAL				-	18	2	11	31	25.5

SEMESTER IV

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
THEORY									
1.	23GET401	Environmental Science and Engineering	BSC	40/60	2	0	0	2	2
2.	23EET401	Electrical Machines-II	PCC	40/60	3	0	0	3	3
3.	23EET402	Transmission and Distribution	PCC	40/60	3	0	0	3	3
4.	23EET403	Control System	PCC	40/60	3	0	0	3	3
5.	23EET404	Linear Integrated Circuits	PCC	40/60	3	0	0	3	3
6.	23EET405	Measurements and Instrumentation	PCC	40/60	3	0	0	3	3
7.		NCC Credit Course Level2#			3	0	0	3	3#
PRACTICALS									
8.	23EEP401	Electrical Machines Laboratory -II	PCC	60/40	0	0	3	3	1.5
9.	23EEP402	Control and Instrumentation Laboratory	PCC	60/40	0	0	3	3	1.5
10.	23EEP403	Linear and Digital Circuits Laboratory	PCC	60/40	0	0	3	3	1.5
TOTAL				-	20	0	9	29	21.5

SEMESTER V

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
THEORY									
1.	23EET501	Power System Analysis	PCC	40/60	3	0	0	3	3
2.	23EET502	Power Electronics	PCC	40/60	3	0	0	3	3
3.	23EET503	Microprocessor and Microcontroller	PCC	40/60	3	0	0	3	3
4.		Professional Elective I	PEC	50/50	2	0	2	4	3
5.		Professional Elective II	PEC	50/50	2	0	2	4	3
6.		Professional Elective III	PEC	50/50	2	0	2	4	3
7.		Mandatory Course-I ^{&}	MC		3	0	0	3	0
PRACTICALS									
8.	23EEP501	Power Electronics Laboratory	PCC	60/40	0	0	4	4	2
9.	23EEP502	Microprocessor and Microcontroller Laboratory	PCC	60/40	0	0	4	4	2
TOTAL				-	18	0	14	32	22

SEMESTER VI

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
THEORY									
1.	23EET601	Protection and Switchgear	PCC	40/60	3	0	0	3	3
2.	23EET602	Power System Operation and Control	PCC	40/60	3	0	0	3	3
3.		Open Elective –I*	OEC	50/50	2	0	2	4	3
4.		Professional Elective IV	PEC	40/60	3	0	0	3	3
5.		Professional Elective V	PEC	50/50	2	0	2	4	3
6.		Professional Elective VI	PEC	50/50	2	0	2	4	3
7.		Mandatory Course-II&	MC		3	0	0	3	0
8.		NCC Credit Course Level 3#			3	0	0	3	3#
PRACTICALS									
9.	23EEP601	PowerSystemLaboratory	PCC	60/40	0	0	4	4	2
10.	23EEP602	Mini Project	EEC	60/40	0	0	4	4	2
TOTAL				-	21	0	14	35	22

SEMESTER VII

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
THEORY									
1.	23EET701	Renewable Energy Systems	PCC	40/60	3	0	0	3	3
2.	23GET701	Human Values and Ethics	HSMC	40/60	2	0	0	2	2
3.		Elective– Management [#]	HSMC	40/60	3	0	0	3	3
4.		Open Elective – II ^{**}	OEC	40/60	3	0	0	3	3
5.		Professional Elective VII	PEC	40/60	3	0	0	3	3
PRACTICALS									
6.	23EEP701	Project Work I	EEC	60/40	0	0	8	8	4
TOTAL				-	14	0	8	22	18

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
PRACTICALS									
3.	23EEP801	Project Work II	EEC	60/40	0	0	12	12	6
TOTAL					6	0	12	18	16

ELECTIVE - MANAGEMENT COURSES

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contact s Period	Cred its
					L	T	P		
THEORY									
1	23EMT001	Principles of Management	HSMC	40/60	3	0	0	3	3
2	23EMT002	Total Quality Management	HSMC	40/60	3	0	0	3	3
3	23EMT003	Engineering Economics and Financial Accounting	HSMC	40/60	3	0	0	3	3
4	23EMT004	Human Resource Management	HSMC	40/60	3	0	0	3	3
5	23EMT005	Knowledge Management	HSMC	40/60	3	0	0	3	3
6	23EMT006	Industrial Management	HSMC	40/60	3	0	0	3	3
TOTAL									

MANDATORY COURSES I

S. N o	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contact s 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 risk reduction and management	MC	100/-	3	0	0	3	0
TOTAL									

MANDATORY COURSES II

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
THEORY									
1	23MCT005	Well Being with Traditional Practices (Yoga, Ayurveda and Siddha)	MC	100/-	3	0	0	3	0
2	23MCT006	History of Science and Technology in India	MC	100/-	3	0	0	3	0
3	23MCT007	Political and Economic Thought for a Humane Society	MC	100/-	3	0	0	3	0
4	23MCT008	State, Nation Building and Politics in India	MC	100/-	3	0	0	3	0
5	23MCT009	Industrial Safety	MC	100/-	3	0	0	3	0
TOTAL									

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL 1: POWER ENGINEERING

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1	23EEE001	Utilization and Conservation of Electrical Energy	PEC	40/60	3	0	0	3	3
2	23EEE002	Under Gound Cable Engineering	PEC	40/60	3	0	0	3	3
3	23EEE003	Substation Engineering and Substation and Substation Automation	PEC	40/60	3	0	0	3	3

4	23EEE004	HVDC and FACTS	PEC	40/60	3	0	0	3	3
5	23EEE005	Energy Management and Auditing	PEC	40/60	3	0	0	3	3
6	23EEE006	Power Quality	PEC	40/60	3	0	0	3	3
	23EEE007	Smart Grids	PEC	40/60	3	0	0	3	3
	23EEE008	Restructured Power Market	PEC	40/60	3	0	0	3	3

VERTICAL 2: CONVERTERS AND DRIVES

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1	23EEE009	Special Electrical Machines	PEC	50/50	2	0	2	4	3
2	23EEE010	Analysis of Electrical Machines	PEC	50/50	2	0	2	4	3
3	23EEE011	Multilevel Power Converters	PEC	50/50	2	0	2	4	3
4	23EEE012	Electrical Drives	PEC	50/50	2	0	2	4	3
5	23EEE013	SMPS and UPS	PEC	50/50	2	0	2	4	3
6	23EEE014	Power Electronics for Renewable Energy Systems	PEC	50/50	2	0	2	4	3
7	23EEE015	Control of Power Electronics Circuits	PEC	50/50	2	0	2	4	3

VERTICAL 3: EMBEDDED SYSTEMS

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1	23EEE016	Embedded System Design	PEC	50/50	2	0	2	4	3
2	23EEE017	Embedded C-programming	PEC	50/50	2	0	2	4	3
3	23EEE018	Embedded Processors	PEC	50/50	2	0	2	4	3
4	23EEE019	Embedded Control for Electrical	PEC	50/50	2	0	2	4	3

		Drives							
5	23EEE020	Smart System Automation	PEC	50/50	2	0	2	4	3
6	23EEE021	Embedded System for Automotive Applications.	PEC	50/50	2	0	2	4	3
	23EEE022	VLSIDesign	PEC	50/50	2	0	2	4	3
	23EEE023	MEMS and NEMS	PEC	50/50	2	0	2	4	3
	23EEE024	Digital Signal Processing System design	PEC	50/50	2	0	2	4	3

VERTICAL 4: ELECTRIC VEHICLE TECHNOLOGY

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1	23EEE025	Electric Vehicle Architecture	PEC	40/60	3	0	0	3	3
2	23EEE026	Design of Motor and Power Converters for Electric Vehicles	PEC	50/50	2	0	2	4	3
3	23EEE027	Electric Vehicle Design, Mechanics and Control	PEC	50/50	2	0	2	4	3
4	23EEE028	Design of Electric Vehicle Charging System	PEC	50/50	2	0	2	4	3
5	23EEE029	Testing of Electric Vehicles	PEC	50/50	2	0	2	4	3
6	23EEE030	Grid Integration of Electric Vehicles	PEC	40/60	3	0	0	3	3
7	23EEE031	Intelligent Control of Electric Vehicles	PEC	50/50	2	0	2	4	3

VERTICAL 5: ADVANCED CONTROL

S. N	Course Code	Course Title	Category	Internal / External	Periods per Week	Total Contacts	Credits

o					L	T	P	Period	
1	23EEE032	Process Modelling and Simulation	PEC	40/60	3	0	0	3	3
2	23EEE033	Computer Control of Processes	PEC	40/60	3	0	0	3	3
3	23EEE034	System Identification	PEC	40/60	3	0	0	3	3
4	23EEE035	Model Based Control	PEC	40/60	3	0	0	3	3
5	23EEE036	Nonlinear Control	PEC	40/60	3	0	0	3	3
6	23EEE037	Optimal Control	PEC	40/60	3	0	0	3	3
7	23EEE038	Adaptive Control	PEC	40/60	3	0	0	3	3
8	23EEE039	Machine Monitoring System	PEC	40/60	3	0	0	3	3

VERTICAL 6: (DIVERSIFIED COURSES)

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1	23EEE040	Energy Storage Systems	PEC	40/60	3	0	0	3	3
2	23EEE041	Hybrid Energy Technology	PEC	40/60	3	0	0	3	3
3	23EEE042	Design and Modeling of Renewable Energy Systems	PEC	40/60	3	0	0	3	3
4	23EEE043	Grid integrating Techniques and Challenges	PEC	50/50	2	0	2	4	3
5	23EEE044	Sustainable and Environmental Friendly HV Insulation System	PEC	40/60	3	0	0	3	3
6	23EEE045	Power System Transients	PEC	40/60	3	0	0	3	3
7	23EEE046	PLC Programming	PEC	40/60	3	0	0	3	3
8	23EEE047	Big Data Analytics	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	23CSO001	Artificial Intelligence and Machine Learning Fundamentals	OEC	50/50	2	0	2	4	3
2	23CSO002	IoT Concepts and Applications	OEC	50/50	2	0	2	4	3
3	23CSO003	Data Science Fundamentals	OEC	50/50	2	0	2	4	3
4	23CSO004	Augmented and Virtual Reality	OEC	50/50	2	0	2	4	3
5	23CSO009	Data structures in Programming	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	23HSO001	English for Competitive Examinations	OEC	40/60	3	0	0	3	3
2	23MGO001	NGOs and Sustainable Development	OEC	40/60	3	0	0	3	3
3	23MGO002	Democracy and Good Governance	OEC	40/60	3	0	0	3	3
4	23HSO002	Project Report Writing	OEC	40/60	3	0	0	3	3
5	23MEO001	Applied Design Thinking	OEC	40/60	3	0	0	3	3
6	23MEO002	Reverse Engineering	OEC	40/60	3	0	0	3	3
7	23MEO003	Sustainable Manufacturing	OEC	40/60	3	0	0	3	3
8	23EEO002	Electric and Hybrid Vehicle	OEC	40/60	3	0	0	3	3

9	23ECO002	Space Engineering	OEC	40/60	3	0	0	3	3
10	23MGO004	Industrial Management	OEC	40/60	3	0	0	3	3
11	23MGO003	Quality Engineering	OEC	40/60	3	0	0	3	3
12	23CHO001	Fire Safety Engineering	OEC	40/60	3	0	0	3	3
13	23CEO001	Introduction to non-destructive testing	OEC	40/60	3	0	0	3	3
14	23MEO004	Mechatronics	OEC	40/60	3	0	0	3	3
15	23MEO005	Foundation of Robotics	OEC	40/60	3	0	0	3	3
16	23MEO006	Fundamentals of Aeronautical engineering	OEC	40/60	3	0	0	3	3
17	23CEO002	Remote Sensing Concepts	OEC	40/60	3	0	0	3	3
18	23CEO003	Urban Agriculture	OEC	40/60	3	0	0	3	3
19	23CEO004	Drinking Water Supply And Treatment	OEC	40/60	3	0	0	3	3
20	23CEO002	Lean Concepts, Tools And Practices	OEC	40/60	3	0	0	3	3
21	23EEO004	Introduction to PLC Programming	OEC	40/60	3	0	0	3	3
22	23CHO002	Nano Technology	OEC	40/60	3	0	0	3	3
23	23MEO007	Functional Materials	OEC	40/60	3	0	0	3	3
24	23BMO001	Biomedical Instrumentation	OEC	40/60	3	0	0	3	3
25	23BTO001	Traditional Indian Foods	OEC	40/60	3	0	0	3	3

26	23BTO002	Introduction to food processing	OEC	40/60	3	0	0	3	3
27	23BTO003	IPR for PharmaIndustry	OEC	40/60	3	0	0	3	3
28	23CHO003	Basics of Textile Finishing	OEC	40/60	3	0	0	3	3
29	23CHO004	Industrial Engineering For Garment Industry	OEC	40/60	3	0	0	3	3
30	23CHO005	Basics of Textile Manufacture	OEC	40/60	3	0	0	3	3
31	23CHO006	Introduction to Petroleum Refining And Petrochemicals	OEC	40/60	3	0	0	3	3
32	23EEO005	Energy Conservation And Management	OEC	40/60	3	0	0	3	3
33	23CHO007	Basics of Plastics Processing	OEC	40/60	3	0	0	3	3
34	23ECO003	Signals and Systems	OEC	40/60	3	0	0	3	3
35	23ECO004	Fundamentals of Electronic Devices andCircuits	OEC	40/60	3	0	0	3	3
36	23MEO008	Foundation Skills in integrated product Development	OEC	40/60	3	0	0	3	3
37	23BMO002	Assistive Technology	OEC	40/60	3	0	0	3	3
38	23MAO001	Operations Research	OEC	40/60	3	0	0	3	3
39	23MAO002	Algebra and Number Theory	OEC	40/60	3	0	0	3	3
40	23MAO003	Linear Algebra	OEC	40/60	3	0	0	3	3

OPEN ELECTIVE - IV

S. N	Course Code	Course Title	Category	Internal / External	Periods per Week	Total Contacts	Credits

o					L	T	P	Period	
1	23EEO001	Renewable Energy Technologies	OEC	40/60	3	0	0	3	3
2	23MAO005	Advanced Numerical Methods	OEC	40/60	3	0	0	3	3
3	23MAO006	Random Processes	OEC	40/60	3	0	0	3	3
4	23MAO007	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	40/60	3	0	0	3	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	Nano materials and applications	OEC	40/60	3	0	0	3	3
22	23CEO011	Hydraulics and Pneumatics	OEC	40/60	3	0	0	3	3
23	23EEO008	Sensors	OEC	40/60	3	0	0	3	3
24	23MEO022	Foundation of Automation	OEC	40/60	3	0	0	3	3
25	23ECO006	Concepts in Mobile Robots	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 System	OEC	40/60	3	0	0	3	3
31	23CEO006	Agriculture Entrepreneurship Development	OEC	40/60	3	0	0	3	3
32	23CEO010	Bio diversity Conservation	OEC	40/60	3	0	0	3	3
33	23CEO008	Basics of Integrated Water Resources	OEC	40/60	3	0	0	3	3

		Management							
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	23CEO007	Environment and Agriculture	OEC	40/60	3	0	0	3	3
37	23BTO004	Fundamentals of Food Engineering	OEC	40/60	3	0	0	3	3
38	23BTO005	Food safety and Quality Regulations	OEC	40/60	3	0	0	3	3
39	23BTO006	Nutraceuticals	OEC	40/60	3	0	0	3	3
40	23CHO010	Basics of Dyeing and Printing	OEC	40/60	3	0	0	3	3
41	23CHO011	Fibre Science	OEC	40/60	3	0	0	3	3
42	23CHO012	Garment Manufacturing Technology	OEC	40/60	3	0	0	3	3
43	23CEO009	Industrial safety	OEC	40/60	3	0	0	3	3
44	23CHO013	Unit Operations in Petro-Chemical Industries	OEC	40/60	3	0	0	3	3
45	23MEO018	Plastic Materials for Engineers	OEC	40/60	3	0	0	3	3
46	23MEO019	Properties and Testing of Plastics	OEC	40/60	3	0	0	3	3
47	23ECO008	VLSI Design	OEC	40/60	3	0	0	3	3

48	23ECO010	Industrial IoT and Industry 4.0	OEC	50/50	2	0	2	4	3
49	23ECO009	Wearable devices	OEC	40/60	3	0	0	3	3
50	23BMO004	Medical Informatics	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	9	-	-	-	-	-	-	14
4	PCC	-	6	20.5	19.5	13	8	3	-	70
5	PEC	-	-	-	-	9	9	3	-	21
6	OEC	-	-	-	-	-	3	3	6	12
7	EEC	1	2	1	-	-	2	4	6	16
8	Non-Credit (Mandatory)	-	-	-	-	✓	✓	-	-	-
Total		22	27	25.5	21.5	22	22	18	12	170

VERTICALS FOR MINOR DEGREE**(In addition to all the verticals of other programmes)**

Vertical I Fintech and Block	Vertical II	Vertical III	Vertical IV	Vertical V

chain				
Fintech and Block Chain	Entrepreneurship	Public Administration	Business Data Analytics	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	Datamining 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 Blockchain 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 Entrepreneurs	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	60/40	3	0	0	3	3
2.	23CMG002	Fundamentals of Investment	PEC	60/40	3	0	0	3	3
3.	23CMG003	Banking, Financial Services and Insurance	PEC	60/40	3	0	0	3	3
4.	23CMG004	Introduction to Blockchain and its Applications	PEC	60/40	3	0	0	3	3
5.	23CMG005	Fintech Personal Finance and Payments	PEC	60/40	3	0	0	3	3
6.	23CMG006	Introduction to Fintech	PEC	60/40	3	0	0	3	3
		TOTAL			18	0	0	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	60/40	3	0	0	3	3
2.	23CMG008	Team Building and Leadership Management for Business	PEC	60/40	3	0	0	3	3
3.	23CMG009	Creativity and Innovation in Entrepreneurship	PEC	60/40	3	0	0	3	3
4.	23CMG010	Principles of Marketing Management for Business	PEC	60/40	3	0	0	3	3
5.	23CMG011	Human Resource Management for Entrepreneurs	PEC	60/40	3	0	0	3	3

6.	23CMG012	Financing New Business Ventures	PEC	60/40	3	0	0	3	3
		TOTAL			18	0	0	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	60/40	3	0	0	3	3
2.	23CMG014	Constitution of India	PEC	60/40	3	0	0	3	3
3.	23CMG015	Public Personnel Administration	PEC	60/40	3	0	0	3	3
4.	23CMG016	Administrative Theories	PEC	60/40	3	0	0	3	3
5.	23CMG017	Indian Administrative System	PEC	60/40	3	0	0	3	3
6.	23CMG018	Public Policy Administration	PEC	60/40	3	0	0	3	3
		TOTAL			18	0	0	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	60/40	3	0	0	3	3
2.	23CMG020	Datamining for Business Intelligence	PEC	60/40	3	0	0	3	3
3.	23CMG021	Human Resource Analytics	PEC	60/40	3	0	0	3	3
4.	23CMG022	Marketing and Social Media Web Analytics	PEC	60/40	3	0	0	3	3
5.	23CMG023	Operation and Supply Chain Analytics	PEC	60/40	3	0	0	3	3
6.	23CMG024	Financial Analytics	PEC	60/40	3	0	0	3	3
		TOTAL			18	0	0	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	60/40	3	0	0	3	3
2.	23CES002	Sustainable Agriculture and Environmental Management	PEC	60/40	3	0	0	3	3
3.	23CES003	Sustainable Bio Materials	PEC	60/40	3	0	0	3	3
4.	23CES004	Materials for Energy Sustainability	PEC	60/40	3	0	0	3	3
5.	23CES005	Green Technology	PEC	60/40	3	0	0	3	3
6.	23CES006	Environmental Quality Monitoring and Analysis	PEC	60/40	3	0	0	3	3
7.	23CES007	Integrated Energy Planning for Sustainable Development	PEC	60/40	3	0	0	3	3
8.	23CES008	Energy Efficiency for Sustainable Development	PEC	60/40	3	0	0	3	3
		TOTAL			24	0	0	24	24

SEMESTER I

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 technicalcontexts).					
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 chartetc,), 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 Jovani, 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: Use appropriate words in a professional context													Remembering(K1)		
CO2: Gain understanding of basic grammatical structures and use them in right context													Understanding(K2)		
CO3: Read and infer the denotative and connotative meanings of technical texts													Apply(K3)		
CO4: Write definitions, descriptions, narrations and essays on various topics													Creating(K5)		
CO5: 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	-	-	-

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	-	-	-

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, CO₂ 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	PSO1	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	-	-	-	-	-	-	-	-	

23CYT101	ENGINEERING CHEMISTRY (Common to BME,BT,CIVIL,CHEMICAL,ECE,EEE,MECH)	Category: BSC			
		L	T	P	C
		3	0	0	3
Prerequisites NIL					
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													Remembering(K1)		
CO2: Understand adsorption, its types and phases, phase rule													Understanding(K2)		
CO3: To use alloys and polymers in day to day life													Apply(K3)		
CO4: To Understand the advantages of batteries, super capacitors and solar cell fabrication													Understanding(K2)		
CO5: To Analyse chemical composition of coal and understand petroleum process and uses of shock waves in real life.													Analyze(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	-	-	-

23GET101	PROGRAMMING IN C	Category: HSMC			
		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 -Compilationprocess		
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.ReemaThareja,“ProgramminginC”,Oxford UniversityPress,Second Edition,2016. 2. Kernighan, B.W and Ritchie,D.M, “The C Programming language”, Second Edition,PearsonEducation,2015.		
References:		
1.Paul Deitel and Harvey Deitel,“C How to Program with an Introduction to C++”,Eighth edition, Pearson Education,2018.		
2.YashwantKanetkar,LetusC,17thEdition,BPBPublishations,2020.		
3.ByronS.Gottfried,“Schaum’s Outline of Theory and Problems of Programming with C”,McGraw-HillEducation,1996.		
4.Pradip Dey, Manas Ghosh, “Computer Fundamentals and Programming in C”, Second Edition,Oxford University Press,2013.		

5.AnitaGoel and AjayMittal,“Computer Fundamentals and Programming in C”,1 st Edition,PearsonEducation,2013.															
Course Outcomes:												Blooms Taxonomy			
CO 1: Demonstrate knowledge on C Programming constructs												Understand(K2)			
CO2: Develop simple applications in C using basic constructs												Apply(K3)			
CO3: Design and implement applications using arrays and strings												Apply(K3)			
CO4: Develop and implement modular applications in C using functions.												Apply(K3)			
CO5: Develop applications in C using structures and pointers.												Apply(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	-

23GET102	தமிழர் மரபு	Category: HSMC			
		L	T	P	C
		1	0	0	1
Prerequisites Nil					
Course Objectives: - To explain the evolution and key characteristics of Tamil Language and Classical Literature, including its secular and ethical underpinnings. - To appreciate the artistic heritage, ranging from ancient rock art and traditional sculpture to the variety of musical instruments and the social role of temples. - To identify and describe the significance of Folk and Martial Arts and traditional sports as expressions of Tamil culture and physical prowess - To analyze the Thinaï (Geo-Socio-Cultural) concept in Tamil literature and understand the principles of Aram (Virtue) and ancient Tamil trade/maritime history. - To discuss the political, social, and medicinal contributions of Tamils to Indian culture and the National Movement.					
அலகு I	மொழி மற்றும் இலக்கியம்:				3

இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.		
அலகு II	மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக் கலை:	3
நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள்- பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளூர் சிலை - இசைக் கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.		
அலகு III	நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்:	3
தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஓயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.		
அலகு IV	தமிழர்களின் திணைக் கோட்பாடுகள்:	3
தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.		
அலகு V	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு:	3
இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்ச வரலாறு.		
Total periods: 15		
Text Books:		
1. ஐயங்கார் இயக்கம் - ஐயங்கார் இயக்கம் - ஐயங்கார் இயக்கம் (ஐயங்கார் இயக்கம்: ஐயங்கார் இயக்கம் ஐயங்கார் இயக்கம் ஐயங்கார் இயக்கம்).		
2. ஐயங்கார் இயக்கம் - ஐயங்கார் இயக்கம். (ஐயங்கார் இயக்கம்).		
3. ஐயங்கார் - ஐயங்கார் இயக்கம் இயக்கம் இயக்கம் இயக்கம் (ஐயங்கார் இயக்கம் இயக்கம் இயக்கம்)		
4. ஐயங்கார் - ஐயங்கார் இயக்கம் இயக்கம். (ஐயங்கார் இயக்கம் இயக்கம்)		

References:															
1. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).															
2. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).															
3. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)															
4. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamilnadu)															
5. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)															
Course Outcomes:													Blooms Taxonomy		
CO1:	Explain the evolution and key characteristics of Tamil Language and Classical Literature, including its secular and ethical underpinnings.												Understand(K2)		
CO2:	Appreciate the artistic heritage, ranging from ancient rock art and traditional sculpture to the variety of musical instruments and the social role of temples.												Understand(K2)		
CO3:	Identify and describe the significance of Folk and Martial Arts and traditional sports as expressions of Tamil culture and physical prowess												Remember(K1)		
CO4:	Analyze the Thinai (Geo-Socio-Cultural) concept in Tamil literature and understand the principles of Aram (Virtue) and ancient Tamil trade/maritime history.												Analyze(K4)		
CO5:	Discuss the political, social, and medicinal contributions of Tamils to Indian culture and the National Movement.												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	3	-	2	-	-	-
CO2	-	-	-	-	-	3	-	1	1	2	-	2	-	-	-
CO3	-	-	-	-	-	3	-	-	2	2	-	1	-	-	-
CO4	-	-	-	-	-	3	3	3	1	2	-	2	-	-	-
CO5	-	-	-	-	-	3	1	2	1	2	-	3	-	-	-
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.		

23GEP101	PROGRAMMING IN C LABORATORY	Category: ESC			
		L	T	P	C
		0	0	4	2
Prerequisites Nil					
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-HillEducation,1996.															
4.PradipDey, ManasGhosh, “Computer Fundamentals and Programming in C”,Second Edition, OxfordUniversityPress, 2013.															
5.AnitaGoelandAjayMittal,“Computer Fundamentals and Programming in C”,1 st Edition,Pearson Education,2013															
Course Outcomes:													Blooms Taxonomy		
CO1: Demonstrate knowledge on C programming constructs.													Understand(K2)		
CO2: Develop programs in C using basic constructs.													Analysis(K3)		
CO3: Develop programs inC using arrays.													Analysis(K3)		
CO4: Develop applications in C using strings,pointers,functions.													Analysis(K3)		
CO5: Develop applications in c using structures.													Analysis(K3)		
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	-
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23BSP101	PHYSICS LABORATORY (Common to All Branches)	Category: ESC			
		L	T	P	C
		0	0	2	2
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.

References:

1.

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.**Analyze(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	-	-	-	-	-	-	-	-	-	-

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

23BSP101	CHEMISTRY LABORATORY (Common to All Branches)												Category: ESC			
													L	T	P	C
													0	0	2	2
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													CO	PO/PSO		
1	Determination of total, temporary & permanent hardness of water by EDTA method												CO1	1,2,6,7,9,11,12		
2	Determination of chloride content of water sample by Argentometric method												CO1	1,2,6,7,9,11,12		
3	Determination of types and amount of alkalinity in water sample												CO2	1,6,7,9,12		
4	Determination of DO content of water sample by Winkler's method												CO2	1,6,7,9,12		
5	Determination of strength of acids in a mixture of acids using conductivity meter.												CO3	1,6,7,9,12		
6	Conductometric titration of barium chloride against sodium (precipitation titration).												CO4	1,6,7,9,12		
7	Estimation of iron content of the given solution using potentiometer.												CO5	1,6,7,9,12		
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:analyse the quantity of hardness and Chloride in water sample													Analyze(K4)			
CO2: 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:Analyze quantitatively BaCl ₂ present in the given solution by conductivity meter.													Analyze(K4)			
CO5: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	PS	PSO2	PSO3	

													O1		
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			
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23HSP102	English Laboratory (Common to All Branches)	Category: ESC			
		L	T	P	C
		0	0	2	1
Prerequisites					
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: Listen and comprehend complex academic texts .													Remembering(K1)		
CO2: Speak fluently and accurately in formal and informal communicative contexts													Apply(K3)		
CO3: Express their opinions effectively in both oral and written medium of communication													Understanding(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
1 - Low, 2 - Medium, 3 -High , ‘-‘ No correlation2															

SEMESTER II

23HST 201	PROFESSIONAL ENGLISH – II (Common to All BE/B.Tech(Except CSBS))	Category: BSC			
		L	T	P	C
		2	0	0	2
Prerequisites					
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 contexts - 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 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: Compare and contrast products and ideas in technical texts.													Remembering(K1)		
CO2: Identify and report cause and effects in events, industrial processes through technical texts													Understanding(K2)		
CO3: Analyse problems in order to arrive at feasible solutions and communicate them in the written format.													Apply(K3)		
CO4: Present their ideas and opinions in a planned and logical manner													Apply(K3)		
CO5: 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
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MAT202	Laplace Transform and Numerical Methods	Category: BSC			
		L	T	P	C
		3	1	0	4
Prerequisites					
•					
Course Objectives:					
• To acquaint the students with Differential Equations which are significantly used in engineering problems. • To make the students appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated. • To introduce the basic concepts of solving algebraic and transcendental equations. • To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines. • To acquaint the knowledge of various techniques and methods of solving ordinary differential					

equations.		
Unit I	ORDINARY DIFFERENTIAL EQUATIONS	9+3
Higher order linear differential equations with constant coefficients-Method of variation of parameters-Homogenous equation of Euler's and Legendre's type-System of simultaneous linear first order differential equations with constant coefficients.		
Unit II	LAPLACE TRANSFORMS	9+3
Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.		
Unit III	SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS	9+3
Solution of algebraic and transcendental equations - Bisection Method -Fixed point iteration method – Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting - 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 IV	NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION	9+3
Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivate using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.		
Unit V	NUMERICAL SOLUTION OF 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 differential equations - Multi step methods: Milne's and Adams - Bash forth predictor corrector methods for solving first order differential equations.		
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., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44 th Edition, 2018		
3. Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.		
References:		
1. 1. Narayanan. S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.		
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. . Narayanan. S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.		
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.		
6. 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

At the end of the course, the student will be able to															
CO 1: Acquaint the students with Differential Equations which are significantly used in engineering problems													Apply (K3)		
CO2: Understand the mathematical principles on Laplace transforms and would provide them the ability to formulate and solve some of the physical problems of engineering.													Understand (K2)		
CO3: Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.													Apply (K3)		
CO4: Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.													Understand (K2)		
CO5: Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.													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	2	-	-	-	-	-	-	-	2	-	-	-
CO2	3	2	2	2	-	-	-	-	-	-	-	2	-	-	-
CO3	3	2	2	2	-	-	-	-	-	-	-	2	-	-	-
CO4	3	2	2	2	-	-	-	-	-	-	-	2	-	-	-
CO5	3	2	2	2	2	-	-	-	-	-	-	2	-	-	-
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23PHT203	PHYSICS FOR ELECTRICAL ENGINEERING	Category: BSC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To make the students to understand the electrical properties including free electron theory, applications of quantum mechanics. - To understand the magnetic properties of materials and its applications. - To instil knowledge on physics of semiconductors, determination of charge carriers and device applications. - To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications. - To inculcate an idea of significance of nano structures, quantum confinement and ensuing nano device applications.					
Unit I	ELECTRICAL PROPERTIES OF MATERIALS				9

Classical free electron theory – Expression for electrical conductivity – Thermal conductivity, Expression – Wiedemann-Franz law – Quantum free electron theory: Tunneling – Degenerate states – Fermi – Dirac statistics – Density of energy states – Electron in periodic potential – Bloch Theorem – Kronig-Penney model – Energy bands in solids–Tight binding approximation –Electron effective mass.		
Unit II	MAGNETIC PROPERTIES OF MATERIALS	9
Origin of magnetic moment – Bohr magneton – Magnetic field and induction – Magnetization – Magnetic permeability and susceptibility – Magnetic materials: Dia, para and ferromagnetic effects – paramagnetism in the conduction electrons in metals – Exchange interaction and ferromagnetism – Saturation magnetization and Curie temperature – Weiss theory – Domain theory – Structure of Ferrites – Hysterisis curve – Soft and Hard magnetic materials.		
Unit III	SEMICONDUCTOR PHYSICS	9
Semiconductor types – Intrinsic Semiconductors – Energy band diagram – Direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – Extrinsic semiconductors – Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature – Hall effect and Hall coefficients – Ohmic contacts – Schottky diode – Power transistors.		
Unit IV	OPTICAL PROPERTIES OF MATERIALS	9
Classification of optical materials – Optical processes in semiconductors: optical absorption and emission, charge injection and recombination, optical absorption, loss and gain. Optical processes in quantum wells – Optoelectronic devices: light detectors and solar cells – Light emitting diode (LED) – Organic LED – Laser diode – Optical processes in organic semiconductor devices – Excitonic state.		
Unit V	NANOELECTRONIC DEVICES	9
Density of states for solids – Significance between Fermi energy and volume of the material – Quantum confinement – Quantum structures – Density of states for quantum wells, wires and dots – Band gap of nanomaterials –Tunneling – Single electron phenomena – SET. Conductivity of metallic nanowires – Ballistic transport – Quantum resistance and conductance – Carbon nanotubes: Properties and applications – Spintronic devices and applications – Optics in quantum structures – quantum well laser.		
Total periods: 45 PERIODS		
Text Books:		
1. S.O. Kasap. Principles of Electronic Materials and Devices, McGraw Hill Education (Indian Edition), 2020.		
2. R.F.Pierret. Semiconductor Device Fundamentals. Pearson (Indian Edition), 2006.		
3. G.W.Hanson. Fundamentals of Nanoelectronics. Pearson Education (Indian Edition), 2009.		
References:		
1. Laszlo Solymar, Walsh, Donald, Syms and Richard R.A., Electrical Properties of Materials, Oxford Univ. Press (Indian Edition) 2015		
2. Jasprit Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw– Hill Education (Indian Edition), 2019.		
3. Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019		
4. Mark Fox, Optical Properties of Solids, Oxford Univ.Press, 2001		
5. Parag K. Lala, Quantum Computing: A Beginner's Introduction, McGraw–Hill Education (Indian Edition), 2020.		
Course Outcomes:		Blooms Taxonomy
At the end of the course, the student will be able to:		
CO 1: Know basics of electrical properties of materials.		Analyze (K4)
CO2: Gain knowledge on the magnetic properties of materials and their applications		Analyze (K4)
CO3: Understand clearly of semiconductor physics and functioning of semiconductor devices.		Understand (K2)

CO4: Understand the optical properties of materials and working principles of various optical devices.													Understand (K2)		
CO5: Appreciate the importance of nanotechnology and Nano devices.													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	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	1	-	-	-	-	-	-	-	-	-
CO3	3	2	1	-	-	1	-	-	-	-	-	-	-	-	-
CO4	3	2	1	-	-	1	-	-	-	-	-	-	-	-	-
CO5	3	2	1	-	-	1	-	-	-	-	-	-	-	-	-

23BET201	BASIC CIVIL AND MECHANICAL ENGINEERING	Category: ESC			
		L	T	P	C
		3	0	0	3
Prerequisites					
•					
Course Objectives:					
• To provide the students an illustration of the significance of the Civil and Mechanical Engineering Profession in satisfying the societal needs. • To help students acquire knowledge in the basics of surveying and the materials used for construction. • To provide an insight to the essentials of components of a building and the infrastructure facilities. • To explain the component of power plant units and detailed explanation to IC engines their working principles. • To explain the Refrigeration & Air-conditioning system.					
Unit I	PART A: OVERVIEW OF CIVIL ENGINEERING				5
Civil Engineering contributions to the welfare of Society - Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering – National building code – terminologists: Plinth area, Carpet area, Floor area, Buildup area, Floor space index - Types of buildings: Residential buildings, Industrial buildings.					
Unit I	PART B: OVERVIEW OF MECHANICAL ENGINEERING				4
Overview of Mechanical Engineering - Mechanical Engineering Contributions to the welfare of Society – Specialized sub disciplines in Mechanical Engineering – Manufacturing, Automation, Automobile and Energy Engineering - Interdisciplinary concepts in Mechanical Engineering.					
Unit II	SURVEYING AND CIVIL ENGINEERING MATERIALS				9
Surveying: Objects – Classification – Principles – Measurements of Distances and angles – Leveling – Determination of areas– Contours. Civil Engineering Materials: Bricks – Stones – Sand – Cement – Concrete – Steel - Timber – Modern Materials, Thermal and Acoustic Insulating Materials, Decorative Panels, Water Proofing Materials. Modern uses of Gypsum, Pre-fabricated Building component (brief discussion only).					
Unit III	III BUILDING COMPONENTS AND INFRASTRUCTURE				9
Building plans – Setting out of a Building - Foundations: Types of foundations - Bearing capacity					

and settlement – Brick masonry – Stone Masonry – Beams – Columns – Lintels – Roofing – Flooring – Plastering. Types of Bridges and Dams – Water Supply Network - Rain Water Harvesting – Solid Waste Management - Introduction to Highways and Railways - Introduction to Green Buildings.																
Unit IV		INTERNAL COMBUSTION ENGINES AND POWER PLANTS												9		
Classification of Power Plants- Working principle of steam, Gas, Diesel, Hydro -electric and Nuclear Power plants- Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines. Working principle of Boilers-Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps, Concept of hybrid engines. Industrial safety practices and protective devices.																
UNIT V		REFRIGERATION AND AIR CONDITIONING SYSTEM												9		
Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system–Layout of typical domestic refrigerator–Window and Split type room Air conditioner. Properties of air - water mixture, concepts of psychometric and its process.																
Total periods: 45 PERIODS																
Text Books:																
1. G Shanmugam, M S Palanichamy, Basic Civil and Mechanical Engineering, McGraw Hill Education; First edition, 2018.																
References:																
1. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2018.																
2. Ramamrutham S., “Basic Civil Engineering”, Dhanpat Rai Publishing Co.(P) Ltd, 2013.																
3. Seetharaman S., “Basic Civil Engineering”, Anuradha Agencies, 2005.																
4. Shantha Kumar SRJ., “Basic Mechanical Engineering”, Hi-tech Publications, Mayiladuthurai, 2000.																
Course Outcomes: At the end of the course, the student will be able to:														Blooms Taxonomy		
CO 1: Understand profession of Civil and Mechanical engineering														Understand(K2)		
CO2: Summarise the planning of building, infrastructure and working of Machineries														Analyze(K4)		
CO3: Apply the knowledge gained in respective discipline														Apply(K3)		
CO4: Illustrate the ideas of Civil and Mechanical Engineering applications.														Analyze(K4)		
CO5: Appraise the material, Structures, machines and energy.														Analyze(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	-	-	-	-	2	2	2	-	
CO2	3	1	-	-	-	1	1	-	-	-	-	2	2	2	-	
CO3	3	2	2	-	-	1	1	-	-	-	-	2	2	2	-	
CO4	3	2	2	-	-	1	1	-	-	-	-	2	2	2	-	
CO5	3	2	2	-	-	1	1	-	-	-	-	2	2	2	-	

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 sketching		
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															

23EET201	ELECTRIC CIRCUIT ANALYSIS	Category: PCC			
		L	T	P	C
		3	1	0	4
Prerequisites					
•					
Course Objectives:					
- To introduce DC circuit analysis analysis - To impart knowledge in AC circuit analysis - To impart knowledge on solving network Theorems - To educate on obtaining the transient response of circuits - To introduce Phasor diagrams and analysis of three phase circuits.					
Unit I	DC CIRCUITS ANALYSIS				6+6
Voltage and current sources -Resistive elements - Ohm's Law Resistors in series and parallel circuits – Kirchoffs laws – voltage and current division, source transformation -Mesh current and node voltage - methods of analysis.					
Unit II	AC CIRCUIT ANALYSIS				6+6
A.C circuits – Average and RMS value - Phasor Diagram – Power, Power Factor and Energy- Mesh current and node voltage - methods of analysis. Series and parallel resonance – their frequency response – Quality factor and Bandwidth.					
Unit III	NETWORK THEOREMS FOR AC AND DC CIRCUITS				6+6
Thevenin's and Norton Theorems –Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem – Millman's theorem.					
Unit IV	TRANSIENT RESPONSE ANALYSIS				6+6

Transient response of L,C,RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input.																
Unit V		THREE PHASE CIRCUITS												6+6		
Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, star- delta conversion-balanced & unbalanced – phasor diagram of voltages and currents – power measurement in three phase circuits.																
Total periods: 60 PERIODS																
Text Books:																
1. 1. William H. HaytJr, Jack E. Kemmerly and Steven M. Durbin, “Engineering Circuits Analysis”,McGraw Hill publishers, 9 th edition, New Delhi, 2020.																
2. 2. Charles K. Alexander, Mathew N.O. Sadiku, “Fundamentals of Electric Circuits”, Second Edition,McGraw Hill, 2019.																
3. Allan H. Robbins, Wilhelm C. Miller, “Circuit Analysis Theory and Practice”, Cengage LearningIndia, 2013.																
References:																
1. Chakrabarti A, “Circuits Theory (Analysis and synthesis), Dhanpat Rai& Sons, New Delhi, 2020.																
2. Joseph A. Edminister, Mahmood Nahvi, “Electric circuits”, Schaum’s series, McGraw-Hill, First Edition, 2019.																
3. ME Van Valkenburg, “Network Analysis”,Prentice-Hall of India Pvt Ltd, New Delhi, 2015.																
4. Richard C. Dorf and James A. Svoboda, “Introduction to Electric Circuits”, 7th Edition, John Wiley & Sons, Inc. 2018.																
5. Sudhakar A and Shyam Mohan SP, “Circuits and Networks Analysis and Synthesis”,McGraw Hill, 2015.																
Course Outcomes: At the end of the course, the student will be able to														Blooms Taxonomy		
CO 1: Apply mesh analysis/ nodal analysis in DC circuits.														Apply (K3)		
CO2: Apply mesh analysis/ nodal analysis in AC circuits.														Apply (K3)		
CO3: Analyse network theorems to determine behavior of the given DC and AC circuit														Analyze (K4)		
CO4: Compute the transient response of L,C,RL, RC and RLC Circuits with different input.														Analyze (K4)		
CO5: Compute power, line/ phase voltage and currents of the given three phase circuit.														Analyze (K4)		
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	3	3	-	-	-	-	-	-	-	2	-	2	-	2	
CO2	3	3	2	-	-	-	-	-	-	-	2	-	2	-	1	
CO3	3	3	-	-	1	-	-	-	-	-	-	-	2	-	2	
CO4	3	3	3	3	-	-	-	-	-	-	-	3	2	2	2	
CO5	3	3	3	-	-	-	-	-	-	-	2	-	2	1	2	

23GET202	TAMILS AND TECHNOLOGY	Category: HSMC			
		L	T	P	C
		1	0	0	1
Prerequisites					

• Nil		
Course Objectives: • To learn the basic concepts and behavior of DC and AC circuits. • To understand various methods of circuit/ network analysis using network theorems. • To understand the steady state response of the circuits subjected to DC excitations and AC with sinusoidal excitations. • To understand the transient response of the circuits subjected to DC excitations and AC with sinusoidal excitations. • To learn the concept of coupling in circuits and topologies.		
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:		

1. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.															
Course Outcomes:													Blooms Taxonomy		
CO1:	Explain the underlying principles and processes of the ancient Tamils' weaving and ceramic technology												Understand(K2)		
CO2:	Correlate the structural and aesthetic features of present-day engineering and architecture with ancient Tamil design and construction technology.												Understand(K2)		
CO3:	Recognize the ingenuity behind ancient Tamil manufacturing technology, particularly in metallurgy, coinage, and shipbuilding.												Understand(K2)		
CO4:	Analyze the engineering principles applied in ancient irrigation and agricultural technology (e.g., dams, tanks, Kumizhi Thoompu).												Apply(K3)		
CO5:	Develop awareness of the evolution of Scientific Tamil and utilize modern tools and platforms for Tamil Computing and Digitalization												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	2	-	2	-	-	-
CO2	-	-	-	-	-	3	3	-	1	2	-	2	-	-	-
CO3	-	-	-	-	-	3	-	-	1	1	-	2	-	-	-
CO4	-	-	-	-	-	3	3	1	1	2	-	2	-	-	-
CO5	-	-	-	-	-	2	-	-	2	3	-	3	-	-	-
1 - Low, 2 - Medium, 3 - High, ‘-‘ No correlation															

23GET202	தமிழரும் தொழில்நுட்பமும்		Category: HSMC			
			L	T	P	C
			1	0	0	1
Prerequisites						
• Nil						
Course Objectives:						
• To learn the basic concepts and behavior of DC and AC circuits. • To understand various methods of circuit/ network analysis using network theorems. • To understand the steady state response of the circuits subjected to DC excitations and AC with sinusoidal excitations. • To understand the transient response of the circuits subjected to DC excitations and AC with sinusoidal excitations. • To learn the concept of coupling in circuits and topologies.						
அலகு I	நெசவு மற்றும் பானைத் தொழில்நுட்பம்:					3
சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.						
அலகு II	வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்:					3
சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.						

அலகு III	உற்பத்தித் தொழில் நுட்பம்:	3
கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.		
அலகு IV	வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்:	3
அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குழுழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.		
அலகு V	அறிவியல் தமிழ் மற்றும் கணித்தமிழ்:	3
அறிவியல் தமிழின் வளர்ச்சி -கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.		
Total periods: 15		
Text Books:		
1. ஐயங்கார் ஐயங்கார் - ஐயங்கார் ஐயங்கார் - ஐ.ஐ. ஐயங்கார் (ஐயங்கார் ஐயங்கார் ஐயங்கார் ஐயங்கார் ஐயங்கார் ஐயங்கார்).		
2. ஐயங்கார் ஐயங்கார் - ஐயங்கார் ஐ. ஐயங்கார். (ஐயங்கார் ஐயங்கார்).		
3. ஐயங்கார் - ஐயங்கார் ஐயங்கார் ஐயங்கார் ஐயங்கார் ஐயங்கார் (ஐயங்கார் ஐயங்கார் ஐயங்கார்)		
4. ஐயங்கார் - ஐயங்கார் ஐயங்கார். (ஐயங்கார் ஐயங்கார் ஐயங்கார்)		
References:		
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, Tamilnadu)		
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)		
Course Outcomes:		Blooms Taxonomy
CO1:	Explain the underlying principles and processes of the ancient Tamils' weaving and ceramic technology	Understand(K2)
CO2:	Correlate the structural and aesthetic features of present-day engineering and architecture with ancient Tamil design and construction technology.	Understand(K2)
CO3:	Recognize the ingenuity behind ancient Tamil manufacturing technology, particularly in metallurgy, coinage, and shipbuilding.	Understand(K2)
CO4:	Analyze the engineering principles applied in ancient irrigation and agricultural technology (e.g., dams, tanks, Kumizhi Thoombu).	Apply(K3)
CO5:	Develop awareness of the evolution of Scientific Tamil and utilize modern tools and platforms for Tamil Computing and Digitalization	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	2	-	2	-	-	-
CO2	-	-	-	-	-	3	3	-	1	2	-	2	-	-	-
CO3	-	-	-	-	-	3	-	-	1	1	-	2	-	-	-
CO4	-	-	-	-	-	3	3	1	1	2	-	2	-	-	-
CO5	-	-	-	-	-	2	-	-	2	3	-	3	-	-	-
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23EEP201	ELECTRIC CIRCUITS LABORATORY	Category: PCC			
		L	T	P	C
		0	0	4	2
Prerequisites					
Course Objectives: - To simulate various electric circuits using Pspice/ Matlab/e-Sim/Sci lab - To gain practical experience on electric circuits and verification of theorems.					
LIST OF EXPERIMENTS					
1	Simulation and experimental verification of series and parallel electrical circuit using fundamental laws.				
2	Simulation and experimental verification of electrical circuit problems using Thevenin’s theorem.				
3	Simulation and experimental verification of electrical circuit problems using Norton’s theorem.				
4	Simulation and experimental verification of electrical circuit problems using Superposition theorem.				
5	Simulation and experimental verification of Maximum Power transfer theorem.				
6	Simulation and Experimental validation of R-C,R-L and RLC electric circuit transients.				
7	Simulation and Experimental validation of frequency response of RLC electric circuit.				
8	Design and implementation of series and parallel resonance circuit.				
9	Simulation and experimental verification of three phase balanced and unbalanced star, delta networks circuit (Power and Power factor calculations).				
Total periods : 60 PERIODS					
Text Books:					
1. William H. HaytJr, Jack E. Kemmerly and Steven M. Durbin, “Engineering Circuits Analysis”,McGraw Hill publishers, 9 th edition, New Delhi, 2020.					
2. Charles K. Alexander, Mathew N.O. Sadiku, “Fundamentals of Electric Circuits”, Second Edition,McGraw Hill, 2019.					
3. Allan H. Robbins, Wilhelm C. Miller, “Circuit Analysis Theory and Practice”, Cengage LearningIndia, 2013.					
References:					
1. Chakrabarti A, “Circuits Theory (Analysis and synthesis), Dhanpat Rai& Sons, New Delhi, 2020.					

2. Joseph A. Edminister, Mahmood Nahvi, “Electric circuits”, Schaum’s series, McGraw-Hill, First Edition, 2019.															
3. M E Van Valkenburg, “Network Analysis”,Prentice-Hall of India Pvt Ltd, New Delhi, 2015.															
4. Richard C. Dorf and James A. Svoboda, “Introduction to Electric Circuits”, 7th Edition, John Wiley & Sons, Inc. 2018.															
5. Sudhakar A and Shyam Mohan SP, “Circuits and Networks Analysis and Synthesis”,McGraw Hill, 2015.															
Course Outcomes: At the end of the course, the student will be able to													Blooms Taxonomy		
CO1: Use simulation and experimental methods to verify the fundamental electrical laws for the given DC/AC circuit (Ex 1).													Analyze (K4)		
CO2: Use simulation and experimental methods to verify the various electrical theorems (Superposition, Thevenin, Norton and maximum power transfer) for the given DC/AC circuit (Ex 2-5).													Analyze (K4)		
CO3: Analyze transient behaviour of the given RL/RC/RLC circuit using simulation and experimental methods (Ex 6).													Analyze (K4)		
CO4: Analyze frequency response of the given series and parallel RLC circuit using simulation and experimentation methods (Ex 7-8).													Analyze (K4)		
CO5: Analyze the performance of the given three-phase circuit using simulation and experimental methods (Ex 9).													Analyze (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	2	-	-	2	1	1
CO2	3	3	-	-	-	-	-	-	2	1	2	1	2	1	2
CO3	3	3	1	-	-	-	2	-	3	-	2	-	2	2	2
CO4	3	3	1	-	-	1	2	-	2	-	-	1	1	1	2
CO5	3	3	2	-	-	2	1	-	2	1	1	1	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

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, planning, 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 inhousehold 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.Kalpajian 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)		
														Applying(K3)		
CO4; Perform basic welding, machining, sheet metal work, and mechanical assembly.																
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															

23GEP202	COMMUNICATION LABORATORY	Category: EEC			
		L	T	P	C
		0	0	4	2
Prerequisites					
Course Objectives: - Expose students to learn the basic skills of pronunciation/Vocabulary. - Help the learners learn the basic level of listening activity. - Remove the fear and hesitation of students in participating speaking activities. - Expose them learn different types of reading . - Make them to learn the basics of writing.					
LIST OF EXPERIMENTS					
1	UNIT I: PRONUNCIATION AND SPELLING (12)				
	Confusing words of mispronunciation – Syllabic division with examples – Mispronounced word exercises – Tongue Twisters				
2	UNIT II: LISTENING (12)				
	Audio Listening exercises for making gist – Listening to the audio extract - Find the unknown words – Listening to the motivational videos – Listening to the BBC News				
3	UNIT III: SPEAKING (12)				
	Group Discussion (Advanced level) – Oral Presentation on Social Issues – Narrating a story/unforgettable moments in life – Role Play (minimum two or more participants) – Extempore Speech				
4	UNIT IV: READING (12)				
	Intensive Reading – Extensive Reading – Reading Advertisements or Graphs – Picture Description				
5	UNIT V: WRITING (12)				
	Writing a letter of Application and Resume – Writing the review of the favourite film/story – Translating a passage of your mother tongue into English – Writing Proposals				
Total periods: 60 PERIODS					
Text Books:					
1. 1. Brooks,Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press, Oxford: 2011.					
2. Richards,C. Jack. & David Bholke. Speak Now Level 3. Oxford University Press, Oxford: 2010.					
References:					
1. Bhatnagar, Nitin and MamtaBhatnagar. Communicative English for Engineers and Professionals. Pearson: New Delhi, 2010.					

2. Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press: Oxford, 2014.															
3. Vargo, Mari. Speak Now Level 4. Oxford University Press: Oxford, 2013.															
4. Richards C. Jack. Person to Person (Starter). Oxford University Press: Oxford, 2006.															
5. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014.															
Course Outcomes: At the end of the course, the student will be able to													Blooms Taxonomy		
CO1: Listen and respond appropriately.													Analyze (K4)		
CO2: Participate in group discussions.													Analyze (K4)		
CO3: Participate well in conversation													Analyze (K4)		
CO4: Learn different types of writing both formal & informal.													Analyze (K4)		
CO5: Understand the correct way of pronunciation.													Understand(K2)		
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	0	0	0
CO2	1	0	0	0	0	0	2	2	2	3	2	3	0	0	0
CO3	1	0	0	0	0	0	2	2	2	3	2	3	0	0	0
CO4	1	0	0	0	0	0	2	2	2	3	2	3	0	0	0
CO5	1	0	0	0	0	0	2	2	2	3	2	3	0	0	0
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

SEMESTER III

23MAT301	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	Category: BSC			
		L	T	P	C
		3	1	0	4
Prerequisites					
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 typesLagrange’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" 44thEdition, 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", 4thEdition, 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
Upon successful completion of the course, students should be able to:		
CO 1: Understand how to solve the given standard partial differential equations.		Understand(K2)
CO2: Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.		Apply(K3)
CO3: Apply the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.		Apply(K3)
CO4: Understand 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.		Understand(K2)
CO5: Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.		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	-	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	-	-	-
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23EET301	ELECTROMAGNETIC FIELDS		Category: PCC			
			L	T	P	C
			3	0	0	3
Prerequisites						
●						
Course Objectives:						
● To introduce the basic mathematical concepts related to electromagnetic vector fields and impart knowledge on Coulomb’s law and Gauss’s law ● To impart knowledge on the concepts of Electrostatic fields, electric potential, energy density. ● To impart knowledge on the concepts of Magneto static fields, magnetic flux density, vector potential. ● To impart knowledge on the concepts of different methods of emf generation and Maxwell’s equations ● To impart knowledge on the concepts of Electromagnetic waves and characterizing parameters						
Unit I	ELECTROSTATICS – I					8+1
Coordinate Systems – Vector fields – Gradient, Divergence, Curl – Divergence theorem and Stoke’s theorem - Coulomb’s Law – Electric field intensity – Field due to discrete and continuous charges – Gauss’s law and applications.						
Unit II	ELECTROSTATICS – II					8+1
Electric potential – Equipotential plots – Electric field in free space, conductors, dielectrics - Dielectric polarization – Electric field in multiple dielectrics – Boundary conditions, Poisson’s and Laplace’s equations, Capacitance, Energy and Energy density.						
Unit III	MAGNETOSTATICS					8+1
Lorentz force, Magnetic field intensity (H) – Biot–Savart’s Law - Ampere’s Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization, Magnetic field in multiple media – Boundary conditions, Magnetic scalar and vector potential, Poisson’s Equation, Magnetic Torque, Inductance, Energy and Energy density.						
Unit IV	ELECTRODYNAMIC FIELDS					8+1
Faraday’s law – Transformer and motional EMF – Continuity equation of current - Displacement current - Maxwell’s equations (differential and integral form) – Relation between field theory and circuit theory.						
Unit V	ELECTROMAGNETIC WAVES					8+1
Electromagnetic wave generation and equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors- skin depth - Poynting vector, Poynting theorem.						

Total periods:45 Periods															
Text Books:															
1.Mathew N. O. Sadiku, ‘Principles of Electromagnetics’, 6th Edition, Oxford University Press Inc. Asian edition, 2015.															
2.William H. Hayt and John A. Buck, ‘Engineering Electromagnetics’, McGraw Hill Special Indian edition, 2014.															
3.K A Gangadhar, ‘Electromagnetic Field Theory’, Khanna Publishers; Sixteenth Edition Eighth Reprint :2015															
4.Kraus and Fleish, ‘Electromagnetics with Applications’, McGraw Hill International Editions, Fifth Edition, 2010.															
References:															
1.V.V.Sarwate, ‘Electromagnetic fields and waves’, Second Edition, Newage Publishers,2018.															
2.J.P.Tewari, ‘Engineering Electromagnetics - Theory, Problems and Applications’, Second Edition, Khanna Publishers 2013.															
3.Joseph. A.Edminister, ‘Schaum’s Outline of Electromagnetics, Fifth Edition (Schaum’s Outline Series), McGraw Hill, 2018															
4.S.P.Ghosh, Lipika Datta, ‘Electromagnetic Field Theory’, First Edition, McGraw Hill Education(India) Priva															
Course Outcomes: At the end of the course, the student will be able to:													Blooms Taxonomy		
CO 1: Explain Gradient, Divergence, and Curl operations on vector fields and Coulomb’s law and Gauss’s law.													Understand(K2)		
CO2: Explain electrostatic fields, electric potential, capacitance and energy density													Understand(K2)		
CO3: Calculate magneto static fields, magnetic flux density, vector potential, inductance and energy density													Apply(K3)		
CO4:: Explain different methods of emf generation and Maxwell’s equations													Analyse(K4)		
CO5: Explain the concept of electromagnetic waves and characterizing parameters.													Analyse(K4)		
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	3	3
CO2	3	2	2	2	1	1	-	-	-	-	-	3	3	3	3
CO3	3	2	2	2	1	1	-	-	-	-	-	3	3	3	3
CO4	3	2	2	2	1	1	-	-	-	-	-	3	3	3	3
CO5	3	2	2	2	1	1	-	-	-	-	-	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23EET302	ELECTRICAL MACHINES - I	Category: PCC			
		L	T	P	C
		3	1	0	4
Prerequisites					
Course Objectives: •To understand the concept of electromechanical energy conversion system. • To identify the appropriate DC generators for a given application based on its characteristics. • To identify the appropriate test to determine the performance parameters of a given DC motors. • To familiarize with the equivalent circuit of transformer and procedure for predetermining the efficiency and regulation. • To deliberate the working of auto transformer and three phase transformers.					
Unit I	ELECTROMECHANICAL ENERGY CONVERSION				9+3
Fundamentals of Magnetic circuits- Statically and dynamically induced EMF - Principle of electromechanical energy conversion forces and torque in magnetic field systems energy balance in magnetic circuits- magnetic force- co-energy in singly excited and multi excited magnetic field system mmf of distributed windings – Winding Inductances-,magnetic fields in rotating machines- magnetic saturation and leakage fluxes. Introduction to Indian Standard Specifications (ISS) - Role and significance in testing.					
Unit II	DC GENERATORS				9+3
Principle of operation, constructional details, armature windings and its types, EMF equation, wave shape of induced emf, armature reaction, demagnetizing and cross magnetizing Ampere turns, compensating winding, commutation, methods of improving commutation, interpoles, OCC and load characteristics of different types of DC Generators. Parallel operation of DC Generators, equalizing connections- applications of DC Generators.					
Unit III	DC MOTORS				9+3
Principle of operation, significance of back emf, torque equations and power developed by armature, speed control of DC motors, starting methods of DC motors, load characteristics of DC motors, losses and efficiency in DC machine, condition for maximum efficiency. Testing of DC Machines: Brake test, Swinburne’s test, Hopkinson's test, Field test, Retardation test, Separation of core losses-applications of DC motors.					
Unit IV	SINGLE PHASE TRANSFORMER				9+3
Construction and principle of operation, equivalent circuit, phasor diagrams, testing - polarity test, open circuit and short circuit tests, voltage regulation, losses and efficiency, all day efficiency, back-to- back test, separation of core losses, parallel operation of singlephase transformers, applications of single-phase transformer					

Unit V	AUTOTRANSFORMER AND THREE PHASE TRANSFORMER												9+3		
Construction and working of auto transformer, comparison with two winding transformers, applications of autotransformer. Three Phase Transformer- Construction, types of connections and their comparative features, Scott connection, applications of Scott connection.															
Total periods:60 periods															
Text Books:															
I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 5 th Edition,2017.															
2.P. S. Bimbhra, “Electric Machinery”, Khanna Publishers, 2 nd Edition, 2021.															
3.Stephen J. Chapman, ‘Electric Machinery Fundamentals’4th edition, McGraw Hill Education Pvt. Ltd, 4th Edition 2017.															
References:															
1.A. E. Fitzgerald and C. Kingsley, "Electric Machinery”, New York, McGraw Hill Education, 6 th Edition 2017.															
2.Sahdev S. K. “Electrical Machines”, Cambridge University Press, 2018.															
3.A. E. Clayton and N. N. Hancock, “Performance and design of DC machines”, CBSPublishers, 2018.															
4.M. G. Say, “Performance and design of AC machines”, CBS Publishers, First Edition 2008															
Course Outcomes: At the end of the course students will be able to													Blooms Taxonomy		
CO 1:Apply the laws governing the electromechanical energy conversion for singly and multiple excited systems.													Apply (K3)		
CO2:Explain the construction and working principle of DC generators and interpret various characteristics of DC generators.													Understand(K2)		
CO3: Explain the construction and working principle of DC motors and Compute various performance parameters of DC motors by conducting suitable tests.													Understand(K2)		
CO4: Draw the equivalent circuit of transformer and predetermine the efficiency and regulation.													Apply (K3)		
CO5: Describe the working principle of auto transformer, three phase transformer with different types of connections.													Understand(K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	2	1	-	-	1	-	-	-	3	3	3	3
CO2	3	3	1	2	1	-	-	1	-	-	-	3	3	3	3
CO3	3	3	1	2	1	-	-	1	-	-	-	3	3	3	3
CO4	3	3	1	2	1	-	-	1	-	-	-	3	3	3	3

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

23EET303	ELECTRON DEVICES AND CIRCUITS	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites					
•					
Course Objectives:					
• To understand the structure of and operation of PN junction diode, Zener diode, LED and Laser diode and design clipper, clamper, half wave and full wave rectifier, regulator circuits using diodes. • To familiarize the operation and applications of transistor like BJT and UJT. • To familiarize the operation and applications of JFET. • To learn the performance of various types of multistage amplifiers. • To learn the operation of various feedback amplifiers and oscillators					
Unit I	PN JUNCTION DEVICES				9
PN junction diode –Structure, operation and V-I characteristics, diffusion and transition capacitance – Clipping & Clamping circuits - Rectifiers – Half Wave and Full Wave Rectifier – Zener diode - characteristics – Zener diode as regulator - Display devices - LED, Laser diodes.					
Unit II	TRANSISTOR CIRCUITS				9
UJT - Construction, operation and characteristics - BJT – CB, CE and CC transistor configuration - Construction, Biasing, operation and characteristics. BJT small signal model – Construction, Operation and Analysis of CE, CB, CC amplifiers - Frequency response.					
Unit III	FET CIRCUITS				9
JFET & MOSFET- Construction, Biasing, operation and characteristics –MOSFET small signal model– Analysis of CS, CD and CG amplifier – Gain and frequency response - Low frequency response of JFET amplifier					
Unit IV	MULTISTAGE AMPLIFIERS				9
Differential amplifier – Common mode and Difference mode analysis – Single tuned amplifiers – Gain and frequency response – Neutralization methods - Power amplifiers – Types (Qualitative analysis).					
Unit V	FEEDBACK AMPLIFIERS AND OSCILLATOR				9
Advantages of negative feedback – Voltage / Current, Series / Shunt feedback – Positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.					

Total periods:45 Periods															
Text Books:															
1David A. Bell , ”Electronic devices and circuits”, Oxford University higher education, 5 th edition 2008.															
2.Robert L.Boylestad, “Electronic devices and circuit theory”, 11th edition, Pearson prentice Hall 2013.															
3.Albert Malvino, David J. Bates, “Electronic Principles 7th Edition, Tata McGraw Hill, 2017															
References:															
1.Balbir Kumar, Shail.B.Jain, “Electronic devices and circuits” PHI learning private limited, 2 ndedition 2014.															
2.Thomas L.Floyd, “Electronic devices” Conventional current version, Pearson prentice hall,10th Edition, 2017.															
3Donald A Neamen, “Electronic Circuit Analysis and Design” Tata McGraw Hill, 3rd Edition,2003.															
4.Robert B. Northrop, “Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation”, CRC Press, Second edition, 2012															
Course Outcomes: At the end of the course, the student will be able to:													Blooms Taxonomy		
CO 1: Explain the structure and operation of PN junction diode, Zener diode, LED and Laser diode and design clipper, clamper, half wave and full wave rectifier, regulator circuits using diodes													Understand(K2)		
CO2: Explain the structure and characteristics of UJT & BJT and analyze the performance of various configurations of BJT based amplifier													Understand(K2)		
CO3:: Explain the structure and characteristics of JFET & MOSFET and analyze the performance of various configurations of JFET based amplifier													Understand(K2)		
CO4: Analyze the performance of various types of multistage amplifiers													Analyze(K4)		
CO5: Explain the operation of various feedback amplifiers and oscillators													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	2	2	-	-	-	-	-	-	1	3	-	1
CO2	2	2	3	2	2	-	-	-	-	-	-	1	3	-	1
CO3	2	2	3	2	2	-	-	-	-	-	-	1	3	-	1
CO4	2	2	3	2	2	-	-	-	-	-	-	1	3	-	1
CO5	2	2	3	2	2	-	-	-	-	-	-	1	3	-	1
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23EET304	DIGITAL LOGIC CIRCUITS	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: • To study various number systems and characteristics of digital logic families • To study the combinational circuits and its implementations by simplifying the Boolean functions. • To study the design of various synchronous and asynchronous circuits • To understand about the asynchronous sequential circuits and programmable logic devices • To introduce digital simulation techniques for development of application oriented logiccircuit					
Unit I	NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES				9
Number system, error detection, corrections & codes conversions, Boolean algebra: DeMorgan’s theorem, - Digital Logic Families -comparison of RTL, DTL, TTL, ECL and MOS families - operation, characteristics of digital logic family.					
Unit II	COMBINATIONAL CIRCUITS				9
Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps - Quine McCluskey method, simplification and implementation of combinational logic – multiplexers and de multiplexers - code converters, adders, subtractors, Encoders and Decoders.					
Unit III	SYNCHRONOUS SEQUENTIAL CIRCUITS				9
Sequential logic- SR, JK, D and T flip flops - level triggering and edge triggering - counters -asynchronous and synchronous type - Modulo counters - Shift registers - design of synchronous sequential circuits – Moore and Mealy models- Counters, state diagram; statereduction; state assignment.					
Unit IV	ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABILITY LOGIC DEVICES				9
Asynchronous sequential logic Circuits-Transition stability, flow stability-race conditions,hazards &errors in digital circuits; analysis of asynchronous sequential logic circuits-introduction to Programmability Logic Devices: PROM – PLA –PAL, CPLD-FPGA.					
Unit V	VHDL				9

RTL Design – combinational logic – Sequential circuit – Operators – Introduction to Packages – Subprograms – Test bench. (Simulation /Tutorial Examples: adders, counters, flip flops, Multiplexers & De multiplexers).															
Total periods:45 Periods															
Text Books:															
1.Morris Mano.M, 'Digital Logic and Computer Design', Prentice Hall ofIndia, 3 rd Edition, 2005.															
2.Thomas L Floyd, 'Digital fundamentals', Pearson Education Limited, 11 th Edition, 2018															
3.Donald D.Givone, 'Digital Principles and Design', Tata McGraw Hill,1 st Edition, 2003															
4.A Anand Kumar, 'Fundamentals of Digital Circuits' Prentice Hall ofIndia, 4 th Edition, 2016.															
References:															
1.Tocci R.J., Neal S. Widmer, 'Digital Systems: Principles and Applications',Pearson Education Asia, 12 th Edition, 2017.															
2.Donald P Leach, Albert Paul Malvino, Goutam Sha, 'Digital Principles and Applications', Tata McGraw Hill, 7 th Edition, 2010.															
Course Outcomes: Upon the successful completion of the course, students will be able to:													Blooms Taxonomy		
CO 1:Explain various number systems and characteristics of digital logic families													Apply(K3)		
CO2:Apply K-maps and Quine McCluskey methods to simplify the given Boolean expressions and explain the implementation of combinational circuit													Apply(K3)		
CO3:Design various synchronous and asynchronous circuits using Flip Flops													Create(K6)		
CO4:Explain asynchronous sequential circuits and programmable logic devices													Understand(K2)		
CO5:Use VHDL for simulating and testing RTL, combinatorial and sequential circuits													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	1	3	-	-	-	-	-	1	3	-	3	2
CO2	3	3	3	1	3	-	-	-	-	-	1	3	-	3	2
CO3	3	3	3	1	3	-	-	-	-	-	1	3	-	3	2
CO4	3	3	3	1	3	-	-	-	-	-	1	3	-	3	2
CO5	3	3	3	1	3	-	-	-	-	-	1	3	-	3	2
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23CST201	PROBLEM SOLVING AND PYTHON PROGRAMMING	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To understand the basics of algorithmic problem solving. - To learn to solve problems using Python conditionals and loops. - To define Python functions and use function calls to solve problems. - To use Python data structures - lists, tuples, dictionaries to represent complex data.					
Unit I	COMPUTATIONAL THINKING AND PROBLEM SOLVING				9
Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, and guess an integer number in a range, Towers of Hanoi.					
Unit II	VARIABLES, DATA TYPES, EXPRESSIONS, STATEMENTS				9
Python interpreter and interactive mode,debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.					
Unit III	CONTROL FLOW, FUNCTIONS, STRINGS				9
Conditionals: Boolean values and operators, conditional (if), alternative (if else),chained conditional (if elif-else);Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, GCD, exponentiation, sum an array of numbers, linear search, binary search.					
Unit IV	LISTS, TUPLES, DICTIONARIES				9
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks					

statement, Retail bill preparation.																
Unit V		FILES, MODULES, PACKAGES												9		
Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter’s age validation, Marks range validation (0-100).																
Total periods: 45 Periods																
Text Books:																
1.Allen B. Downey, “Think Python: How to Think like a Computer Scientist”, 2nd Edition, O’Reilly Publishers, 2016.																
2.Karl Beecher, “Computational Thinking: A Beginner's Guide to Problem Solving and Programming”, 1st Edition, BCS Learning & Development Limited, 2017																
References:																
1.Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.																
2.G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.																
3.John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data”, Third Edition, MIT Press, 2021																
4.Eric Matthes, “Python Crash Course, A Hands - on Project Based Introduction to Programming”, 2nd Edition, No Starch Press, 2019.																
5. https://www.python.org/																
6.Martin C. Brown, “Python: The Complete Reference”, 4th Edition, Mc-Graw Hill, 2018.																
Course Outcomes: At the end of the course, the student will be able to:														Blooms Taxonomy		
CO 1: Develop algorithmic solutions to simple computational problems.														Understand(K2)		
CO2: Develop and execute simple Python programs														Understand(K2)		
CO3:Write simple Python programs using conditionals and loops for solving problems.														Apply(K3)		
CO4: Decompose a Python program into functions.														Understand(K2)		
CO5:Represent compound data using Python lists, tuples, dictionaries etc.														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	2	-	-	-	-	-	2	2	3	3	-	
CO2	3	3	3	3	2	-	-	-	-	-	2	2	3	-	-	
CO3	3	3	3	3	2	-	-	-	-	-	2	-	3	-	-	

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

23EEP301	ELECTRICAL MACHINES LABORATORY - I	Category: PCC			
		L	T	P	C
		0	0	3	1.5
Prerequisites					
•					
Course Objectives:					
• To expose the students to determine the characteristics of DC machines and transformers by performing experiments on these machines.					
• To provide hands on experience to evaluate the performance parameters of DC machines and transformer by conducting suitable tests.					
LIST OF EXPERIMENTS					
1	Open circuit and load test on DC shunt generator- calculation of critical resistance and critical speed.				
2	Load test on DC compound generator with differential and cumulative connections.				
3	Load test on DC shunt motor.				
4	Load test on DC compound motor.				
5	Load test on DC series motor.				
6	Swinburne’s test and speed control of DC shunt motor.				
7	Hopkinson’s test on DC motor – generator set.				
8	Load test on single-phase transformer and three phase transformers.				
9	Open circuit and short circuit tests on single phase transformer.				
10	Sumpner’s test on single phase transformers.				
11	Separation of no-load losses in single phase transformer.				
12	Study of starters and 3-phase transformers connections.				
Total periods:45 PERIODS					
Text Books:					
I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 5 th Edition, 2017.					

2.P. S. Bimbhra, “Electric Machinery”, Khanna Publishers, 2 nd Edition, 2021.															
3.Stephen J. Chapman, ‘Electric Machinery Fundamentals’4th edition, McGraw Hill Education Pvt. Ltd, 4th Edition 2017.															
References:															
1.A. E. Fitzgerald and C. Kingsley, "Electric Machinery”, New York, McGraw Hill Education, 6 th Edition 2017.															
2.Sahdev S. K. “Electrical Machines”, Cambridge University Press, 2018.															
3.A. E. Clayton and N. N. Hancock, “Performance and design of DC machines”, CBSPublishers, 2018.															
4.M. G. Say, “Performance and design of AC machines”, CBS Publishers, First Edition 2008															
Course Outcomes: At the end of the course students will be able to:													Blooms Taxonomy		
CO1: Experimentally determine the characteristics of different types of DC machines.													Apply(K3)		
CO2: Demonstrate the speed control techniques for a DC motor for industrial applications.													Apply(K3)		
CO3: Identify suitable methods for testing of transformer and DC machines.													Understand(K2)		
CO4: Predetermine the performance parameters of transformers and DC motor.													Analyse (K4)		
CO5: Understand DC motor starters and 3-phase transformer connections.													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	1	1	-	-	-	-	3	2	1	3	2	-	3
CO2	3	3	1	1	-	-	-	-	3	2	1	3	2	-	3
CO3	3	3	1	1	-	-	-	-	3	2	1	3	2	-	3
CO4	3	3	1	1	-	-	-	-	3	2	1	3	2	-	3
CO5	3	3	1	1	-	-	-	-	3	2	1	3	2	-	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CSP201	PROBLEM SOLVING AND PYTHON PRORAMMING LABORATORY	Category: PCC			
		L	T	P	C
		0	0	3	1.5
Prerequisites					
•					

Course Objectives:

- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To practice various computing strategies for Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

LIST OF EXPERIMENTS

Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines.

1	Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2	Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3	Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4	Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5	Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6	Implementing programs using Functions. (Factorial, Swapping two values, largest 2 numbers in a list, area of shape)
7	Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8	Implementing programs using written modules and Python Standard Libraries (pandas, numpy, Matplotlib, scipy)
9	Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10	Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)
11	Exploring Pygame tool.
12	Developing a game activity using Pygame like bouncing ball, car race etc.

Total periods:45 periods

Text Books:

1.Allen B. Downey, “Think Python : How to Think like a Computer Scientist”, 2nd Edition, O’Reilly Publishers, 2016.															
2.Karl Beecher, “Computational Thinking: A beginner's guide to problem-solving and programming,” 1st Edition, BCS Learning & Development Limited, 2017.															
References:															
1.Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.															
2.John V Guttag, —Introduction to Computation and Programming Using Python“, Revised and expanded Edition, MIT Press , 2013.															
3.Eric Matthes, “Python Crash Course, A Hands - on Project Based Introduction to Programming”, 2nd Edition, No Starch Press, 2019.															
4. https://www.python.org/															
5.Process compound data using Python data structures.															
Course Outcomes: On completion of the course, students will be able to:													Blooms Taxonomy		
CO1: Develop algorithmic solutions to simple computational problems													Analyse (K4)		
CO2: Develop and execute simple Python programs.													Analyse (K4)		
CO3: Solve problems by structuring simple Python programs.													Apply(K3)		
CO4: Deploy functions to decompose a Python program													Analyse (K4)		
CO5: Process compound data using Python data structures.													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	3	3	3	-	-	-	-	-	3	2	3	3	-
CO2	3	3	3	3	3	-	-	-	-	-	3	2	3	-	-
CO3	3	3	3	3	2	-	-	-	-	-	2	-	3	-	-
CO4	3	2	-	-	2	-	-	-	-	-	1	-	3	-	-
CO5	1	2	-	-	1	-	-	-	-	-	1	-	2	-	-
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23EEP302	ELECTRONIC DEVICES AND CIRCUITS LABORATORY	Category: PCC			
		L	T	P	C
		0	0	3	1.5
Prerequisites					
•					

Course Objectives: • To enable the students to understand the behavior of semiconductor device based on experimentation. • Be exposed to active and passive circuit elements. • Familiarize the operation and characteristics of transistor like BJT and FET. • Explore the characteristics of amplifier gain and frequency response. • Learn the required functionality of positive and negative feedback systems	
LIST OF EXPERIMENTS	
1	Measurement of frequency and phase angle using CRO
2	Characteristics of Semiconductor diode, Zener diode , photo diode , and photo transistor,
3	Characteristics of NPN Transistor under common emitter , common collector and common base configurations
4	Characteristics of JFET and draw the equivalent circuit
5	Characteristics of UJT and generation of saw tooth waveforms
6	Design and frequency response characteristics of a Common Emitter amplifier
7	Characteristics of light activated relay circuit
8	Design and testing of RC phase shift and LC oscillators
9	Characteristics of Single Phase half-wave and full wave rectifiers with inductive and capacitive filters
10	Design of Differential amplifiers using FET
Total periods:45 Periods	
Text Books:	
1.David A. Bell , "Electronic devices and circuits", Oxford University higher education, 5 th edition 2008.	
2. Robert L.Boylestad, "Electronic devices and circuit theory", 11th edition, Pearson prenticeHall 2013.	
3.Albert Malvino, David J. Bates, "Electronic Principles 7th Edition, Tata McGraw Hill, 2017	
References:	
1.Balbir Kumar, Shail.B.Jain, "Electronic devices and circuits" PHI learning private limited, 2 nd edition 2014.	
2.Thomas L.Floyd, "Electronic devices" Conventional current version, Pearson prentice hall,10th Edition, 2017.	
3.Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition,2003.	
4.Robert B. Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC Press, Second edition, 2012	
Course Outcomes:	Blooms Taxonomy

At the end of the course, the student will be able to:															
CO1: Analyze the characteristics of PN, Zener diode and BJT in CE,CC,CB configurations experimentally													Analyse (K4)		
CO2: Analyze the characteristics of JFET and UJT experimentally													Analyse (K4)		
CO3: Analyze frequency response characteristics of a Common Emitter amplifier experimentally													Analyse (K4)		
CO4: Analyze the characteristics of RC phase shift and LC oscillators experimentally													Analyse (K4)		
CO5: Analyze the characteristics of half-wave and full-wave rectifier with and without filters experimentally													Analyse (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	1	-	-	-	1	3	-	3	2	2	3	-
CO2	3	1	2	1	-	-	-	1	3	-	3	2	2	3	-
CO3	3	1	2	1	-	-	-	1	3	-	3	2	2	3	-
CO4	3	1	2	1	-	-	-	1	3	-	3	2	2	3	-
CO5	3	1	2	1	-	-	-	1	3	-	3	2	2	3	-
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23GEP301	PROFESSIONAL DEVELOPMENT	Category: EEC			
		L	T	P	C
		0	0	2	1
Prerequisites					
Course Objectives: To be proficient in important Microsoft Office tools: MS WORD, EXCEL, POWERPOINT. • To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the presentability and overall utility value of content. • To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize, interlink, and utilizing many more critical features offered • To be able to create and share quality presentations by using the features of MS					

PowerPoint, including: organization of content, presentability, aesthetics, using media elements and enhance the overall quality of presentations.	
LIST OF EXPERIMENTS	
1	MS WORD
	Create and format a document Working with tables Working with Bullets and Lists Working with styles, shapes, smart art, charts Inserting objects, charts and importing objects from other office tools Creating and Using document templates Inserting equations, symbols and special characters Working with Table of contents and References, citations Insert and review comments Create bookmarks, hyperlinks, endnotes footnote Viewing document in different modes Working with document protection and security Inspect document for accessibility
2	MS EXCEL:
	Work with different types of data: text, currency, date, numeric etc. Split, validate, consolidate, Convert data Sort and filter data Perform calculations and use functions: (Statistical, Logical, Mathematical, date, Time etc.,) Work with Lookup and reference formulae Create and Work with different types of charts Use pivot tables to summarize and analyse data Perform data analysis using own formulae and functions Combine data from multiple worksheets using own formulae and built-in functions to generate results Export data and sheets to other file formats

	Working with macros Protecting data and Securing the workbook														
3	MS POWERPOINT:														
	Select slide templates, layout and themes Formatting slide content and using bullets and numbering Insert and format images, smart art, tables, charts Using Slide master, notes and handout master Working with animation and transitions Organize and Group slides Import or create and use media objects: audio, video, animation Perform slideshow recording and Record narration and create presentable videos														
Total periods: 10 periods															
Course Outcomes: At the end of the course, the student will be able to:													Blooms Taxonomy		
CO1:Use MS Word to create quality documents, by structuring for their day to day technical and academic requirements													Apply(K3)		
CO2:Use MS Word to create quality documents, by organizing content for their day to day technical and academic requirements													Apply(K3)		
CO3:Use MS EXCEL to perform data operations and analytics, record data as per requirements and visualize data for ease of understanding													Apply(K3)		
CO4:Use MS EXCEL to perform data operations and retrieve data as per requirements and visualize data for ease of understanding													Apply(K3)		
CO5: Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects.													Apply(K3)		
CO – PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	1	1	-	-	3	-	1	2	-	-	-
CO2	-	-	-	-	1	1	-	-	3	-	1	2	-	-	-
CO3	-	-	-	-	1	1	-	-	3	-	1	2	-	-	-
CO4	-	-	-	-	1	1	-	-	3	-	1	2	-	-	-
CO5	-	-	-	-	1	1	-	-	3	-	1	2	-	-	-
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

SEMESTER IV

23GET401	ENVIRONMENTAL SCIENCE AND ENGINEERING	Category: BSC			
		L	T	P	C
		2	0	0	2
Prerequisites					
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. 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. Ecosystems: Forest ecosystem and grassland ecosystem.					
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											6		
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’, 3rd edition, Tata McGraw-Hill, New Delhi, 2017.															
2. Gilbert M.Masters, ‘Introduction to Environmental Engineering and Science’, 2nd edition, Pearson Education, 2004															
3. Anubha Kaushik and C.P. Kaushiks, ‘Perspectives in Environmental Studies, 6th 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, 3rd edition, 2015.															
3. Erach Bharucha, ‘Textbook of Environmental Studies for Undergraduate Courses, Orient Black swan Private limited, 2013.															
Course Outcomes: At the end of the course, the student will be able:													Blooms Taxonomy		
CO 1: To familiar the functions of ecosystems, environment and biodiversity.													Understand(K2)		
CO2: To know well about the effects of environmental pollutions.													Understand(K2)		
CO3: To inculcate the basic knowledge of renewable energy resources.													Understand(K2)		
CO4: To differentiate various social problems.													Understand(K2)		
CO5: To know the importance/impacts of population growth.													Understand(K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	1	3	-	-	1	-	1	-	-	-
CO2	3	2	1	-	-	1	3	-	-	1	1	1	-	-	-
CO3	3	2	-	-	-	1	3	-	-	1	-	1	-	-	-
CO4	3	2	-	-	-	1	3	-	-	1	-	1	-	-	-
CO5	3	2	1	-	-	1	3	-	-	1	1	1	-	-	-
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23EET401	ELECTRICAL MACHINES – II											Category: PCC			
												L	T	P	C

		3	0	0	3
Prerequisites					
• 23EET302-ELECTRICAL MACHINES – I					
Course Objectives: To impart knowledge on the following Topics					
• Construction and performance of salient and non – salient type synchronous generators.					
• Principle of operation and performance of synchronous motor.					
• Construction, principle of operation and performance of induction machines.					
• Starting and speed control of three-phase induction motors.					
• Construction, principle of operation and performance of single phase induction motors and special machines.					
Unit I	SYNCHRONOUS GENERATOR				9
Constructional details – Types of rotors –winding factors- EMF equation – Synchronous reactance – Armature reaction – Phasor diagram -Synchronizing and parallel operation – Synchronizing torque - Voltage regulation – EMF, MMF, ZPF and A.S.A method – steady state power- angle characteristics– Two reaction theory –slip test -short circuit transients - Capability Curves.					
Unit II	SYNCHRONOUS MOTOR				9
Principle of operation – Torque equation – Operation on infinite bus bars - V and Inverted V curves – Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power Developed-Hunting – natural frequency of oscillations – damper windings- synchronous condenser.					
Unit III	THREE PHASE INDUCTION MOTOR				9
Constructional details – Types of rotors – Principle of operation – Slip –cogging and crawling- Equivalent circuit – Torque-Slip characteristics - Condition for maximum torque – Losses and efficiency – Load test - No load and blocked rotor tests - Circle diagram – Separation of losses – Double cage induction motors – Induction generators – Synchronous induction motor.					
Unit IV	STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR				9
Need for starting – Types of starters – DOL, Rotor resistance, Autotransformer and Star delta starters – Speed control – Voltage control, Frequency control and pole changing – Cascaded Connection-V/f control – Slip power recovery Scheme-Braking of three phase induction motor: Plugging, dynamic braking and regenerative braking.					
Unit V	SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES				9
Constructional details of single phase induction motor – Double field revolving theory and operation – Equivalent circuit – No load and blocked rotor test – Performance analysis – Starting methods of single-phase induction motors – Capacitor-start capacitor run Induction motor- Shaded pole induction motor – Construction, working principle and applications of Linear induction motor – BLDC motor - Hysteresis motor - AC series motor - Stepper motors - introduction to magnetic levitation systems.					
Total periods: 45 PERIODS					
Text Books:					
1. D.P. Kothari and I.J. Nagrath, ‘Electric Machines’, McGraw Hill Publishing Company Ltd, 5th Edition 2017					
2. P.S. Bhimbhra, ‘Electrical Machinery’, Khanna Publishers, edition 2, 2021.					
3. A.E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, ‘Electric Machinery’, Mc Graw Hill publishing Company Ltd, 6th Edition 2017.					
4. Stephen J. Chapman, ‘Electric Machinery Fundamentals’, 4th edition, McGraw Hill Education Pvt. Ltd, 4th Edition 2017.					
References:					
1. Vincent Del Toro, ‘Basic Electric Machines’, Pearson India Education, 2016.					

2. M.N. Bandyo padhyay, ‘Electrical Machines Theory and Practice’, PHI Learning Pvt. Ltd., New Delhi, 2011															
3. B.R.Gupta, ’Fundamental of Electric Machines’, New age International Publishers, 3rd Edition, Reprint 2015.															
4. Murugesh Kumar, ‘Synchronous and Induction machines’, Vikas Publishing House Pvt. Ltd, First edition 2010															
5. M. G. Say, ‘Performance and design of AC machines’, CBS Publishers, First Edition 2008.															
Course Outcomes: At the end of the course, the student will be able to:													Blooms Taxonomy		
CO 1: Understand the construction and working principle of Synchronous generator													Understand(K2)		
CO2: Understand the construction and working principle of Synchronous Motor													Understand(K2)		
CO3: Understand the construction and working principle of Three Phase Induction Motor													Understand(K2)		
CO4: Acquire knowledge about the starting and speed control of induction motors.													Understand(K2)		
CO5: Gain knowledge about the basic principles and working of Single phase induction motors and Special Electrical Machines.													Analyze (K4)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	1	-	-	-	-	-	3	2	2	3
CO2	3	3	2	2	1	1	-	-	-	-	-	3	2	2	3
CO3	3	3	2	2	1	1	-	-	-	-	-	3	2	2	3
CO4	3	3	2	2	1	1	-	-	-	-	-	3	2	2	3
CO5	3	3	2	2	1	1	-	-	-	-	-	3	2	2	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23EET402	TRANSMISSION AND DISTRIBUTION	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites • 23EET201-ELECTRIC CIRCUIT ANALYSIS • 23EET301-ELECTROMAGNETIC FIELDS					
Course Objectives: • To impart knowledge about the configuration of the electrical power systems. • To study the line parameters and interference with neighbouring circuits. • To understand the mechanical design and performance analysis of transmission lines. • To learn about different insulators and underground cables. • To understand and analyze the distribution system.					
Unit I	TRANSMISSION LINE PARAMETERS				9
Structure of electric power system – introduction to EHVAC and HVDC Parameters of single and three phase transmission lines with single and double circuits -Resistance, inductance, and capacitance of solid, stranded, and bundled conductors - Typical configuration, conductor types - Symmetrical and unsymmetrical spacing and transposition – application of self and mutual GMD; skin and proximity effects - Interference with neighbouring communication circuits.					
Unit II	MODELLING AND PERFORMANCE OF TRANSMISSION LINES				9

Performance of Transmission lines – short line, medium line and long line – equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance – transmission efficiency and voltage regulation – introduction to FACTS - Power Circle diagrams – Ferranti effect – Formation of Corona – Critical Voltages – Effect on line Performance.		
Unit III	SAG CALCULATION AND LINE SUPPORTS	9
Mechanical design of overhead lines – Line Supports –Types of towers – Tension and Sag Calculation for different weather conditions – Methods of grounding - Insulators: Types, voltage distribution in insulator string, improvement of string efficiency, testing of insulators.		
Unit IV	UNDERGROUND CABLES	9
Underground cables – Types of cables – Construction of single-core and 3-core belted cables – Insulation Resistance – Potential Gradient – Capacitance of single-core and 3-core belted cables – Grading of cables – DC cables.		
Unit V	DISTRIBUTION SYSTEMS	9
Distribution Systems – General Aspects – Kelvin’s Law –DC distributions –Concentrated and Distributed loading- Techniques of Voltage Control and Power factor improvement – Distribution Loss – Types of Substations (DC distribution problems only).		
Total periods: 45 PERIODS		
Text Books:		
1. D.P.Kothari, I.J. Nagarath, ‘Power System Engineering’, Mc Graw-Hill Publishing Company limited, New Delhi, Third Edition, 2019.		
2. C.L.Wadhwa, ‘Electrical Power Systems’, New Age International Ltd, seventh edition 2022.		
3. S.N. Singh, ‘Electric Power Generation, Transmission and Distribution’, Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 2008.		
4. John J. Grainger and WUliam D. Stevenson, Jr., ‘Power System Analysis’, McGraw Hill Education Pvt. Ltd., New Delhi, 1994.		
References:		
1. B.R.Gupta, ‘Power System Analysis and Design’ S. Chand, New Delhi, Sixth Edition, 2011.		
2. Luces M.Fualken berry, Walter Coffe, ‘Electrical Power Distribution and Transmission’, Pearson Education, 2007.		
3. Arun Ingle, "Power transmission and distribution" Pearson Education, first edition, 2018.		
4. J.Brian Hardy and Colin R.Bayliss ‘Transmission and Distribution in Electrical Engineering’, Newnes; Fourth Edition, 2011.		
5. G.Ramamurthy, “Handbook of Electrical power Distribution,” Universities Press, 2013.		
6. V.K.Mehta, Rohit Mehta, ‘Principles of power system’, S. Chand & Company Ltd, New Delhi, 2013		
7. Hadi Saadat, ‘Power System Analysis’, McGraw Hill Education Pvt. Ltd., New Delhi, 3rd Edition, 23rd reprint, 2015.		
8. R.K.Rajput, ‘A Text Book of Power System Engineering’ 2nd edition, Laxmi Publications Ltd., New Delhi, 2016.		
Course Outcomes:		Blooms Taxonomy
At the end of the course, the student will be able to:		
CO 1: Understand the structure of power system, computation of transmission line parameter for different configurations and the impact of skin and proximity effects.		Understand(K2)
CO2: Model the transmission lines to determine the line performance and to understand the impact of Ferranti effect and corona on line performance.		Understand(K2)
CO3: Do Mechanical design of transmission lines, grounding and to understand about the insulators in transmission system.		Understand(K2)
CO4: Design the underground cables and understand the performance analysis of		Analyze (K4)

underground cable.															
CO5: Understand the modelling, performance analysis and modern trends in distribution 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	-	-	-	-	3	1	3
CO2	3	2	1	1	-	1	-	2	-	-	-	-	3	2	3
CO3	3	2	1	1	-	1	-	2	-	-	-	-	3	3	3
CO4	3	2	1	1	-	1	-	2	-	-	-	-	3	3	3
CO5	3	2	1	1	-	1	-	2	-	-	-	-	3	3	3
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23EET403	CONTROL SYSTEMS	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites 23MAT101-MATRICES AND CALCULUS 23EET201-ELECTRIC CIRCUIT ANALYSIS					
Course Objectives: - To make familiarize with various representations of systems. - To analyze the stability of linear systems in the time domain. - To analyze the stability of linear systems in the frequency domain. - To design compensator based on the time and frequency domain specifications. - To develop linear models: mainly state variable model and Transfer function model.					
Unit I	MODELING OF LINEAR TIME INVARIANT SYSTEM (LTIV)				9
Control system: Open loop and Closed loop – Feedback control system characteristics – First principle modeling: Control Mechanical, Electrical and Electromechanical systems – Transfer function representations: Block diagram and Signal flow graph.					
Unit II	TIME DOMAIN ANALYSIS				9
Standard test inputs – Time response – Time domain specifications – Stability analysis: Concept of stability – Routh Hurwitz stability criterion – Root locus: Construction and Interpretation. Effect of adding poles and zeros					
Unit III	FREQUENCY DOMAIN ANALYSIS				9
Bode plot, Polar plot and Nyquist plot – Frequency domain specifications - Introduction to closed loop - Frequency Response - Effect of adding lag and lead compensators.					
Unit IV	DESIGN OF FEED BACK CONTROL SYSTEM				9

Design specifications – Lead, Lag and Lag-lead compensators using Root locus and Bode plot techniques – PID controller - Design using reaction curve and Ziegler-Nichols technique - PID control in State Feedback form.																
Unit V		STATE VARIABLE ANALYSIS												9		
State variable formulation – Non uniqueness of state space model – State transition matrix –Eigen values – Eigen vectors - Free and forced responses for Time Invariant and Time Varying Systems –Controllability – Observability.																
Total periods: 45 PERIODS																
Text Books:																
1. . Nagarath, I.J. and Gopal, M., “Control Systems Engineering”, New Age International.																
2. Benjamin C. Kuo, “Automatic Control Systems”, 7th edition PHI Learning Private Ltd, 2010.																
References:																
1. Richard C.Dorf and Bishop, R.H., “Modern Control Systems”, Education Pearson, 3 Impression 2009.																
2. John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, “Linear Control System Analysis and Design with MATLAB”, CRC Taylor& Francis Reprint 2009.																
3.Katsuhiko Ogata, “Modern Control Engineering”, PHI Learning Private Ltd, 5 th Edition, 2010																
4. NPTEL Video Lecture Notes on “Control Engineering” by Prof.S.D.Agashe, IIT Bombay.																
Course Outcomes: At the end of the course, the students will be able to:													Blooms Taxonomy			
CO 1: Represent simple systems in transfer function using block diagram reduction technique and signal flow graph													Understand(K2)			
CO2: Analyze simple systems in time domain.													Analyze (K4)			
CO3: Analyze stability of linear systems in frequency domain using different plots.													Analyze (K4)			
CO4: Analyze the design of different compensators based on time and frequency domain and infer the stability of systems in time and frequency domain.													Analyze (K4)			
CO5: Interpret the characteristics of the system and find out the solution for simple control problems using state variable model.													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	3	-	-	1	-	-	-	3	3	3	3	
CO2	3	3	3	3	3	-	-	1	-	-	-	3	3	3	3	
CO3	3	3	3	3	3	-	-	1	-	-	-	3	3	3	3	
CO4	3	3	3	3	3	-	-	1	-	-	-	3	3	3	3	
CO5	3	3	3	3	3	-	-	1	-	-	-	3	3	3	3	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation																

23EET404	LINEAR INTEGRATED CIRCUITS											Category: PCC			
												L	T	P	C

		3	0	0	3
Prerequisites					
• 23EET303-ELECTRON DEVICES AND CIRCUITS					
Course Objectives: To impart knowledge on the following topics.					
- Monolithic IC fabrication process and fabrication of diodes, capacitance, resistance and PV Cell. - AC and DC characteristics of Op-Amp. - Applications of Op-amp. - Functional blocks and the applications of special ICs like Timers, PLL circuits. - Applications of ICs in Instrumentation amplifier, fixed and variable voltage regulator, SMPS and function generator.					
Unit I	IC FABRICATION				9
IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities - Realisation of monolithic ICs and packaging - Fabrication of diodes, capacitance, resistance and PV Cell.					
Unit II	CHARACTERISTICS OF OPAMP				9
Ideal OP-AMP characteristics, DC characteristics, AC characteristics, frequency response of OP-AMP; differential amplifier, Voltage-shunt feedback and inverting amplifier - Voltage series feedback: and Non-Inverting Amplifier.					
Unit III	APPLICATIONS OF OPAMP				9
Instrumentation amplifier and its applications for transducer Bridge – summer, differentiator, Integrator - V/I & I/V converters, comparators, multi vibrators, waveform generators, clippers, claspers, peak detector-D/A converter (R- 2R ladder and weighted resistor types), A/D converters (Successive Approximation (SAR) ADC and Flash ADC types).					
Unit IV	SPECIAL ICs				9
Functional block, characteristics of 555 Timer and its PWM application - IC-566 voltage controlled oscillator IC; 565-phase locked loop IC, AD633 Analog multiplier ICs.					
Unit V	APPLICATION ICs				9
AD623 Instrumentation Amplifier and its application as load cell weight measurement - IC voltage regulators – LM78XX, LM79XX; Fixed voltage regulators its application as Linear power supply - LM317, 723 Variability voltage regulators, switching regulator - SMPS.					
Total periods: 45 PERIODS					
Text Books:					
1. D. Roy Choudhary, Sheil B. Jani, ‘Linear Integrated Circuits’, , New Age, Fourth Edition, 2018.					
2. Ramakant A.Gayakward, ‘Op-amps and Linear Integrated Circuits’, IV edition, Pearson Education, PHI 2021.					
3. David A. Bell, ‘Op-amp & Linear ICs’, Oxford, Third Edition, 2011.					
References:					
1. Robert F.Coughlin, Fredrick F. Driscoll, ‘Op-amp and Linear ICs’, Pearson, 6th edition,2012.					
2. Sergio Franco, ‘Design with Operational Amplifiers and Analog Integrated Circuits’, McGraw Hill, 2016 – Fourth Edition.					
3. Fiore,”Opamps & Linear Integrated Circuits Concepts & applications”, Cengage, 2010.					
4. Floyd ,Buchla,”Fundamentals of Analog Circuits, Pearson, 2013.					
5. Jacob Millman, Christos C.Halkias, ‘Integrated Electronics - Analog and Digital circuits system’, McGraw Hill, 2nd Edition, 2017.					
6. Muhammad H. Rashid,’ Microelectronic Circuits Analysis and Design’ Cengage Learning, 2nd Edition, 2012					

Course Outcomes: At the end of the course, the student will be able to:													Blooms Taxonomy		
CO 1: Explain monolithic IC fabrication process and fabrication of diodes, capacitance, resistance and PV Cell													Understand(K2)		
CO2: Analyze the AC and DC characteristics of Op-Amp													Analyze (K4)		
CO3: Explain circuit for various applications of Op-Amp													Understand(K2)		
CO4: Explain the functional blocks, characteristics and applications of Timer, VCO, PLL, analog multiplier ICs													Understand(K2)		
CO5: Explain the applications of ICs in Instrumentation amplifier, fixed and variable voltage Regulator and SMPS													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	2	2	1	-	-	-	-	2	2	1	2	3
CO2	3	3	3	2	2	1	-	-	-	-	2	2	1	2	3
CO3	3	3	3	2	2	1	-	-	-	-	2	2	1	2	3
CO4	3	3	3	2	2	1	-	-	-	-	2	2	1	2	3
CO5	3	3	3	2	2	1	-	-	-	-	2	2	1	2	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23EET405	MEASUREMENTS AND INSTRUMENTATION	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites • 23EET201-ELECTRIC CIRCUIT ANALYSIS • 23EET303-ELECTRON DEVICES AND CIRCUITS					
Course Objectives: • To educate the fundamental concepts and characteristics of measurement and errors • To impart the knowledge on the functional aspects of measuring instruments • To educate the fundamental working of sensors and transducers and their applications • To infer the importance of various bridge circuits used with measuring instruments. • To summarize the overall measurement and instrumentation with the knowledge on digital instrumentation principles.					
Unit I	CONCEPTS OF MEASUREMENTS				9
Instruments: classification, applications – Elements of a generalized measurement system - Static and dynamic characteristics - Errors in measurement - Statistical evaluation of measurement data - Instrument standards					
Unit II	MEASUREMENT OF PARAMETERS IN ELECTRICAL SYSTEMS				9
Classification of instruments – moving coil and moving iron meters – Induction type, dynamometer type watt meters – Energy meter – Megger – Instrument transformers (CT & PT)					
Unit III	TRANSDUCERS FOR MEASUREMENT OF NON- ELECTRICAL PARAMETERS				9
Classification of transducers – Measurement of pressure (Capacitive and Piezoelectric type) - Measurement of temperature - Measurement of displacement (Linear Variable Differential Transducer) - Measurement of flow (Electromagnetic and Ultrasonic type) - Measurement of angular velocity – Digital transducers – Smart Sensors.					

Unit IV	AC/DC BRIDGES												9		
Wheatstone bridge, Kelvin bridge and Kelvin double bridge - Maxwell, Hay, Wien and Schering bridges – Errors and compensation in A.C. bridges.															
Unit V	DIGITAL INSTRUMENTATION												9		
Measurement of voltage, Current, frequency and phase - DSO - Data Loggers – Basics of PLC programming - Introduction to Virtual Instrumentation															
Total periods: 45 PERIODS															
Text Books:															
1.A.K. Sawhney, Puneet Sawhney ‘A Course in Electrical & Electronic Measurements & Instrumentation’, Dhanpat Rai and Co, New Delhi, Edition 2011.															
2.H.S. Kalsi, ‘Electronic Instrumentation’, Tata McGraw-Hill, New Delhi, 2010.															
References:															
1. M.M.S. Anand, ‘Electronics Instruments and Instrumentation Technology’, Prentice Hall India,New Delhi, 2009.															
2. J.J. Carr, ‘Elements of Electronic Instrumentation and Measurement’, Pearson Education India,New Delhi, 2011.															
3. W.Bolton, ‘Programmable Logic Controllers’, 6 th Edition, Elseiver, 2015.															
4. R.B. Northrop, ‘Introduction to Instrumentation and Measurements’, Taylor & Francis, New Delhi,3 rd Edition 2014															
5. E. O. Doebelin and D. N. Manik, ‘Measurement Systems – Application and Design’, Tata McGraw-Hill, New Delhi, 6 th Edition 2017.															
6. R. K. Rajput, ‘Electrical and Electronics Measurements and Instrumentation’, Chand Pub, 2016.															
Course Outcomes: At the end of the course, the student will be able to:													Blooms Taxonomy		
CO 1: Understand the fundamental concepts of measurement and the structural elements of various instruments													Understand(K2)		
CO2: Describe the working principle of various instruments used for measuring parameters in electrical systems.													Analyze (K4)		
CO3:Understand about various transducers and their characteristics													Understand(K2)		
CO4: Design the different types of bridge circuits.													Analyze (K4)		
CO5: Understand the concept of digital instrumentation and virtual instrumentation													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	1	2	2	-	2	2	-	-	3	3	3	3
CO2	3	3	3	1	2	2	-	-	2	-	-	3	3	3	3
CO3	3	3	3	1	2	2	-	-	2	-	-	3	3	3	3
CO4	3	3	3	1	2	2	-	-	2	-	-	3	3	3	3
CO5	3	3	3	1	2	2	-	-	2	-	-	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23EEP401	ELECTRICAL MACHINES LABORATORY - II	Category: PCC

		L	T	P	C
		0	0	3	1.5
Prerequisites					
• 23EEP301-ELECTRICAL MACHINES LABORATORY - I					
Course Objectives:					
• To expose the students to the operation of synchronous machines and induction motors and give them experimental skill.					
LIST OF EXPERIMENTS					
1	Computation of voltage regulation of three phase alternator by EMF and MMF methods.				
2	Computation of voltage regulation of three phase alternator by ZPF method.				
3	Regulation of three phase salient pole alternator by slip test.				
4	Measurements of negative sequence and zero sequence impedance of alternators.				
5	V and Inverted V curves of Three Phase Synchronous Motor				
6	Load test on three-phase induction motor.				
7	No load and blocked rotor tests on three-phase induction motor (Determination of equivalent circuit parameters).				
8	Load test on single-phase induction motor.				
9	No load and blocked rotor test on single-phase induction motor.				
10	Separation of No-load losses of three-phase induction motor.				
11	Study of Induction Motor Starters.				
Total periods: 45 PERIODS					
Text Books:					
1. D.P. Kothari and I.J. Nagrath, ‘Electric Machines’, McGraw Hill Publishing Company Ltd, 5th Edition 2017					
2. P.S. Bhimbhra, ‘Electrical Machinery’, Khanna Publishers, edition 2, 2021.					
3. A.E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, ‘Electric Machinery’, Mc Graw Hill publishing Company Ltd, 6th Edition 2017.					
4. Stephen J. Chapman, ‘Electric Machinery Fundamentals’, 4th edition, McGraw Hill Education Pvt. Ltd, 4th Edition 2017					
References:					
1. Vincent Del Toro, ‘Basic Electric Machines’, Pearson India Education, 2016.					
2. M.N. Bandyopadhyay, ‘Electrical Machines Theory and Practice’, PHI Learning Pvt. Ltd., New Delhi, 2011.					
3. B.R.Gupta, ‘Fundamental of Electric Machines’, New age International Publishers, 3rd Edition, Reprint 2015.					
4. Murugesh Kumar, ‘Synchronous and Induction machines’, Vikas Publishing House Pvt. Ltd, First edition 2010.					
5. M. G. Say, ‘Performance and design of AC machines’, CBS Publishers, First Edition 2008.					
Course Outcomes: At the end of the course, the student will be able to:					Blooms Taxonomy
CO1: Understand and analyze EMF, MMF and ZPF methods					Understand(K2)
CO2: Acquire hands on experience of conducting various tests on alternators and obtaining their performance indices using standard analytical as well as graphical methods to understand the importance of Synchronous machines					Understand(K2)
CO3: Analyze the characteristics of V and Inverted V curves					Analyze(K4)
CO4: Acquire hands on experience of conducting various tests on induction motor and obtaining their performance indices using standard analytical as well as					Understand(K2)

graphical methods. to understand the importance of single and three phase Induction motors															
CO5: Acquire knowledge on separation of losses and starters													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	1	2	-	-	-	-	2	-	-	3	3	3	3
CO2	3	3	1	2	-	-	-	-	2	-	-	3	3	3	3
CO3	3	3	1	2	-	-	-	-	2	-	-	3	3	3	3
CO4	3	3	1	2	-	-	-	-	2	-	-	3	3	3	3
CO5	3	3	1	2	-	-	-	-	2	-	-	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23EEP402	CONTROL AND INSTRUMENTATION LABORATORY	Category: PCC			
		L	T	P	C
		0	0	3	1.5
Prerequisites					
•					
Course Objectives:					
- To make the students familiarize with various physical systems and simulate the performance in analog and digital platform. - To develop the different compensators based on time and frequency domain specifications. - To make the students to design and implement simple controllers in standard forms. - To make the students to design a complete closed loop control system and evaluate its performance. - To develop the stability of a physical system in both continuous and discrete domains.					
LIST OF EXPERIMENTS					
1	Analog (op amp based) simulation of linear differential equations.				
2	Numerical Simulation of given nonlinear differential equations.				
3	Real time simulation of differential equations.				
4	System Identification through process reaction curve.				
5	Stability analysis using Pole zero maps and Routh Hurwitz Criterion in simulation platform.				
6	Root Locus based analysis in simulation platform.				
7	Determination of transfer function of a physical system using frequency response and Bode's asymptotes.				
8	Design of Lag, lead compensators and evaluation of closed loop performance.				
9	Design of PID controllers and evaluation of closed loop performance.				
10	. Discretization of continuous system and effect of sampling.				
11	Test of controllability and observability in continuous and discrete domain in simulation platform.				
12	State feedback and state observer design and evaluation of closed loop performance.				

13	Mathematical modeling and simulation of physical systems in at least two fields.
	• Mechanical • Electrical • Chemical process
	Mini Project 1: Simulation of complete closed loop control systems including sensor and actuator dynamics. Mini Project 2: Demonstration of a closed loop system in hardware.
Total periods: 45 PERIODS	
Text Books:	
1. Nagarath, I.J. and Gopal, M., “Control Systems Engineering”, New Age International	
2. Benjamin C. Kuo, “Automatic Control Systems”, 7th edition PHI Learning Private Ltd, 2010.	
References:	
1. . Richard C.Dorf and Bishop, R.H., “Modern Control Systems”, Education Pearson, 3 Impression 2009.	
2. John J.D., Azzo Constantine, H. and Houpis Stuart, N Sheldon, “Linear Control System Analysis and Design with MATLAB”, CRC Taylor& Francis Reprint 2009.	
3. Katsuhiko Ogata, “Modern Control Engineering”, PHI Learning Private Ltd, 5th Edition, 2010.	
4. NPTEL Video Lecture Notes on “Control Engineering” by Prof.S.D.Agashe, IIT Bombay.	
Course Outcomes:	
At the end of the course, the student will be able to:	
CO1: Model and analyze simple physical systems and simulate the performance in analog and digital platform.	Analyze (K4)
CO2: Design compensators based on time and frequency domain specifications.	Understand (K2)
CO3: Design and implement simple controllers in standard forms.	Understand (K2)
CO4: Analyze a complete closed control loop system and evaluate its performance for simple physical systems.	Analyze (K4)
CO5: Model and simulate physical systems in different fields.	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 3 2 3 2 - 2 3 2 - 3 2 2 2
CO2	3 3 3 2 3 2 - 2 3 2 - 3 2 2 2
CO3	3 3 3 2 3 2 - 2 3 2 - 3 2 2 2
CO4	3 3 3 2 3 2 - 2 3 2 - 3 2 2 2
CO5	3 3 3 2 3 2 - 2 3 2 - 3 2 2 2
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation	

23EEP403	LINEAR AND DIGITAL CIRCUITS LABORATORY	Category: PCC			
		L	T	P	C
		0	0	3	1.5
Prerequisites					
•					
Course Objectives:					
• To learn design, testing and characterizing of circuit behavior with combinational logic gate ICs. • To learn design, testing and characterizing of circuit behavior with register/ counter and sequential logic ICs.					

- To learn design, testing and characterizing of circuit behavior with OPAMP ICs.
- To learn design, testing and characterizing of circuit behavior with analog ICs like 555 Timer, VCO and regulators.
- To learn design, testing and characterizing of circuit behavior with digital ICs like decoders, Multiplexers.

LIST OF EXPERIMENTS

1	Implementation of Boolean Functions, Adder and Subtractor circuits.
2	Code converters: Excess-3 to BCD and Binary to Gray code converter and vice versa.
3	Parity generator and parity checking
4	Encoders and Decoders
5	Counters: Design and implementation of 3-bit modulo counters as synchronous and Asynchronous types using FF IC's and specific counter IC.
6	Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitable IC's.
7	Study of multiplexer and demultiplexer
8	Timer IC application: Study of NE/SE 555 timer in Astable, Monostable operation.
9	Application of Op-Amp: inverting and non-inverting amplifier, Adder, comparator, Integrator and Differentiator.
10	Voltage to frequency characteristics of NE/ SE 566 IC.
11	Variable Voltage Regulator using IC LM317.

Total periods: 45 PERIODS**Text Books:**

1. D. Roy Choudhary, Sheil B. Jani, 'Linear Integrated Circuits', , New Age, Fourth Edition, 2018.
2. Ramakant A. Gayakward, 'Op-amps and Linear Integrated Circuits', IV edition, Pearson Education, PHI 2021.
3. David A. Bell, 'Op-amp & Linear ICs', Oxford, Third Edition, 2011.

References:

1. Robert F. Coughlin, Fredrick F. Driscoll, 'Op-amp and Linear ICs', Pearson, 6th edition, 2012.
2. Sergio Franco, 'Design with Operational Amplifiers and Analog Integrated Circuits', McGraw Hill, 2016 – Fourth Edition.
3. Fiore, 'Opamps & Linear Integrated Circuits Concepts & applications', Cengage, 2010.
4. Floyd, Buchla, 'Fundamentals of Analog Circuits', Pearson, 2013.
5. Jacob Millman, Christos C. Halkias, 'Integrated Electronics - Analog and Digital circuits system', McGraw Hill, 2nd Edition, 2017.
6. Muhammad H. Rashid, 'Microelectronic Circuits Analysis and Design' Cengage Learning, 2nd Edition, 2012.

Course Outcomes:

At the end of the course, the student will be able to

Blooms Taxonomy

CO1: Understand Boolean Functions and implement Adder/ Subtractor circuits.	Understand(K2)
CO2: Design and implement the Combinational circuits (Code converters & Shift registers)	Analyze(K4)
CO3: Design and implement circuits with digital ICs like decoders, multiplexers, register.	Analyze(K4)
CO4: Demonstrate the applications of Op-Amp (inverting and non-inverting amplifier, Adder, comparator, Integrator and Differentiator).	Analyze(K4)
CO5: Design and implement counters using analog ICs like timers, VCOs and digital ICs like Flip-flops and counters.	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	-	-	-	2	2	2	3	-	3	3
CO2	3	3	3	3	3	-	-	-	2	2	2	3	-	3	3
CO3	3	3	3	3	3	-	-	-	2	2	2	3	-	3	3
CO4	3	3	2	3	3	-	-	-	2	1	2	3	-	3	3
CO5	3	3	3	3	3	-	-	-	2	1	2	3	-	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

SEMESTER V

23EET501	POWER SYSTEM ANALYSIS	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites 23EET402-TRANSMISSION DISTRIBUTION					
Course Objectives: - To understand and model various power system components under steady state operating condition. - To understand and apply iterative techniques for power flow analysis - To model and carry out short circuit studies on power system - To acquire knowledge on fault analysis. - To model and analyze stability problems in power system					
Unit I	INTRODUCTION				9
Need for system planning and operational studies - Power scenario in India - Power system components – Representation - Single line diagram - per unit quantities - p.u. impedance diagram - p.u. reactance diagram - Network graph, Bus incidence matrix, Primitive parameters, Bus admittance matrix from primitive parameters - Direct inspection method – Singular Transformation method.					
Unit II	POWER FLOW ANALYSIS				9

Bus classification - Formulation of Power Flow problem in polar coordinates - Power flow solution using Gauss Seidel method - Handling of Voltage controlled buses - Power Flow Solution by Newton Raphson method. comparison of methods		
Unit III	SYMMETRICAL FAULT ANALYSIS	9
Assumptions in short circuit analysis - Symmetrical short circuit analysis using Thevenin's theorem - Bus Impedance matrix building algorithm (without mutual coupling) - Symmetrical fault analysis through bus impedance matrix - Post fault bus voltages - Fault level		
Unit IV	UNSYMMETRICAL FAULT ANALYSIS	9
Symmetrical components - Sequence impedances - Sequence networks - Analysis of unsymmetrical faults at generator terminals: LG, LL and LLG - unsymmetrical fault occurring at any point in a power system		
Unit V	STABILITY ANALYSIS	9
Classification of power system stability – Rotor angle stability - Swing equation - Swing curve – Power Angle equation - Equal area criterion - Critical clearing angle and time - Classical step-by-step solution of the swing equation – modified Euler method.		
Total periods:45 Periods		
Text Books:		
1.John J. Grainger, William D. Stevenson, Jr, 'Power System Analysis', Mc Graw Hill Education (India)Private Limited, New Delhi, 2015.		
2.Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw-Hill Education, Second Edition, 2008		
3.Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.		
References:		
1.Pai M A, 'Computer Techniques in Power System Analysis', Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.		
2.J. Duncan Glover, Mulukutla S.Sarma, Thomas J. Overbye, 'Power System Analysis & Design', Cengage Learning, Fifth Edition, 2012.		
3.Gupta B.R., 'Power System - Analysis and Design', S. Chand Publishing, 2001.		
4.Kundur P., 'Power System Stability and Control', Tata McGraw Hill Education Pvt.Ltd., New Delhi, 10th reprint, 2010		
Course Outcomes: At the end of the course, the student will be able to:		Blooms Taxonomy
CO 1: Understand and model various power system components under steady state operating condition		Understand(K2)
CO2: Apply iterative techniques for power flow analysis		Apply(K3)
CO3: Infer the significance of short circuit studies in designing circuit breakers.		Understand(K2)
CO4: Acquire knowledge on Fault analysis.		Understand(K2)

CO5: Model and analyze stability problems in power system													Analyze (K4)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	1	-	-	2	-	-	3	3	1	3
CO2	3	3	3	2	1	1	-	-	2	-	-	3	3	-	3
CO3	3	3	3	2	1	1	-	-	2	-	-	3	3	-	3
CO4	3	3	3	2	2	1	-	-	2	-	-	3	3	1	3
CO5	3	3	3	2	2	1	-	-	2	-	-	3	3	-	3
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23EET502	POWER ELECTRONICS	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites 23EET201-ELECTRIC CIRCUIT ANALYSIS 23EET303-ELECTRON DEVICES AND CIRCUITS					
Course Objectives: To impart knowledge on the following Topics - Different types of power semiconductor devices and their switching Switching regulators. - Operation, switching techniques and basics topologies of DC-DC - Different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods - Operation of AC voltage controller and various configurations. - Operation, characteristics and performance parameters of controlled rectifiers					
Unit I	POWER SEMI-CONDUCTOR DEVICES				9
Study of switching devices, SCR, TRIAC, GTO, BJT, MOSFET, IGBT and IGCT- Static characteristics: SCR,MOSFET and IGBT - Triggering and commutation circuit for SCR- Introduction to Driver and snubber circuits.					
Unit II	DC TO DC CONVERTERS				9

Step-down and step-up chopper-control strategy– Introduction to types of choppers-A, B, C, D and E - Switched mode regulators- Buck, Boost, Buck- Boost regulator, Introduction to Resonant Converters, Applications-Battery operated vehicles.		
Unit III	DC TO AC CONVERTERS	9
Single phase and three phase voltage source inverters (both 120 mode and 180 mode)– Voltage & harmonic control--PWM techniques: Multiple PWM, Sinusoidal PWM, modified sinusoidal PWM – Introduction to space vector modulation –Current source inverter, Applications-Induction heating, UPS		
Unit IV	AC TO AC CONVERTERS	9
Single phase and Three phase AC voltage controllers–Control strategy- Power Factor Control – Multistage sequence control -single phase and three phase cyclo converters – Introduction to Matrix converters, Applications – welding .		
Unit V	AC TO DC CONVERTERS	9
2-pulse, 3-pulse and 6-pulse converters– performance parameters –Effect of source inductance— Firing Schemes for converter - Applications-light dimmer, Excitation system, Solar PV systems.		
Total periods:45 Periods		
Text Books:		
1.M.H. Rashid, ‘Power Electronics: Circuits, Devices and Applications’, Pearson Education, switching techniques and basic topologies of DC-DC Conversion, Third Edition, New Delhi, 2004.		
2.P.S.Bimbhra “Power Electronics” Khanna Publishers, third Edition, 2003		
3.Ashfaq Ahmed ‘Power Electronics for Technology’, Pearson Education, Indian reprint, 2003		
References:		
1.. Joseph Vithayathil, ‘Power Electronics, Principles and Applications’, McGraw Hill Series, 6 th Reprint, 2013.		
2.Philip T. Krein, “Elements of Power Electronics” Oxford University Press, 2004 Edition.		
3.L. Umanand, “Power Electronics Essentials and Applications”, Wiley, 2010.		
4.Ned Mohan Tore. M. Undel and, William. P. Robbins, ‘Power Electronics: Converters, Applications and Design’, John Wiley and sons, third edition, 2003.		
5.S.Rama Reddy, ‘Fundamentals of Power Electronics’, Narosa Publications, 2014.6. M.D. Singh and K.B. Khanchandani, “Power Electronics,” Mc Graw Hill India, 2013.		
6.JP Agarwal,” Power Electronic Systems: Theory and Design” 1e, Pearson Education, 2002.		
Course Outcomes:		Blooms Taxonomy
At the end of the course, the student will be able to:		
CO 1: Understand different types of power semi-conductor devices and their switching characteristics.		Understand(K2)

CO2: Apply the switching techniques and basic topologies of DC-DC switching regulators.													Apply(K3)		
CO3: Apply different modulation techniques of pulse width modulated inverters and harmonic reduction methods to inverter.													Apply(K3)		
CO4: Understand the operation of AC voltage controller and Matrix converters.													Understand(K2)		
CO5: Understand the operation, characteristics and performance parameters of controlled rectifiers.													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	-	-	2	1	-	-	3	3	3	3	3
CO2	3	3	3	3	-	-		1	-	-	-	-	3	3	3
CO3	3	3	3	3	-	-	2	1	-	-	2	-	3	3	3
CO4	3	3	3	3	-	-	1	1	-	-	2	3	3	3	3
CO5	3	3	3	3	-	-	1	1	-	-	2	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23EET503	MICROPROCESSOR AND MICROCONTROLLER	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites • 23EET303-ELECTRON DEVICES AND CIRCUITS • 23EET304-DIGITAL LOGIC CIRCUITS					
Course Objectives: • To study the architecture & instruction set of 8085 and to develop skills in simple program writing in assembly languages. • To introduce commonly used peripheral/interfacing ICs used with 8085. • To study the architecture & instruction set of 8051. • To study peripheral interfacing with 8051. • To study the advanced architecture based microcontroller.					
Unit I	8085 MICROPROCESSOR ARCHITECTURE AND PROGRAMMING				9
Architecture of 8085 -Bus structure –Interrupt structure -Timing Diagram – Instruction format andaddressing modes – Instruction set – Simple programming.					
Unit II	INTERFACING BASICS AND ICS				9

Memory interfacing - Study of Architecture and programming of ICs: 8255 PPI, 8259PIC, 8251 USART, 8279 Keyboard display controller and 8254 Timer/Counter – Interfacing with 8085 - A/D and D/A converter interfacing.		
Unit III	8051 MICROCONTROLLER ARCHITECTURE AND PROGRAMMING	9
Functional block diagram - Instruction format and addressing modes – Interrupt structure – I/O ports – Instruction Set – Simple programming		
Unit IV	INTERFACING WITH MICROCONTROLLER	9
Serial communication -Timer – keyboard and display interface – Temperature control system – stepper motor control - Usage of IDE for assembly language programming		
Unit V	ADVANCED MICROCONTROLLER	9
PIC16 /18 architecture - Memory organization – Addressing modes – Instruction set - Programming techniques– Timers – I/O ports – Interrupt programming.		
Total periods:45 Periods		
Text Books:		
1.Ramesh S. Gaonkar, ‘Microprocessor Architecture Programming and Application’, Pen ram International (P)ltd., Mumbai, 6th Education, 2013.		
2.Muhammad Ali Mazidi & Janice Gilli Mazidi, ‘The 8051 MicroController and Embedded Systems’, Pearson Education, Second Edition 2011.		
3.Muhammad Ali Mazidi & Janice Gilli Mazidi, ‘The PIC Micro Controller and Embedded Systems’, 2010		
References:		
1.Douglas V. Hall, “Micro-processors & Interfacing”, Tata McGraw Hill 3 rdEdition, 2017.		
2.Krishna Kant, “Micro-processors & Micro-controllers”, Prentice Hall of India, 2007.		
3.Mike Predko, “8051 Micro-controllers”, McGraw Hill, 2009		
4.Kenneth Ayala, ‘The 8051 Microcontroller’, Thomson, 3 rd Edition 2004		
Course Outcomes:	Blooms Taxonomy	
At the end of the course, the student will be able to:		
CO 1: Describe the architecture of 8085 microprocessor and write assembly language program for microprocessor	Analyze(K4)	
CO2: Design and implement the interfacing of peripherals with 8085 microprocessor	Create(K6)	
CO3: Describe the architecture of 8051 microcontroller and write assembly language program for microcontroller.	Analyze(K4)	
CO4: Design and implement the interfacing of peripherals with 8051 microcontroller.	Create(K6)	

CO5: Understand and appreciate the advanced architecture based microcontroller													Understand(K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	3	-	-	-	1	-	-	-	3	3	1	3
CO2	2	1	2	3	-	-	-	1	-	-	-	3	3	1	3
CO3	2	1	2	3	-	-	-	1	-	-	-	3	3	1	3
CO4	2	1	2	3	-	-	-	1	-	-	-	3	3	1	3
CO5	2	1	2	3	-	-	-	1	-	-	-	3	3	1	3
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23EEP501	POWER ELECTRONICS LABORATORY	Category: PCC			
		L	T	P	C
		0	0	4	2
Prerequisites					
Course Objectives: •To study the VI characteristics of SCR, TRIAC, MOSFET and IGBT. • To analyze the performance of semi converter, full converter, step up, step down choppers by simulation and experimentation. • To study the behavior of voltage waveforms of PWM inverter applying various modulation techniques. • To design and analyze the performance of SMPS. • To study the performance of AC voltage controller by simulation and Experimentation.					
LIST OF EXPERIMENTS					
1	Characteristics of SCR and TRIAC.				
2	Characteristics of MOSFET and IGBT.				

3	Single phase AC to DC half controlled converter.
4	Single phase AC to DC fully controlled converter
5	MOSFET based Boost and Buck converter..
6	IGBT based single phase PWM inverter.
7	IGBT based three phase PWM inverter.
8	AC Voltage controller.
9	Switched mode power converter.
10	Simulation of PE circuits (Single phase & three phase semi converter, Single phase & three phase full converter, dc-dc converters, ac voltage controllers)
Total periods:45 Periods	
Text Books:	
1.M.H. Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Operation, switching techniques and basics topologies of DC-DC Education, Third Edition, New Delhi, 2004.	
2.P.S.Bimbira "Power Electronics" Khanna Publishers, third Edition, 2003	
3.Ashfaq Ahmed 'Power Electronics for Technology', Pearson Education, Indian reprint, 2003	
References:	
1. Joseph Vithayathil, 'Power Electronics, Principles and Applications', McGraw Hill Series, 6 th Reprint, 2013.	
2.Philip T. Krein, "Elements of Power Electronics" Oxford University Press, 2004 Edition.	
3.L. Umanand, "Power Electronics Essentials and Applications", Wiley, 2010.	
4. Ned Mohan Tore. M. Undel and, William. P. Robbins, 'Power Electronics: Converters, Applications and Design', John Wiley and sons, third edition, 2003.	
5.S.Rama Reddy, 'Fundamentals of Power Electronics', Narosa Publications, 2014.6. M.D. Singh and K.B. Khanchandani, "Power Electronics," Mc Graw Hill India, 2013.	
6.JP Agarwal," Power Electronic Systems: Theory and Design" 1e, Pearson Education, 2002.	
Course Outcomes: At the end of the course, the students will be able to:	Blooms Taxonomy
CO 1: Determine the characteristics of SCR, IGBT, TRIAC, MOSFET and IGBT	
CO2: Find the transfer characteristics of full converter, semi converter, step up and step down choppers by simulation and experimentation.	
CO3: Analyze the voltage waveforms for PWM inverter using various modulation techniques.	
CO4: Design and experimentally verify the performance of basic DC/DC converter Topologies used for SMPS.	

CO5: Understand the performance of AC voltage controllers by simulation and Experimentation.													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	-	-	2	-	2	3	3	2	2	1	3	-
CO2	3	3	3	-	-	2	-	2	3	3	2	2	1	3	2
CO3	3	3	3	-	-	2	-	2	3	3	2	2	1	3	-
CO4	3	3	3	2	2	2	-	2	3	3	2	2	1	3	2
CO5	3	3	3	-	3	2	-	2	3	3	2	2	1	3	2
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23EEP502	MICROPROCESSOR AND MICROCONTROLLER LABORATORY	Category: PCC			
		L	T	P	C
		0	0	4	2
Prerequisites • 23EEP302-ELECTRONIC DEVICES AND CIRCUITS LABORATORY • 23EEP403-LINEAR AND DIGITAL CIRCUITS LABORATORY					
Course Objectives: • To perform simple arithmetic operations by developing assembly language program using the instruction set of 8085 • To perform interfacing experiments with μP8085 • To perform simple arithmetic operations by developing assembly language program using the instruction set of 8051 • To perform interfacing experiments with μC8051.					
LIST OF EXPERIMENTS					
PROGRAMMING EXERCISES / EXPERIMENTS WITH μP8085:					
1	Simple arithmetic operations: Addition / Subtraction.				
2	Simple arithmetic operations: Multiplication / Division.				
3	Programming with control instructions: Ascending / Descending Order.				
4	Programming with control instructions: Rotate instructions, Code conversion BCD/ Hexa				
5	Interface Experiments: A/D Interfacing. D/A Interfacing, Stepper motor control with 8085.				
6	Displaying a moving/ rolling message in the student trainer kit's output device.				
	PROGRAMMING EXERCISES / EXPERIMENTS WITH μC8051:				
7	Simple arithmetic operations with 8051: Addition / Subtraction				
8	Simple arithmetic operations with 8051: Multiplication/ Division.				

9	Programming with control instructions: Maximum / Minimum of numbers.														
10	Interface Experiments: A/D Interfacing. D/A Interfacing.														
11	Stepper motor controller Interface with 8051.														
Total periods:45 Periods															
Text Books:															
1.Ramesh S. Gaonkar, ‘Microprocessor Architecture Programming and Application’, Pen ram International (P) ltd., Mumbai, 6th Education, 2013.															
2.Muhammad Ali Mazidi & Janice Gilli Mazidi, ‘The 8051 MicroController and Embedded Systems’, Pearson Education, Second Edition 2011.															
3.Muhammad Ali Mazidi & Janice Gilli Mazidi, ‘The PIC Micro Controller and Embedded Systems’, 2010															
References:															
1.Douglas V. Hall, “Micro-processors & Interfacing”, Tata McGraw Hill 3 rd Edition, 2017.															
2.Krishna Kant, “Micro-processors & Micro-controllers”, Prentice Hall of India, 2007.															
3.Mike Predko, “8051 Micro-controllers”, McGraw Hill, 2009															
4.Kenneth Ayala, ‘The 8051 Microcontroller’, Thomson, 3 rd Edition 2004															
Course Outcomes: At the end of the course, the students will be able to:													Blooms Taxonomy		
CO 1:Develop assembly language program for microprocessor													Analyze (K4)		
CO2:Interface peripherals with 8085 microprocessor.													Apply(K3)		
CO3:Develop assembly language program for microcontroller.													Analyze (K4)		
CO4:Analyze, comprehend and design microcontroller based systems used for control and monitoring.													Analyze (K4)		
CO5:Design and implement interfacing of peripheral with microcontroller													Create(K6)		
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	3	3	3	3	1	2	2
CO2	2	1	2	-	-	1	-	1	3	3	3	3	1	2	2
CO3	2	1	2	-	-	1	-	1	3	3	3	3	1	2	2
CO4	2	1	2	-	-	1	-	1	3	3	3	3	1	2	2
CO5	2	1	2	-	-	1	-	1	3	3	3	3	1	2	2
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

SEMESTER VI

23EET601	PROTECTION AND SWITCHGEAR	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To understand the significance of protection, protection schemes and role of earthing. - To study the characteristics, functions and application areas of various relays. - To acquire practical knowledge about common faults in power system apparatus and applying suitable protective schemes. - To understand the functioning of static relays and Numerical protection concepts. - To understand the problems associated with circuit breaking and to discuss about various circuit breakers.					
Unit I	PROTECTION SCHEMES				9
Significance and need for protective schemes – nature and causes of faults – types of faults Effects of faults - Zones of protection and essential qualities of protection – Types of Protection schemes - Power system Grounding and Methods of Grounding.					

Unit II	BASICS OF RELAYS												9		
Operating principles of relays –Universal torque equation - R-X diagram –Electromagnetic Relays – Over current, Directional and non-directional, Distance, Differential, Negative sequence and Under frequency relays.															
Unit III	OVERVIEW OF EQUIPMENT PROTECTION												9		
Current transformers and Potential transformers and their applications in protection schemes - Protection of transformer, generator, motor, bus bars and transmission line.															
Unit IV	STATIC RELAYS AND NUMERICAL PROTECTION												9		
Static relays – Phase, Amplitude Comparators – Block diagram of Numerical relays – Over current protection, transformer differential protection, and distance protection of transmission lines.															
Unit V	CIRCUIT BREAKERS												9		
Physics of arcing phenomenon and arc interruption – DC and AC circuit breaking – re-striking voltage and recovery voltage - rate of rise of recovery voltage - current chopping - interruption of capacitive current - resistance switching - Types of circuit breakers – air blast, oil, SF6 and vacuum circuit breakers – comparison of different circuit breakers – HVDC Breaker.															
Total periods:45 Periods															
Text Books:															
1.Sunil S.Rao, ‘Switchgear and Protection’, Khanna Publishers, New Delhi, Four Edition, 2010.															
2.Badri Ram ,B.H. Vishwakarma, ‘Power System Protection and Switchgear’, New Age International Pvt Ltd Publishers, Second Edition 2011.															
3.B.Rabindranath and N.Chander, ‘Power System Protection and Switchgear’, New Age International (P) Ltd., Second Edition, 2018.															
4. Arun Ingole, ‘Switch Gear and Protection’ Pearson Education, 2018.															
References:															
1.Y.G.Paithankar and S.R.Bhide, ‘Fundamentals of power system protection’, Second Edition,Prentice Hall of India Pvt. Ltd., New Delhi, 2013.															
2.C.L.Wadhwa, ‘Electrical Power Systems’, 6th Edition, New Age International (P) Ltd., 2018															
3.VK Metha,” Principles of Power Systems”, S. Chand, Reprint, 2013															
4.Bhaves Bhalja, R.P. Maheshwari, Nilesh G. Chotani,’Protection and Switchgear’ Oxford University Press, 2nd Edition 2018.															
Course Outcomes: Upon the successful completion of the course, students will have the ability to:													Blooms Taxonomy		
CO 1: Understand and select proper protective scheme and type of earthing.													Understand(K2)		
CO2: Explain the operating principles of various relays.													Understand(K2)		
CO3: Suggest suitable protective scheme for the protection of various power system apparatus.													Apply(K3)		
CO4: Analyze the importance of static relays and numerical relays in power system protection.													Analyze(K4)		
CO5: Summarize the merits and demerits and application areas of various circuit breakers													Understand(K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2	1	2	1	1	1	1	2	-	3	1	-
CO2	3	1	1	2	1	2	1	1	1	1	2	-	3	1	-
CO3	3	1	1	2	1	2	1	1	1	1	2	-	3	2	-
CO4	3	1	1	2	1	2	1	1	1	1	2	-	3	2	1
CO5	3	1	1	2	2	2	1	1	1	1	2	-	3	1	1
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23EET602	POWER SYSTEM OPERATION AND CONTROL	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites 23EET501-POWER SYSTEM ANALYSIS					
Course Objectives: To impart knowledge on, - The significance of power system operation and control. - Real power– frequency interaction and design of power– frequency controller. - Reactive power– voltage interaction and the compensators for maintaining the voltage profile. - The generation scheduling and economic operation of power system. - The generation scheduling and economic operation of power system.					
Unit I	INTRODUCTION				9
Requirements of good power system – Necessity of voltage and frequency regulation – real power vs frequency and reactive power vs voltage control loops - System load variation, load curves – Load forecasting – Computational methods in load forecasting – Load shedding and Islanding – deregulation					
Unit II	REAL POWER FREQUENCY CONTROL				9
Basics of speed governing mechanisms and modeling – Speed regulation of two generators in parallel Load Frequency Control (LFC) of single area system – Static and dynamic analysis –LFC of two area system –Tie line modelling – Block diagram representation of two area system – Static and dynamic analysis – Tie line with frequency bias control – State variable model					
Unit III	REACTIVE POWER – VOLTAGE CONTROL				9
Generation and absorption of reactive power – Basics of reactive power control – Automatic Voltage Regulator (AVR) – Brushless AC excitation system – Block diagram representation of AVR loop static and dynamic analysis – Stability compensation – Methods of reactive power injection – Tap changing transformer, SVC and STATCOM for voltage control.					
Unit IV	ECONOMIC OPERATION OF POWER SYSTEM				9
Statement of economic dispatch problem – Input and output characteristics of thermal plant incremental cost curve – Optimal operation of thermal units without and with transmission losses (no derivation of transmission loss coefficients) – Lambda–iteration method – Base point and participation factors method. Statement of Unit Commitment (UC) problem – Constraints on UC problem – Solution of UC problem using priority list					
Unit V	COMPUTER AIDED CONTROL OF POWER SYSTEM				9
Need of computer control of power system – Concept of energy control centers and functions –PMU system monitoring, Data acquisition and controls – System hardware configurations – SCADA and EMS functions – State estimation – Measurements and errors – Weighted least square estimation – Various operating states – State transition diagram.					
Total periods:45 Periods					
Text Books:					
1. Olle. I. Elgerd, ‘Electric Energy Systems theory – An introduction’, McGraw Hill Education Pvt. Ltd., New Delhi, 2nd edition, 2017.					
2. Allen. J. Wood and Bruce F. Wollen berg, ‘Power Generation, Operation and Control’, John Wiley & Sons, Inc., 3rd edition, 2013.					

3. 3Abhijit Chakrabarti and Sunita Halder, ‘Power System Analysis Operation and Control’, PHI learning Pvt. Ltd., New Delhi, Fourth Edition, 2018.																
													Category: PCC			
References:		POWER SYSTEM LABORATORY											L	T	P	C
1. Kothari D.P. and Nagrath I.J., ‘Power System Engineering’, Tata McGraw–Hill Education, Second Edition, Reprint 2018.		2.Hadi Saadat, ‘Power System Analysis’, McGraw Hill Education Pvt. Ltd., New Delhi, 23rd reprint,2015											0	0	4	2
Prerequisites		3.Kundur P., ‘Power System Stability and Control, McGraw Hill Education Pvt. Ltd., New Delhi, 12th reprint, 2013.														
Course Objectives:		● To provide a better understanding of modelling of transmission lines in impedance and admittance forms														
4.B.M. Weedy, B.J. Cory et al., ‘Electric Power systems’, Wiley, Fifth Edition, 2012.		● To apply iterative techniques for power flow analysis and to carry out short circuit and stability studies of power system.														
Course Outcomes:		Blooms Taxonomy														
● CO 1: Students will be able to understand the day – to – day operation of power system.		Understand (K2)														
● To analyze the load – frequency and voltage controls.																
● To analyze optimal dispatch of generators and perform state estimation.		Analyze (K3)														
● CO2: Students will be able to model and analyze the control actions that are implemented to meet the minute-to minute variation of system real power demand.																
● CO3: Students will be able to model and analyze the compensators for reactive power control and various devices used for voltage control.		Analyze (K3)														
1. Computation and modelling of transmission lines																
● CO4: Students will be able to prepare day ahead and real time economic generation scheduling		Understand (K2)														
2. Formation of Bus Admittance and Impedance Matrices																
● CO5: Students will be able to understand the necessity of computer control of power systems.		Understand (K2)														
3. Power Flow Analysis Using Gauss-Seidel Method																
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	3	2	2	
CO2	3	2	2	2	-	-	-	-	-	-	2	2	3	2	2	
CO3	3	2	2	2	-	-	-	-	-	-	2	1	3	2	2	
CO4	3	2	2	2	-	2	-	-	-	-	2	2	3	2	2	
CO5	2	1	1	-	2	2	-	-	-	-	3	2	3	3	2	
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation																

4	Power Flow Analysis Using Newton Raphson Method
5	Symmetric and Unsymmetrical Fault Analysis
6	Transient Stability Analysis of SMIB System
7	Load – Frequency Dynamics of Single- Area and Two-Area Power System
8	Economic Dispatch in Power Systems
9	State estimation: Weighted least square estimation
10	Performance analysis of over current relay
11	Performance analysis of impedance relay
12	Testing of CT, PT, and Insulator string
13	Relay Coordination in Radial Feeder Protection Scheme
Total periods: 60 periods	
Text Books:	
1.John J. Grainger, William D. Stevenson, Jr, ‘Power System Analysis’, Mc Graw Hill Education (India) Private Limited, New Delhi, 2015.	
2.Kothari D.P. and Nagrath I.J., ‘Power System Engineering’, Tata McGraw-Hill Education, Second Edition, 2008	
3.Hadi Saadat, ‘Power System Analysis’, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.	
References:	
1.Pai M A, ‘Computer Techniques in Power System Analysis’, Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.	
2.J. Duncan Glover, Mulukutla S.Sarma, Thomas J. Overbye, ‘Power System Analysis & Design’, Cengage Learning, Fifth Edition, 2012.	
3.Gupta B.R., ‘Power System - Analysis and Design’, S. Chand Publishing, 2001.	
4.Kundur P., ‘Power System Stability and Control’, Tata McGraw Hill Education Pvt.Ltd., New Delhi, 10th reprint, 2010	
Course Outcomes:	
CO1: Model the performance of the transmission lines.	Blooms Taxonomy Apply (K3)
CO2: Construct power flow, short circuit, and stability analysis for any power system network.	Analyze (K4)
CO3: Design the load frequency control mechanism for power system network.	Create (K6)

CO4:Develop optimal scheduling of generators and compute the state of the power system													Apply (K3)		
CO5: Analyze the operation of various relays for power system protection													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	2	2	3	-	-	-	3	3	2	2	3	1	3
CO2	3	3	2	2	3	-	-	-	3	3	3	2	3	1	3
CO3	3	3	2	2	3	-	-	-	3	3	3	2	3	2	3
CO4	3	3	2	2	3	-	-	-	3	2	3	2	3	2	3
CO5	3	3	1	1	-	-	-	-	3	2	2	2	3	2	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23EEP602	MINI PROJECT												Category: EEC			
													L	T	P	C
													0	0	4	2
Prerequisites 23HST101-PROFESSIONAL ENGLISH-I 23HST201-PROFESSIONAL ENGLISH -II																
Course Objectives: - To develop their own innovative prototype of ideas. - To train the students in preparing mini project reports and examination. The students in a group of 5 to 6 works on a topic approved by the head of the department and prepares a comprehensive mini project report after completing the work to the satisfaction. The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A mini project report is required at the end of the semester. The mini project work is evaluated based on oral presentation and the mini project report jointly by external and internal examiners constituted by the Head of the Department.																
Total periods: 60 Periods																
Course Outcomes:													Blooms Taxonomy			
On Completion of the mini project work students will be in a position to take up their final year project work and find solution by formulating proper methodology.													Analyze(K4)			
CO-PO 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	
CO2	-	-	-	-	3	3	-	-	-	-	-	-	3	-	-	
CO3	-	-	-	-	-	-	3	-	3	-	-	-	-	-	3	
CO4	-	-	-	-	-	-	-	3	3	3	3	-	-	-	3	
CO5	-	-	-	-	-	-	-	-	-	-	-	3	3	3	3	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation																

SEMESTER VII

23EET701	RENEWABLE ENERGY SYSTEMS	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites 23BET201-BASIC CIVIL AND MECHANICAL ENGINEERING					
Course Objectives: To impart knowledge on the following Topics - Awareness about renewable Energy Sources and technologies. - Adequate inputs on a variety of issues in harnessing renewable Energy. - Recognize current and possible future role of renewable energy sources.					
Unit I	RENEWABLE ENERGY (RE) SOURCES				9
Environmental consequences of fossil fuel use, Importance of renewable sources of energy, Sustainable Design and development, Types of RE sources, Limitations of RE sources, Present Indian and international energy scenario of conventional and RE sources.					
Unit II	WIND ENERGY				9

Power in the Wind – Types of Wind Power Plants(WPPs)–Components of WPPs-Working of WPPs- Siting of WPPs-Grid integration issues of WPPs.		
Unit III	SOLAR PV AND THERMAL SYSTEMS	9
Solar Radiation, Radiation Measurement, Solar Thermal Power Plant, Central Receiver Power Plants, Solar Ponds.- Thermal Energy storage system with PCM- Solar Photovoltaic systems : Basic Principle of SPV conversion – Types of PV Systems- Types of Solar Cells, Photovoltaic cell concepts: Cell, module, array ,PV Module I-V Characteristics, Efficiency &Quality of the Cell, series and parallel connections, maximum power point tracking, Applications.		
Unit IV	BIOMASS ENERGY	9
Introduction-Bio mass resources –Energy from Bio mass: conversion processes-Biomass Cogeneration-Environmental Benefits. Geothermal Energy: Basics, Direct Use, Geothermal Electricity. Mini/micro hydro power: Classification of hydropower schemes, Classification of water turbine, Turbine theory, Essential components of hydroelectric system.		
Unit V	OTHER ENERGY SOURCES	9
Tidal Energy: Energy from the tides, Barrage and Non Barrage Tidal power systems. Wave Energy: Energy from waves, wave power devices. Ocean Thermal Energy Conversion (OTEC)- Hydrogen Production and Storage- Fuel cell : Principle of working- various types -construction and applications. Energy Storage System- Hybrid Energy Systems.		
Total periods:45 Periods		
Text Books:		
1.Joshua Earnest, Tore Wizeliu, ‘Wind Power Plants and Project Development’, PHILearning Pvt.Ltd, New Delhi, 2011.		
2. D.P.Kothari, K.C Singal, Rakesh Ranjan “Renewable Energy Sources and EmergingTechnologies”, PHI Learning Pvt.Ltd, New Delhi, 2013.		
3. Scott Grinnell, “Renewable Energy & Sustainable Design”, CENGAGE Learning,USA, 2016.		
References:		
1.A.K.Mukerjee and Nivedita Thakur,” Photovoltaic Systems: Analysis and Design”,PHI Learning Private Limited, New Delhi, 2011		
2.Richard A. Dunlap,” Sustainable Energy” Cengage Learning India Private Limited,Delhi, 2015.		
3. Chetan Singh Solanki, “ Solar Photovoltaics : Fundamentals, Technologies andApplications”, PHI Learning Private Limited, New Delhi, 2011		
4.Bradley A. Striebig,AdebayoA.Ogundipe and Maria Papadakis,” EngineeringApplications in Sustainable Design and Development”, Cengage Learning IndiaPrivate Limited, Delhi, 2016.		
5.Godfrey Boyle, “Renewable energy”, Open University, Oxford University Press in association with the Open University, 2004.		
6.ShobhNath Singh, ‘Non-conventional Energy resources’ Pearson Education ,2015.		
Course Outcomes: At the end of this course, Students will be		Blooms Taxonomy
CO 1: Ability to create awareness about renewable Energy Sources and technologies. Ability to get adequate inputs on a variety of issues in harnessing renewable Energy.		Analyse(K4)
CO2: Ability to recognize current and possible future role of renewable energy sources.		Analyse(K4)
CO3: Ability to explain the various renewable energy resources and technologies and their applications.		Analyse(K4)
CO4: Ability to understand basics about biomass energy.		Understand(K2)
CO5: Ability to acquire knowledge about solar energy.		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	0	3	0	0	0	0	1	3	1	0
CO2	2	2	3	2	2	0	3	0	0	0	0	1	3	1	0
CO3	2	3	3	2	2	0	3	0	0	0	0	2	3	2	0
CO4	1	2	1	3	1	0	2	0	0	0	0	2	1	1	0
CO5	2	2	3	3	2	0	3	0	0	0	0	2	3	1	0
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23GET701	HUMAN VALUES AND ETHICS		Category: HSMC			
			L	T	P	C
			2	0	0	2
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. - To instill the scientific temper in the students’ minds and develop their critical thinking. - To promote sense of responsibility and understanding of the duties of citizen.						
Unit I	DEMOCRATIC VALUES					6
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.						
Unit II	SECULAR VALUES					6
Understanding Secular values – Interpretation of secularism in Indian context - Disassociation of state from religion – Acceptance of all faiths – Encouraging non-discriminatory practices.						
Unit III	SCIENTIFIC VALUES					6
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.						
Unit IV	SOCIAL ETHICS					6
Application of ethical reasoning to social problems – Gender bias and issues – Gender violence – Social discrimination – Constitutional protection and policies – Inclusive practices.						
Unit V	SCIENTIFIC ETHICS					6
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.						
Total periods:30 Periods						
Text Books:						
1. Excerpts from John Stuart Mills’ <i>On Liberty</i>						
2. Excerpt from <i>Secularism in India: Concept and Practice</i> by Ram Puniyani						
3. Excerpt from <i>The Scientific Temper</i> by Antony Michaelis R						

4. Excerpt from <i>21 Lessons for the 21st Century</i> by Yuval Noah Harari															
References:															
1.The Nonreligious: Understanding Secular People and Societies, Luke W. Galen Oxford University Press, 2016.															
2.Secularism: A Dictionary of Atheism, Bullivant, Stephen; Lee, Lois, Oxford University Press, 2016.															
3.The Oxford Handbook of Secularism, John R. Shook, Oxford University Press, 2017.															
4.The Civic Culture: Political Attitudes and Democracy in Five Nations by Gabriel A. Almond and Sidney Verba, Princeton University Press,															
5.Research Methodology for Natural Sciences by Soumitro Banerjee, IISc Press, January 2022															
Course Outcomes: Students will be able to													Blooms Taxonomy		
CO 1: Identify the importance of democratic, secular and scientific values in harmonious functioning of social life													Analyze (K4)		
CO2: Practice democratic and scientific values in both their personal and professional life.													Apply(K3)		
CO3: Find rational solutions to social problems.													Analyze (K4)		
CO4: Behave in an ethical manner in society													Understand(K2)		
CO5: Practice critical thinking and the pursuit of truth.													Understand(K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	1	2	3	-	1	-	1	-	-	-
CO2	-	-	-	-	-	2	2	3	-	1	-	1	-	-	-
CO3	-	-	-	-	-	3	2	3	-	-	-	2	-	-	-
CO4	-	-	-	-	-	3	2	3	-	-	-	2	-	-	-
CO5	-	-	-	-	-	3	2	3	-	-	-	2	-	-	-
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23EEP701	Project Work I	Category: EEC			
		L	T	P	C
		0	0	8	4
Prerequisites • 23HST101-PROFESSIONAL ENGLISH-I • 23HST201-PROFESSIONAL ENGLISH -II					
Course Objectives: • The student should be made to learn methodology to select a good project and able to work in a team leading to development of hardware/software product.prepare a good technical report. Gain Motivation to present the ideas behind the project with clarity. • A Project topic must be selected either from research literature or the students themselves may propose suitable topics in consultation with their guides. The aim of the project work is to deepen Comprehension of principles by applying them to a new problem which may be the design /fabrication of any power component / circuit / sensor / Activator / Controller, a research investigation, a computer or management project or a design problem. The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department					

based on oral presentation and the project report.

Total periods: 120 Periods

Course Outcomes: At the end of this course, the students will have the ability to													Blooms Taxonomy		
CO 1: Ability to identify, formulate, design, interpret,analyze and provide solutions to complex engineering and societal issues by applying knowledge gained on basics of science and Engineering.													Analyze(K4)		
CO2: Ability to choose, conduct and demonstrate a sound technical knowledge of their selected project topics in the field of power components, protection, highvoltage, electronics, process automation, power electronics and drives instrumentation and control by exploring suitable engineering and IT tools.													Understand(K2)		
CO3: Ability to understand, formulate and propose new learning algorithms to solve engineering and societal problems of moderate complexity through multidisciplinary projectsunderstanding commitment towards sustainable development.													Understand(K2)		
CO4: Ability to demonstrate, prepare reports, communicate and work in a team as a member/leader by adhering to ethical responsibilities.													Apply(K3)		
CO5: Ability to acknowledge the value of continuing education for oneself and to stay up with technology advancements.													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	-	-	-	-	-	-	-	-	3	3	3
CO2	-	-	-	-	3	3	-	-	-	-	-	-	3	-	-
CO3	-	-	-	-	-	-	3	-	3	-	-	-	-	-	3
CO4	-	-	-	-	-	-	-	3	3	3	3	-	-	-	3
CO5	-	-	-	-	-	-	-	-	-	-	-	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

SEMESTER VIII

23EEP801	PROJECT WORK - II	Category: EEC			
		L	T	P	C
		0	0	12	6
Prerequisites • 23HST101-PROFESSIONAL ENGLISH-I • 23HST201-PROFESSIONAL ENGLISH -II					

Course Objectives: ● The student should be made to learn methodology to select a good project and able to work in a team leading to development of hardware/software product. prepare a good technical report. Gain Motivation to present the ideas behind the project with clarity. ● A Project topic must be selected either from research literature or the students themselves may propose suitable topics in consultation with their guides. The aim of the project work is to deepen Comprehension of principles by applying them to a new problem which may be the design /fabrication of any power component / circuit / sensor / Activator / Controller, a research investigation, a computer or management project or a design problem. The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.															
Total periods:180 Periods															
Course Outcomes: At the end of this course, the students will have the ability to													Blooms Taxonomy		
CO 1: .Ability to identify, formulate, design, interpret, analyze and provide solutions to complex engineering and societal issues by applying knowledge gained on basics of science and Engineering.													Analyze(K4)		
CO2: Ability to choose, conduct and demonstrate a sound technical knowledge of their selected project topics in the field of power components, protection, high voltage, electronics, process automation, power electronics and drives instrumentation and control by exploring suitable engineering and IT tools.													Understand(K2)		
CO3: Ability to understand, formulate and propose new learning algorithms to solve engineering and societal problems of moderate complexity through multidisciplinary projects understanding commitment towards sustainable development.													Understand(K2)		
CO4: Ability to demonstrate, prepare reports, communicate and work in a team as a member/leader by adhering to ethical responsibilities.													Apply(K3)		
CO5: Ability to acknowledge the value of continuing education for oneself and to stay up with technology advancements.													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	-	-	-	-	-	-	-	-	3	3	3
CO2	-	-	-	-	3	3	-	-	-	-	-	-	3	-	-
CO3	-	-	-	-	-	-	3	-	3	-	-	-	-	-	3
CO4	-	-	-	-	-	-	-	3	3	3	3	-	-	-	3
CO5	-	-	-	-	-	-	-	-	-	-	-	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

ELECTIVE – MANAGEMENT COURSES

23EMT001	PRINCIPLES OF MANAGEMENT												Category: HSMC			
													L	T	P	C

		3	0	0	3
Prerequisites A basic understanding of business, economics, or organizational functions is helpful for learning core management concepts.					
Course Objectives: 1. Sketch the Evolution of Management. 2. Extract the functions and principles of management. 3. Learn the application of the principles in an organization. 4. Study the various HR related activities. 5. Analyze the position of self and company goals towards business.					
Unit I	INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS				9
Definition of Management – Science or Art – Manager Vs Entrepreneur- types of managers managerial roles and skills – Evolution of Management –Scientific, human relations, system and contingency approaches– Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises- Organization culture and Environment – Current trends and issues in Management.					
Unit II	PLANNING				9
Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.					
Unit III	ORGANISING				9
Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.					
Unit IV	DIRECTING				9
Foundations of individual and group behaviour– Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT.					
Unit V	CONTROLLING				9
System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.					
Total periods:45 PERIODS					
Text Books: 1. Harold Koontz and Heinz Weihrich “Essentials of management” Tata McGraw Hill,1998. 2. Stephen P. Robbins and Mary Coulter, “ Management”, Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009.					
References: 1. Robert Kreitner and MamataMohapatra, “ Management”, Biztantra, 2008. 2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, “Fundamentals of Management” Pearson Education, 7th Edition, 2011. 3. Tripathy PC and Reddy PN, “Principles of Management”, Tata Mcgraw Hill, 1999.					
Course Outcomes: CO 1: Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling.					Blooms Taxonomy (K2 – Understand)

CO2: Have same basic knowledge on international aspect of management.													(K2 – Understand)		
CO3: Ability to understand management concept of organizing.													(K2 – Understand)		
CO4: Ability to understand management concept of directing.													(K2 – Understand)		
CO5: Ability to understand management concept of controlling.													(K2 – Understand)		
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	1
CO2	-	1	1	-	-	-	-	-	-	-	-	-	2	1	-
CO3	1		-	2	-	-	1	-	2	-	1	1	-	-	2
CO4	-	1	1	1	2	-	-	1	2	-	-	-	1	1	1
CO5	1		-	-	1	1	-	-	-	3	-	1	1	-	1
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23EMT002	TOTAL QUALITY MANAGEMENT	Category: HSMC			
		L	T	P	C
		3	0	0	3
Prerequisites A basic understanding of management principles and organizational processes is required to grasp quality management concepts.					
Course Objectives: 1. Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM. 2. Explain the TQM Principles for application. 3. Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA. 4. Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR. 5. Illustrate and apply QMS and EMS in any organization.					
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, 183 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:45 PERIODS																
Text Books:																
1. Dale H.Besterfield, Carol B.Michna,Glen H. Bester field,MaryB.Sacre, HemantUrdhwareshe and RashmiUrdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.																
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			
CO 1: Ability to apply TQM concepts in a selected enterprise.													(K3 – Apply)			
CO2: Ability to apply TQM principles in a selected enterprise.													(K3 – Apply)			
CO3: Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.													(K3 – Apply)			
CO4: Ability to understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.													(K3 – Apply)			
CO5: Ability to apply QMS and EMS in any organization.													(K3 – Apply)			
CO - PO & PSO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	-	2	-	-	-	-	-	-	-	-	-	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	-	-	-	-	-	-	-	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation																

23EMT003	ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING	Category: HSMC			
		L	T	P	C
		3	0	0	3
Prerequisites A basic understanding of mathematics and logical reasoning is required to analyze economic problems and financial data.					

Course Objectives:		
1.Understanding the concept of Engineering Economics. 2.Implement various micro economics concept in real life. 3.Gaining knowledge in the field of macro economics to enable the students to have better. 4.understanding of various components of macro economics. 5.Understanding the different procedures of pricing. 6.Learn the various cost related concepts in micro economics.		
Unit I	DEMAND & SUPPLY ANALYSIS	9
Managerial Economics - Relationship with other disciplines - Firms: Types, objectives and goals - Managerial decisions - Decision analysis.Demand - Types of demand - Determinants of demand - Demand function – Demand elasticity - Demand forecasting - Supply - Determinants of supply - Supply function - Supply elasticity.		
Unit II	PRODUCTION AND COST ANALYSIS	9
Production function - Returns to scale - Production optimization - Least cost input - Isoquants - Managerial uses of production function. Cost Concepts - Cost function - Determinants of cost - Short run and Long run cost curves - Cost Output Decision - Estimation of Cost.		
Unit III	PRICING	9
Determinants of Price - Pricing under different objectives and different market structures - Price discrimination - Pricing methods in practice.		
Unit IV	FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT)	9
Balance sheet and related concepts - Profit & Loss Statement and related concepts - Financial Ratio Analysis - Cash flow analysis - Funds flow analysis - Comparative financial statements - Analysis & Interpretation of financial statements.		
Unit V	CAPITAL BUDGETING (ELEMENTARY TREATMENT)	9
Investments - Risks and return evaluation of investment decision - Average rate of return - Payback Period - Net Present Value - Internal rate of return.		
Total periods:45 PERIODS		
Text Books:		
1. Panneer Selvam, R, “Engineering Economics”, Prentice Hall of India Ltd, New Delhi,2001.		
2. Managerial Economics: Analysis, Problems and Cases - P. L. Mehta, Edition, 13. Publisher, Sultan Chand, 2007.		
References:		
1. Chan S.Park, “Contemporary Engineering Economics”, Prentice Hall of India, 2011.		
2. Donald.G. Newman, Jerome.P.Lavelle, “Engineering Economics and analysis” Engg. Press, Texas, 2010.		
3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, “Engineering Economy”, Macmillan, New York, 2011.		
4. Zahid A khan: Engineering Economy, "Engineering Economy", Dorling Kindersley, 2012.		
5. Dr. S. N. Maheswari and Dr. S.K. Maheshwari: Financial Accounting, Vikas, 2009.		
Course Outcomes:		Blooms Taxonomy
CO1: Upon successful completion of this course, students will acquire the skills to apply the basics of economics and cost analysis to engineering and take economically sound decisions		(K3 – Apply)
CO2: Evaluate the economic theories, cost concepts and pricing policies		(K5 – Evaluate)
CO3: Understand the market structures and integration concepts		(K2 – Understand)

CO4: Understand the measures of national income, the functions of banks and concepts of globalization													(K2 – Understand)		
CO5: Apply the concepts of financial management for project appraisal.													(K3 – Apply)		
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	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	2	2
CO3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	3	3	-	2	-	-	-	-	-	-	-	2	3	-
CO5	3	3	3	-	2	-	-	-	-	-	-	-	2	-	2
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23EMT004	HUMAN RESOURCE MANAGEMENT		Category: HSMC			
			L	T	P	C
			3	0	0	3
Prerequisites Basic knowledge of management principles and organizational behavior.						
Course Objectives: 1. To provide knowledge about management issues related to staffing, 2. To provide knowledge about management issues related to training, 3. To provide knowledge about management issues related to performance 4. To provide knowledge about management issues related to compensation 5. To provide knowledge about management issues related to human factors consideration and compliance with human resource requirements.						
Unit I	INTRODUCTION TO HUMAN RESOURCE MANAGEMENT					9
The importance of human resources – Objective of Human Resource Management - Human resource policies - Role of human resource manager.						
Unit II	HUMAN RESOURCE PLANNING					9
Importance of Human Resource Planning – Internal and External sources of Human Resources - Recruitment - Selection – Socialization						
Unit III	TRAINING AND EXECUTIVE DEVELOPMENT					9
Types of training and Executive development methods – purpose – benefits.						
Unit IV	EMPLOYEE COMPENSATION					9
Compensation plan – Reward – Motivation – Career Development - Mentor – Protege relationships.						
Unit V	PERFORMANCE EVALUATION AND CONTROL					9
Performance evaluation – Feedback - The control process – Importance – Methods – grievances – Causes – Redressal methods.						
Total periods:45						
Text Books: 1.Decenzo and Robbins, "Human Resource Management", 8th Edition, Wiley, 2007 2. John Bernardin. H., "Human Resource Management – An Experimental Approach", 5th Edition, Tata McGraw Hill, 2013, N						
References: 1. Luis R., Gomez-Mejia, DavidB. Balkin and Robert L. Cardy, “Managing Human Resources”, 7 th						

Edition, PHI, 2012.															
2. Dessler, "Human Resource Management", Pearson Education Limited, 2007															
Course Outcomes:													Blooms Taxonomy		
CO 1: Students would have gained knowledge on the various aspects of HRM													(K2 – Understand)		
CO2: Students will gain knowledge needed for success as a human resources professional.													(K2 – Understand)		
CO3: Students will develop the skills needed for a successful HR manager.													(K3 – Apply)		
CO4: Students would be prepared to implement the concepts learned in the workplace.													(K3 – Apply)		
CO5: Students would be aware of the emerging concepts in the field of HRM													(K4 – Analyze)		
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	2	2	1	1	2	1	1	1	1	1	1
CO2	3	3	2	3	2	2	2	2	3	1	2	1	1	2	1
CO3	3	3	3	3	3	3	2	2	3	1	2	1	1	2	1
CO4	3	3	2	3	3	2	2	2	2	1	1	1	1	1	1
CO5	3	3	1	2	2	2	2	2	2	1	1	1	1	1	1
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23EMT005	KNOWLEDGE MANAGEMENT	Category: HSMC			
		L	T	P	C
		3	0	0	3
Prerequisites Basic understanding of organizational processes and information systems.					
Course Objectives: 1. Learn the Evolution of Knowledge management. 2. Be familiar with tools. 3. Be exposed to Applications. 4. Be familiar with some case studies					
Unit I	INTRODUCTION				9
Introduction: An Introduction to Knowledge Management - The foundations of knowledge management- including cultural issues- technology applications organizational concepts and processes- management aspects- and decision support systems. The Evolution of Knowledge management: From Information Management to Knowledge Management - Key Challenges Facing the Evolution of Knowledge Management - Ethics for Knowledge Management.					
Unit II	I CREATING THE CULTURE OF LEARNING AND KNOWLEDGE SHARING				9
Organization and Knowledge Management - Building the Learning Organization. Knowledge Markets: Cooperation among Distributed Technical Specialists – Tacit Knowledge and Quality Assurance					

Unit III	KNOWLEDGE MANAGEMENT-THE TOOLS												9			
Telecommunications and Networks in Knowledge Management - Internet Search Engines and Knowledge Management - Information Technology in Support of Knowledge Management - Knowledge Management and Vocabulary Control - Information Mapping in Information Retrieval - Information Coding in the Internet Environment - Repackaging Information.																
Unit IV	KNOWLEDGE MANAGEMENT APPLICATION												9			
Components of a Knowledge Strategy - Case Studies (From Library to Knowledge Center, Knowledge Management in the Health Sciences, Knowledge Management in Developing Countries).																
Unit V	FUTURE TRENDS AND CASE STUDIES												9			
Advanced topics and case studies in knowledge management - Development of a knowledge management map/plan that is integrated with an organization's strategic and business plan - A case study on Corporate Memories for supporting various aspects in the process life -cycles of an organization.																
															Total periods:45	
PERIODS																
Text Books:																
1. .Srikantaiah, T.K., Koenig, M., “Knowledge Management for the Information Professional” Information Today, Inc., 2000																
References:																
1. Nonaka, I., Takeuchi, H., “The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation”, Oxford Unive																
Course Outcomes:													Blooms Taxonomy			
CO 1: Understand the process of acquiry knowledge from experts													(K2: Understand)			
CO2: Understand the learning organization.													(K2: Understand)			
CO3: Use the knowledge management tools.													(K3: Apply)			
CO4: Develop knowledge management Applications.													(K6: Create)			
CO5: Design and develop enterprise applications													(K6: Create)			
CO - PO & PSO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	
CO2	-	-	-	-	2	-	-	-	-	-	-	-	1	-	-	
CO3	-	-	-	-	2	-	-	-	-	-	-	-	-	2	-	
CO4	-	-	-	1	1	-	-	-	1	-	-	-	-	1	-	
CO5	-	-	-	1	1	-	-	-	1	-	-	-	-	1	-	
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation																

23EMT006	INDUSTRIAL MANAGEMENT				Category: HSMC			
					L	T	P	C
					3	0	0	3

Prerequisites		
Basic knowledge of management principles and industrial operations.		
Course Objectives:		
1. To study the basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations. 2. To study the planning; organizing and staffing functions of management in professional organization. 3. To study the leading; controlling and decision making functions of management in professional organization. 4. To learn the organizational theory in professional organization. 5. To learn the principles of productivity and modern concepts in management in professional organization.		
Unit I	INTRODUCTION TO MANAGEMENT	9
Management: Introduction; Definition and Functions – Approaches to the study of Management – Mintzberg's Ten Managerial Roles – Principles of Taylor; Fayol; Weber; Parker – Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative – Public Sector Vs Private Sector Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Merits & Demerits.		
Unit II	FUNCTIONS OF MANAGEMENT - I	9
Planning: Characteristics; Nature; Importance; Steps; Limitation; Planning Premises; Strategic Planning; Vision & Mission statement in Planning– Organizing: Organizing Theory; Principles; Types; Departmentalization; Centralization and Decentralization; Authority & Responsibility – Staffing: Systems Approach; Recruiting and Selection Process; Human Resource Development (HRD) Concept and Design		
Unit III	FUNCTIONS OF MANAGEMENT - II	9
Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake-Mouton, Reddin) – Communication: Purpose; Model; Barriers – Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control – Decision Making: Elements; Characteristics; Nature; Process; Classifications.		
Unit IV	ORGANIZATION THEORY	9
Organizational Conflict: Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management – Maslow's hierarchy of needs theory; Herzberg's motivation-hygiene theory; McClelland's three needs motivation theory; Vroom's valence-expectancy theory – Change Management: Concept of Change; Lewin's Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.		
Unit V	PRODUCTIVITY AND MODERN TOPICS	9
Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Modern Topics (concept, feature/characteristics, procedure, merits and demerits): Business Process Reengineering (BPR); Benchmarking; SWOT/SWOC Analysis; Total Productive Maintenance; Enterprise Resource Planning (ERP); Management of Information Systems (MIS).		
Total periods:45		
Text Books:		
1. M. Govindarajan and S. Natarajan, "Principles of Management", Prentice Hall of India, New Delhi, 2009		
2. Koontz. H. and Weihrich. H., "Essentials of Management: An International Perspective", 8th Edition, Tata McGrawhill, New Delhi, 2010.		
References:		
1. Joseph J, Massie, "Essentials of Management", 4th Edition, Pearson Education, 1987.		
2. Saxena, P. K., "Principles of Management: A Modern Approach", Global India Publications, 2009.		
3. S.Chandran, "Organizational Behaviours", Vikas Publishing House Pvt. Ltd., 1994.		

4. Richard L. Daft, “Organization Theory and Design”, South Western College Publishing, 11th Edition, 2012															
5. S. Trevis Certo, “Modern Management Concepts and Skills”, Pearson Education, 2018															
Course Outcomes:													Blooms Taxonomy		
CO 1: Explain basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.													Understand(K2)		
CO2: Discuss the planning; organizing and staffing functions of management in professional organization.													Understand(K2)		
CO3: Apply the leading; controlling and decision making functions of management in professional organization.													Apply(K3)		
CO4: Discuss the organizational theory in professional organization													Understand(K2)		
CO5: Apply principles of productivity and modern concepts in management in professional organization.													Apply(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	1	3	2	3	2	3	1	3	1	1	1
CO2	1	1	1	1	1	3	2	3	2	3	1	3	1	1	1
CO3	1	1	1	1	1	3	2	3	2	3	1	3	1	1	1
CO4	1	1	1	1	1	3	2	3	2	3	1	3	1	1	1
CO5	1	1	1	1	1	3	2	3	2	3	1	3	1	1	1
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 understanding of social issues and ability to read simple academic content. • Openness to discuss gender-related topics respectfully and critically					
Course Objectives: • To provide students with foundational knowledge of gender, feminism, and social inequalities, enabling them to critically examine how gender shapes individual experiences, institutions, and cultural practices in society.					
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					

23MCT002	ELEMENTS OF LITERATURE	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites • Basic proficiency in English reading and writing to understand literary texts. • Interest in exploring different forms of literature such as poetry, drama, and fiction.					
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..					

COURSE CONTENTS				
13.Relevance of literature 13.Relevance of literature a) Enhances Reading, thinking, discussing and writing skills. b) Develops finer sensibility for better human relationship. Prerequisites c) Increases understanding of the problem of humanity without bias. d) Providing space to reconcile and get a cathartic effect.	Category: MC			
	L	T	P	C
	3	0	0	0
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.				
READINGS: An Introduction to the Study of English Literature, W.H. Hudson, Atlantic, 2007. An Introduction to Literary Studies, Mario Klarer, Routledge, 2013. The Experience of Poetry, Graham Mode, Open college of Arts with Open Univ Press 1991., The Elements of Fiction: A Survey, Ulf Wolf (ed), Wolfstuff, 2114. The Elements of Drama, J.L.Styan, Literary Licensing, 2011.				
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				
ASSESSMENT: 5.1HA: 5.2Quizzes-HA: 5.3Periodical Examination: one 5.4Project/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. 5.5Final Exam:				
Total periods: 45				
References: 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.				
Course Outcomes: Students will be able to understand the relevance of literature in human life and appreciate its aspects in developing finer sensibilities.			Blooms Taxonomy K2 (Understand)	

• Basic interest in films and the ability to understand visual storytelling. • Willingness to observe, interpret, and discuss cinematic techniques and theme.	
Course Objectives: • In this course on film appreciation, the students will be introduced broadly to the development of film as an art and entertainment form. • It will also discuss the language of cinema as it evolved over a century. • The students will be taught as to how to read a film and appreciate the various nuances of a film as a text. • The students will be guided to study film joyfully.	
COURSE CONTENTS Theme - A: The Component of Films 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 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 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 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 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	
READINGS: 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.	
Total periods: 45	

23MCT004	DISASTER RISK REDUCTION AND MANAGEMENT	Category: MC			
		L	T	P	C
		3	0	0	0

Prerequisites		
- Basic knowledge of geography and environmental processes, along with the ability to understand community-level issues. - Willingness to engage in teamwork and apply problem-solving skills during disaster-related scenarios.		
Course Objectives:		
- To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management - To acquaint with the skills for planning and organizing disaster response		
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. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.															
2. Government of India, National Disaster Management Policy, 2009.															
3. Shaw R (2016), Community based Disaster risk reduction, Oxford University Press															
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													Understand(K2)		
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													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	2	3	-	-	2	2	-	-	2	-	2	-	1
CO2	3	3	3	3	-	-	2	1	-	-	2	-	2	-	1
CO3	3	3	3	3	-	-	2	2	-	-	-	-	2	-	1
CO4	3	3	2	3	-	-	2	1	-	-	2	-	2	-	1
CO5	3	3	2	3	-	-	2	2	-	-	2	-	3	-	1
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

MANDATORY COURSES II

23MCT005	WELL-BEING WITH TRADITIONAL PRACTICES-	Category: MC

YOGA, AYURVEDA AND SIDDHA		L	T	P	C
		3	0	0	0
Prerequisites • Basic awareness of health, wellness, and human body functions, with the ability to follow guided physical or reflective practices. • Openness to learn traditional healing systems like Yoga, Ayurveda, and Siddha with a respectful and disciplined approach.					
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				9
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				9
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	UNIT IV ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH				9
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 - Pancheeekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (Tri-Dosha 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				9

Emotional health - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioral 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	9
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: 45 PERIODS		
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		
2. A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England 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: After completing the course, the students will be able to:		Blooms Taxonomy
CO 1: 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		Understand (K2)

23MCT006	HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites • Basic understanding of Indian history and general scientific concepts at the school level. • Interest in exploring the evolution of science and technology within India’s cultural and historical context.					
Course Objectives: • To familiarize students with the evolution of scientific and technological advancements in India from ancient to modern times, and to develop an understanding of their impact on society, culture, and national development.					
Unit I	CONCEPTS AND PERSPECTIVES				9

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	9
Introduction to the works of D.D. Kosambi, Dharmapal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others		
Unit III	SCIENCE AND TECHNOLOGY IN ANCIENT INDIA	9
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	9
Legacy of technology in Medieval India, Interactions with Arabs Development in medical knowledge, interaction between Unani and Ayurveda and alchemy Astronomy and Mathematics: interaction with Arabic Sciences Science and Technology on the eve of British conquest		
Unit V	SCIENCE AND TECHNOLOGY IN COLONIAL INDIA	9
Science and the Empire Indian response to Western Science Growth of techno-scientific institutions		
Unit VI	SCIENCE AND TECHNOLOGY IN A POST-INDEPENDENT INDIA	9
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		

23MCT007	POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites • Basic understanding of social, political, and economic concepts studied at the school level. • Interest in exploring ethical, humane approaches to political and economic thought.					
Course Objectives: • This course will begin with a short overview of human needs and desires and how different political-economic systems try to fulfill them. • In the process, we will end with a critique of different systems and their implementations in the past, with possible future directions.					
TOPICS: 1. Considerations for humane society, holistic thought, human being’s desires, harmony in self, harmony in relationships, society, and nature, societal systems. (9 lectures, 1 hour each) 2. Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism. Liberal democracy. (5 lectures) 3. Fascism and totalitarianism. World war I and II. Cold war. (2 lectures) 4. Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models. 5. Welfare state. Relation with human desires. Empowered human beings, satisfaction. (3 lectures) 6. Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one’s lives. Relationship with nature. (6 lectures)					

7.	Essential elements of Indian civilization. (3 lectures)
8.	Technology as driver of society, Role of education in shaping of society. Future directions. (4 lectures)
Total periods: 45	
References:	
1. A Nagaraj, M K Gandhi, JC Kumarappa	
2. Adam smith, J S Mill	
3. Marx, Lenin, Mao, M N Roy	
4. M K Gandhi, Schumacher, Kumarappa	
5. Pt Sundarlal, R C Mazumdar, Dharampal	
6. Nandkishore Acharya, David Dixon, Levis Mumford	
Course Outcomes: The students will get an understanding of how societies are shaped by philosophy, political and economic system, how they relate to fulfilling human goals & desires with some case studies of how different attempts have been made in the past and how they have fared.	
Blooms Taxonomy	
Understand (K2)	

23MCT008	STATE, NATION BUILDING AND POLITICS IN INDIA	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites • Basic understanding of Indian history, society, and constitutional fundamentals. • Interest in learning how political institutions, state structures, and nation-building processes function in India.					
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.					

TOPICS:

Understanding the need and role of State and politics. Development of Nation-State, sovereignty, sovereignty in a globalized world. L T P C 3 0 0 0 Organs of State – Executive, Legislature, Judiciary. Separation of powers, forms of government unitary-federal, Presidential-Parliamentary, The idea of India. 1857 and the national awakening. 1885 Indian National Congress and development of national movement – its legacies. Constitution making and the Constitution of India. Goals, objective and philosophy. Why a federal system? National integration and nation-building. 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. 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.
4. Sumantra Bose, Transforming India: Challenges to the World's Largest Democracy, Picador India, 2013.
5. Atul Kohli, Democracy and Discontent: India's Growing Crisis of Governability, Cambridge University Press, Cambridge, U. K., 1991.
6. M. P. Singh and Rekha Saxena, Indian Politics: Contemporary Issues and Concerns, PHI, New Delhi, 2008, latest edition.
7. Rajni Kothari, Rethinking Democracy, Orient Longman, New Delhi, 2005.

Course Outcomes:

It is expected that this course will make students aware of the theoretical aspect of the state, its organs, its operationalization aspect, the background and philosophy behind the founding of the present political system, broad streams and challenges of national integration and nation-building in India. It will equip the students with the real understanding of our political system/ process in correct perspective and make them sit up and think for devising ways for better participation in the system with a view to making the governance and delivery system better for the common man who is often left unheard and unattended in our democratic setup besides generating a lot of dissatisfaction and difficulties for the system.

Blooms Taxonomy**Understand (K2)**

23MCT009	INDUSTRIAL SAFETY	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites • Basic understanding of workplace environments and general science concepts. • Willingness to follow safety rules, observe hazards, and participate in practical safety activities.					
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 LimitValue (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		
Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment																
Unit IV	WORKPLACE HEALTH AND SAFETY													9		
Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster 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: Course outcomes on completion of this course the student will be able:														Blooms Taxonomy		
CO 1:Understand the basic concept of safety.														Understand(K2)		
CO2: Obtain knowledge of Statutory Regulations and standards.														Remember(K1)		
CO3: Know about the safety Activities of the Working Place.														Understand(K2)		
CO4: Analyze on the impact of Occupational Exposures and their Remedies														Analyze (K4)		
CO5: Obtain knowledge of Risk Assessment Techniques.														Remember(K1)		
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	1	3	2	2	3	3	1	3	3	3	3	

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

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL 1: POWER ENGINEERING

23EEE001	UTILIZATION AND CONSERVATION OF ELECTRICAL ENERGY	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To know various electric drives and traction motors with applications - To introduce the energy saving concept by different ways of illumination. - To understand the different methods of electric heating and electric welding. - To know the conversion of solar and wind energies into electrical energy for different applications. - To study the domestic utilization of electrical energy.					
Unit I	ELECTRIC DRIVES AND TRACTION				9
Fundamentals of electric drive - choice of an electric motor - application of motors for particular services traction generator set, traction motors, power transformers - characteristic features of traction motor - systems of railway electrification - electric braking - train movement and energy consumption - traction motor control - track equipment and collection gear.					
Unit II	ILLUMINATION				9
Introduction - definition and meaning of terms used in illumination engineering - classification of light sources - incandescent lamps, sodium vapour lamps, mercury vapour lamps, fluorescent lamps – design of illumination systems - indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting - energy saving lamps, LED.					
Unit III	HEATING AND WELDING				9
Introduction - advantages of electric heating – modes of heat transfer - methods of electric heating - resistance heating - arc furnaces - induction heating - dielectric heating - electric welding – types - resistance welding - arc welding - power supply for arc welding - radiation welding.					
Unit IV	ENERGY CONSERVATION AND ITS IMPORTANCE				9
Energy conservation act 2001 and its Features-Review of Industrial Energy Conservation-Energy conservation in electrical Industries-Simulation study of energy conservation using power factor controller. (Three phase circuit simulation with and without capacitor).					
TOTAL: 45 PERIODS					
LIST OF EXPERIMENTS:					

1.Choosing electrical motors for drives and traction applications.															
2.A general design procedure for lighting schemes.															
3.Design of heating element and study of welding methods.															
4.Practical case studies of energy conservation.															
Text Books:															
1.N.V. Suryanarayana, “Utilisation of Electric Power”, Wiley Eastern Limited, New Ag International Limited, 1994 & Second Edition 2017 Feb.															
2.J.B.Gupta, “Utilisation Electric power and Electric Traction”, S.K.Kataria and sons, 200 2012th Edition, 2013, January.															
3.G.D.Rai,”Non-Conventional Energy sources”,Khanna publications Ltd.,New Delhi 1998															
4.D.P.Kothari, K.C.Singal, Rakesh Ranjan, “Renewable Energy Sources and Emergin Technologies”, PHI Learing Private Limited, 3 rd Edition 2022.															
5.Industrial Energy Conservation, Volume I-II, S C Bhatia, Sarvesh Devraj, Energy conservation and Managment by Akshay A pujara1st edition, June 2018.															
References:															
1.R.K.Rajput, Utilisation of Electric Power, Laxmi publications 2 nd Edition 2016.															
2.2H.Partab, Art and Science of Utilisation of Electrical Energy”, Edition, Dhanpat Rai and Co New Delhi-2004.															
3.C.L.Wadhwa,“Generation, Distribution and Utilisation of Electrical Energy”,New Ag international Pvt.Ltd., 3 rd Edition, 2015 January.															
Course Outcomes:													Blooms Taxonomy		
CO 1:Choose suitable electric drives for different applications													Analyze(K4)		
CO2:Design the illumination systems for energy saving.													Understand(K2)		
CO3: Demonstrate the utilization of electrical energy for heating and welding purposes													Analyze(K4)		
CO4:Effective usage of solar and wind energies for electrical application.													Understand(K2)		
CO5:Electric connection for any domestic appliance like refrigerator, battery charging circuit for a specific household application.													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	1	-	1	-	1.5	-	-	-	-	3	-	-
CO2	2	1	3	-	-	-	-	1.5	-	-	-	-	3	-	-
CO3	3	2	2	-	-	1	-	1.5	-	-	-	-	3	-	-
CO4	1	2	3	-	-	-	-	1.5	-	-	-	-	3	-	-
CO5	1	1	3	-	-	1	-	1.5	-	-	-	-	3	3	2

23EEE002	UNDERGROUND CABLE ENGINEERING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites •					
Course Objectives: To impart knowledge on the following topics • Understanding Power Cable Characteristics and Applications. • Cable Manufacturing. • Installation of underground power cables • Underground cable System Fault Locating. • Testing and maintenance of Underground cable system. • Cable Performance and Field Assessment of Power Cables					
Unit I	INTRODUCTION TO ELECTRICAL POWER CABLES				9
Development of Underground Cables - Electric Lighting- Distribution of Energy for Lighting- - Paper Insulated Cables - Underground Residential Distribution Systems- Underground Residential Distribution Systems- Medium Voltage Cable Development.					
Unit II	CABLE ARCHITECHTURE, DIELECTRIC THEORY AND CABLE 9 CHARACTERISTICS (7+2 SKILL				9
Architecture of Underground Cabling System - Basic Dielectric Theory of Cable — Conductors -Armour and Protective Finishes - Cable Characteristics: Electrical Fundamentals of Electrical Insulation Materials - Electrical Properties of Cable Insulating Materials - Cable Standards and Quality Assurance - Cable design parameters- Current Carrying Capacity - Short-circuit Ratings.					
Unit III	SUPPLY DISTRIBUTION SYSTEMS AND CABLES				9
Supply Distribution Systems - Distribution Cable Types, Design and Applications - Paper Insulated Distribution Cables - PVC Insulated Cables - Polymeric Insulated Distribution Cables for 6-30 kV - Manufacture of Distribution Cables - Joints and Terminations for Distribution Cables - Testing of Distribution Cables.					
Unit IV	TRANSMISSION SYSTEMS AND CABLES				9
Basic Cable Types for A.C. Transmission - Self-contained Fluid-filled Cables - Gas Pressure Cables - High Pressure Fluid-filled Pipe Cables - Polymeric Insulated Cables for Transmission Voltages - Techniques for Increasing Current Carrying Capacity - Transmission Cable Accessories and Jointing for Pressure-assisted and Polymeric Cables.					
Unit V	CABLE INSTALLATION, TESTING, MAINTENANCE				9
Installation of Transmission Cables -Splicing, Terminating, and Accessories - Sheath Bonding and Grounding-Testing of Transmission Cable Systems - Underground System Fault Locating - Field Assessment of Power Cable Systems- Condition monitoring tests — PD measurements.					
TOTAL :45 PERIODS					

LIST OF EXPERIMENTS:															
1.Demonstration of cable architecture with cable samples of all types.															
2.Understanding the cable manufacturing process through factory visit.															
3.Familiarization of the cable laying procedure through field visits.															
4.Familiarization of cable jointing / end termination techniques.															
5.Understanding and familiarization of cable fault locating techniques through field visit to local distribution company or inhouse laboratory.															
6.Understanding testing procedures and condition monitoring tests.															
Text Books:															
1.William Thue, ‘Electrical Power Cable Engineering’, CRC Press Taylor & Francis Group., 6000 Broken Sound Parkway NW, Suite 300Boca Raton, FL 33487-2742, 3 rd Edition 2017.															
2.G. F. Moore, ‘Electric Cables Handbook’ -Third edition, Blackwell Science Ltd, 9600 Garsington Road, Oxford OX4 2DQ, UK., January 2017.															
References:															
1.Leonard L. Grigsby, ‘Electrical Power Cable Engineering’ - CRC Press, Marcel Dekker, 3 rd Edition 2012.															
2.Christian Flytkjaer Jensen, Online Location of Faults on AC Cables in Underground Transmission Systems (Springer Theses), 2014, March.															
3. https://kafactor.com/content/technical-resources/kerite-underground-cable-engineering-handbook.pdf															
4.Handbook on Cable Fault Localization (April 2020) https://rdso.indianrailways.gov.in/works/uploads/File/Handbook%20on%20Cable%20Fault%20Localization(2).pdf															
5.K. H. Ali et al.: Industry Practice Guide for Underground Cable Fault-Finding in the LVDN: https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=9807279 , June 2022.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Understand the fundamental of underground cable system.													Understand(K2)		
CO2: Gain knowledge on the architecture of UG cable and physical and electrical characteristics of the UG cable.													Analyze(K4)		
CO3: Understand different types of cable used in distribution system													Understand(K2)		
CO4: Acquire knowledge on Underground cables used in transmission system													Analyze(K4)		
CO5: Understand the cable installations procedures and practices.													Understand(K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	2	1	-	3	2	-	3	-	3
CO2	3	2	-	-	-	-	2	1	-	3	2	-	3	-	3
CO3	3	2	-	-	-	-	2	1	-	3	2	-	3	-	3
CO4	3	2	-	-	-	-	2	1	-	3	2	-	3	-	3
CO5	3	2	3	-	-	-	2	1	-	3	2	-	3	3	3

22EEE003	SUBSTATION ENGINEERINGAND SUBSTATION AND SUBSTATION AUTOMATION	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To help engineering students to have a holistic understanding of the concepts behind substation engineering and design. - The course aims to give an exposure to the students to the requirements of practical aspects including an overview of civil and mechanical aspects. - Course aims to enhance the knowledge, and give the practical guidelines for site selection,construction, protection along with maintenance, safety in a substation. - It also aims at providing knowledge about state-of-the-art technology in substation automation system					
Unit I	SUBSTATION DESIGN DEVELOPMENT (7+2 SKILL)				9
Substation Introduction and Classifications, Different bus bar switching schemes for Substation. Standards and Practices, Factors Influencing Substation Design - Altitude, Ambient Temperature, Earthquake and seismic zones, pollution and corrosion etc., Testing of Electrical Equipment, Concept and development of Single Line Diagram. Requirement of substation calculation.					
Unit II	SUBSTATION EQUIPMENT (7+2 SKILL)				9
Selection and sizing of main substation equipment: Transformer, Isolator, Circuit Breaker, surge arrester, Instrument transformers, classification of equipment with a practical overview, and the performance parameters. Classifications of MV Switchgear and Key Design Parameters, MV/LV Switchgear construction and design of control scheme. Station Auxiliary equipment: Diesel Generator System, Basics of AC/DC Auxiliary Power System & Sizing of Aux. Transformer, DC System Components, Battery Sizing & charger Sizing, DG Set Classification, and sizing. Introduction to gas insulated substation: Operating principle of GIS, Advantage over AIS, construction of GIS.					
Unit III	PROTECTION AND SUBSTATION AUTOMATION (7+2 SKILL)				9
Power System protection, Overcurrent and Earth Fault protection and coordination. Distribution Feeder Protection, Transformer — Unit/Main Protection, Familiarization of NUMERICAL Relays, distance/differential protection for transmission line. Substation Automation: Evolution of Substation Automation, Communication System Fundamentals-Protocol fundamental and choosing the right protocol. Substation integration and automation functional architecture, Substation signal list - DI, DO, AI, AO– Bay Control Unit (BCU), Remote Terminal Unit RTU.					
Unit IV	SUBSTATION DESIGN & LAYOUT ENGINEERING (7+2 SKILL)				9

Layout aspects of Outdoor Air Insulated Substation and GIS: Statutory Clearances, Equipment Layout engineering aspects for Outdoor Substation/GIS and related calculations, and guide lines, Cable routing layout, Erection Key Diagram (EKD), switchyard earthing design as per IEEE80, Importance and Types of Earthing, Earthing Design, Types of Earthing Material, Direct stroke Lightning Protection for switchyard with IS/ IEC 62305. LV Cables - Power & Control, MV Cables, Methods for Cable Installation, Practical aspects of Cable Sizing, Cable accessories, Illumination System Design.		
Unit V	INTERFACE ENGINEERING (7+2 SKILL)	9
Civil & Structural Engineering - Familiarization of site development plan, equipment supports structures, foundation for equipment, familiarization of control building and substation building, infrastructure development, Mechanical System- Fire Detection, Alarm System and Fire Suppression System for transformer, Heating, Ventilation and Air-conditioning (HVAC) for Substation.		
TOTAL : 45 PERIODS		
LIST OF EXPERIMENTS:		
1.Battery sizing for a substation with a load cycle based on IEEE 1115 Ni-cd - A case study OR		
2.DG and auxiliary transformer sizing for a substation auxiliary power supply- A case study		
3.Overcurrent Relay coordination in a substation- A case study		
4.Earthmat sizing calculation for an outdoor substation based on IEEE80- A case study OR		
5.Direct stroke lightning protection calculation for outdoor switchyard based on IEC 62305- A case study		
References:		
1.McDonald John D, “Electric Power Substations Engineering”, CRC Press, 3 rd Edition, 2012		
2.Partap Singh Satnam, P.V. Gupta, “Sub-station Design and Equipment”, Dhanpat Rai Publications, 1 st Edition, 2013		
3.Sunil S. Rao, “Switchgear Protection and Power Systems (Theory, Practice & Solved Problems)”, Khanna Publications, 14 th Edition, 2019 .		
4.Electrical substation and engineering & practice by S.Rao, 3 rd Edition, Khanna Publishers 2015		
5.Manual on Substation by Central Board of irrigation and Power (CBIP) Publication No 342., 2006.		
6.Substation automation system Design and implementation by Evelio Padilla by Wiley Publications, 1 st Edition, 2015 November.		
Course Outcomes:	Blooms Taxonomy	
CO 1: Understand the key deciding factors involved in substation design and operation	Understand(K2)	
CO2: Analyse about the sizing and selection of equipment which forms part of substation	Analyze(K4)	
CO3: Analyse about composite layout design aspects of the substation with different services and the challenges including statutory clearances.	Analyze(K4)	
CO4: Understand about Interdisciplinary aspects involved in substation design	Understand(K2)	

CO5: Understand different protection and control scheme involved in substation design												Understand(K2)			
design												Category: PEC			
CO-PEEOMapping												L	T	P	C
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSQ1	PSQ2	PSQ3
CO1	1	3	2	-	2		3	2	-	-	-	3	3	-	1
Prerequisites	3	3	3	3	2		-	1	2	-	-	2	3	-	1
CO2	3	2	3	3	1		-	2	2	-	-	3	3	-	1
Course Objectives:	3	1	2	-	-		2	1	2	-	-	2	3	-	1
CO4 To understand:	3	3	3	3	-		2	1	1	-	-	3	3	-	1
CO5	3	3	3	3	-		2	1	1	-	-	3	3	-	1
● The problems in AC transmission systems and DC transmission systems ● The operation and control of SVC and TCSC ● The concepts of IGBT based FACTS controllers ● The basic operation Line Commutated Converter(LCC) based HVDC links ● The features of voltage source converter based HVDC link..															
Unit I	INTRODUCTION														9
Reactive power control in electrical power transmission lines–load & system compensation, Uncompensated transmission line–shunt and series compensation. Need for HVDC Transmission, Comparison between AC & DC Transmission, , Types of HVDC transmission System.															
Unit II	STATIC VAR COMPENSATOR (SVC) AND THYRISTOR CONTROLLED SERIES COMPENSATOR (TCSC)														9
VI characteristics of FC+TSR, TSC+TSR, Voltage control by SVC–Advantages of slope in dynamic characteristics–Influence of SVC on system voltage–Design of SVC voltage regulator, Thyristor Controlled Series Compensator (TCSC), Concept of TCSC, Operation of the TCSC– Different modes of operation, Applications:															
Unit III	VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS														9
Static Synchronous Compensator (STATCOM)–Principle of operation–V-I Characteristics. Applications: Steady state power transfer-enhancement of transient stability-prevention of voltage instability. SSSC-operation of SSSC VI characteristics, Enhancement in Power transfer capability –, UPSC — Operation Principle Applications.															
Unit IV	LINE COMMUTATED HVDC TRASMISSION														9
Operation of Gratz bridge - Effect of delay in Firing Angle — Effect of commutation overlap - Equivalent circuit,. Basic concept of HVDC transmission. Model of operations and control of power flow CC and CIA mode of operation															
Unit V	VSC BASED HVDC TRANSMISSION														9
Basic 2 level IGBT inverter operation- 4 Quadrant operation- phase angle control- dq control- Control of power flow in VSC based HVDC Transmission, Topologies of MTDC system.															

TOTAL : 45 PERIODS**LIST OF EXPERIMENTS:**

- 1.Simulation of FC+TSR connected to IEEE 5 bus system
- 2.Realization of reactive power, support by SVC in open loop and closed loop control in simulation.
- 3.Regulation of line flows employing TCSC and TSSC in closed loop control in simulation
- 4.Simulation of two terminal HVDC Link, closed loop control in CC and CIA mode in simulation
- 5.Realization of four quadrant operation of VSC in open loop mode in simulation

TEXT BOOK:

- 1.R.MohanMathur,RajivK.Varma,“Thyristor–Based Facts Controllers for Electrical Transmission Systems”, IEEE press andJohnWiley&Sons,Inc,2002.
- 2.Narain G.Hingorani, “Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems”, Standard Publishers Distributors,Delhi-110006,2011.

References:

- 1.K.R.Padiyar,”FACTS Controllersin Power Transmission and Distribution”, New Age International (P) Limited, Publishers, New Delhi, 2008
- 2.A.T.John,“Flexible A.C.Transmission Systems”,Institution of Electrical and Electronic Engineers(IEEE), 1999
- 3.V.K. Sood, HVDC and FACTS controllers–Applications of Static Converters in Power System, APRIL2004,Kluwer Academic Publishers,2004.

Course Outcomes:**Blooms Taxonomy**

CO 1:Understand the problems in AC transmission systems and understand the need for Flexible AC transmission systems and HVDC Transmission

Understand(K2)

CO2:Understand the operation and control of SVC and TCSC and its applications to enhance the stability and damping.

Understand(K2)

CO3:Analyze basic operation and control of voltage source converter based FACTS controllers

Analyze(K4)

CO4:Demonstrate basic operation and control of Line Commutated HVDC Transmission

Understand(K2)

CO5:Explain the d-q control based operation of VSC based HVDC Transmission

Apply(K3)**CO-PO Mapping**

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

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

23EEE005	ENERGY MANAGEMENT AND AUDITING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To study the concepts behind economic analysis and Load management. - To understand the basics of materials and energy balance. - To analyze the energy efficiency in thermal utilities. - To know the concept of compressed air system. - To illustrate the concept of lighting systems and cogeneration.					
Unit I	GENERAL ASPECTS OF ENERGY MANAGEMENT AND ENERGY AUDIT				9
Commercial and Non-commercial energy - final energy consumption - energy needs of growing economy - energy pricing - energy conservation and its importance - Re-structuring of the energy supply sector - Energy Conservation Act 2001, Energy Conservation (Amendment) Act, 2010, and its features - electricity tariff - Thermal Basics - need and types of energy audit - Energy management/audit approach- understanding energy costs - maximizing system efficiencies - optimizing the input energy requirements - energy audit instruments - Case study.					
Unit II	MATERIAL AND ENERGY BALANCE				9
Methods for preparing process flow - material and energy balance diagrams - Energy policy purpose - location of energy management - roles and responsibilities of energy manager — employees training and planning- Financial Management: financial analysis techniques, simple payback period, return on investment, net present value, internal rate of return — Case Study.					
Unit III	ENERGY EFFICIENCY IN THERMAL UTILITIES				9
Introduction to fuels - properties of fuel oil, coal and gas - principles of combustion - combustion of oil, coal and gas - Boilers: Types, combustion in boilers, performances evaluation, analysis of losses - energy conservation opportunities - FBC boilers - Steam System: Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, condensate and flash steam recovery system, identifying opportunities for energy savings - Furnaces: Classification, general fuel economy measures in furnaces, excess air, heat distribution, temperature control, draft control, waste heat recovery — Refractory : types, selection and application of refractories, heat loss - Cogeneration: classification and saving potentials - Case Study.					
Unit IV	ENERGY EFFICIENCY IN COMPRESSED AIR SYSTEM				9

Compressed Air System: Types of air compressors - efficient compressor operation - Compressed air system components - leakage test - savings opportunities - Refrigeration System: Vapour compression refrigeration cycle — refrigerants - coefficient of performance - factors affecting Refrigeration and Air conditioning system - savings opportunities - Vapour absorption refrigeration system: working principle - types and comparison with vapour compression system - saving potential - Cooling Tower: Types and performance evaluation, efficient system operation - flow control strategies and energy saving - Diesel Generating system: Factors affecting selection - energy performance assessment of diesel conservation avenues - Case Study.		
Unit V	ENERGY EFFICIENCY IN ELECTRICAL UTILITIES	9
Electrical load management and maximum demand control - power factor improvement and its benefit - selection and location of capacitors - performance assessment of PF capacitors - automatic power factor controllers - transformer losses - Electric motors: Types - losses in induction motors - motor efficiency - factors affecting motor performance - rewinding and motor replacement issues - energy saving opportunities with energy efficient motors - soft starters with energy saver - variable speed drives — Fans and blowers: Types - efficient system operation - flow control strategies -Pumps and Pumping System: Types - system operation - flow control methods - Lighting System: Light source, choice of lighting, luminance requirements — ballast - occupancy sensors - energy efficient lighting controls - energy conservation avenues - Case Study.		
TOTAL :45 PERIODS		
LIST OF EXPERIMENTS:		
1.Study of energy conservation and audit		
2.Performance study of Electric Motors.		
3.Analysis on fan characteristic curves at different operating points		
4.Case study of illumination system		
5.Performance analysis of Compressors		
TEXT BOOK:		
1.Mehmet Kanoglu, Yunus A Cengel, "Energy Efficiency and Management for Engineers", McGraw-Hill Education, First Edition, 2020.		
References:		
1.Moncef Krati, 'Energy Audit of Building Systems: An Engineering Approach', Third Edition, CRC Press, Dec.2020.		
2.Sonal Desai, 'Handbook of Energy Audit', McGraw Hill Education (India) Private Limited, 2015.		
3.Michael P.Deru, Jim Kelsey, 'Procedures for Commercial Building Energy Audits', American Society of Heating, Refrigerating and Air conditioning Engineers, 2011.		
4.Thomas D.Eastop, 'Energy Efficiency: For Engineers and Technologists', Longman Scientific & Technical, 1990, 1 st Edition.		
5.'Energy Managers and Energy Auditors Guide book', Bureau of Energy Efficiency, 2006.		
6.Larry C. Witte, Philip S.Schmidt, David R.Brown, 'Industrial Energy Management and Utilization', Springer Berlin Heidelberg, 1988.		
Course Outcomes:		Blooms Taxonomy

CO 1: Develop Students able to acquire knowledge in the field of energy management and auditing process.													Analyze(K4)		
CO2: Learned the about basic concepts of economic analysis and load management.													Analyze(K4)		
CO3: Able to design the effective thermal utility system													Analyze(K4)		
CO4: Able to improve the efficiency in compressed air system.													Understand(K2)		
CO5: Design concepts in the field of lighting systems, light sources and various forms of cogeneration.													Understand(K2)		
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	2	-	-	-	1	-	-		2	3	2	3
CO2	3	-	-	-	-	-	2	1	3	-	1	2	3	2	3
CO3	3	-	1	2	3	-	-	1		-	-	2	3	2	3
CO4	3	3	-	-	-	-	-	1	3	-	-	2	3	2	3
CO5	3	-	1	2	-	-	-	1		-	2	2	3	2	3

23EEE006	POWER QUALITY	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To learn the basic definitions in Power Quality. - To study the power quality issues in Single Phase and Three Phase Systems. - To understand the principles of Power System Harmonics. - To know the way to use DSTATCOM for Harmonic Mitigation. - To learn the concepts related with Series Compensation.					
Unit I	INTRODUCTION				9
Introduction – Characterization of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves — power quality problems: poor load power factor, Non-linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage — Power quality standards.					
Unit II	ANALYSIS OF SINGLE PHASE AND THREE PHASE SYSTEM				9
Single phase linear and non-linear loads — single phase sinusoidal, non-sinusoidal source — supplying linear and nonlinear loads — three phase balanced system — three phase unbalanced system — three phase unbalanced and distorted source supplying non-linear loads — concept of power factor – three phase- three wire – three phase - four wire system.					
Unit III	MITIGATION OF POWER SYSTEM HARMONICS				9

Introduction - Principle of Harmonic Filters — Series-Tuned Filters — Double Band-Pass Filters — damped Filters — Detuned Filters — Active Filters — Power Converters — Harmonic Filter Design — Tuned Filter — Second-Order Damped Filter — Impedance Plots for Filter Banks — Impedance Plots for a Three-Branch 33 kV Filter.		
Unit IV	LOAD COMPENSATION USING DSTATCOM	9
Compensating single – phase loads – Ideal three phase shunt compensator structure – generating reference currents using instantaneous PQ theory – Instantaneous symmetrical components theory – Generating reference currents when the source is unbalanced –Realization and control of DSTATCOM – DSTATCOM in Voltage control mode.		
Unit V	SERIES COMPENSATION OF POWER DISTRIBUTION SYSTEM	9
Rectifier supported DVR – DC Capacitor supported DVR – DVR Structure – Voltage Restoration – Series Active Filter – Unified Power Quality Conditioner.		
TOTAL=45 PERIODS		
LIST OF EXPERIMENTS:		
1.Harmonic analysis of single phase power converters (Semi converters and Full Converters) with R and RL load via simulation		
2.Harmonic analysis of three phase power converters (Semi converters and Full Converters) with R and RL load via simulation		
3.Harmonic analysis of single phase inverters with R and RL load via simulation		
4.Harmonic analysis of three phase inverters with R and RL load via simulation		
5.Mitigation of Harmonics using Tuned Filter		
TEXT BOOK:		
1.Arindam Ghosh and Gerard Ledwich “Power Quality Enhancement Using Custom Power Devices”, Kluwer Academic Publishers, First Edition,2002		
2.G.T.Heydt, “Electric Power Quality”, Stars in a Circle Publications, Second Edition, 2011.		
3.George J. Wakileh, “Power System Harmonics – Fundamentals, Analysis and Filter Design”, Springer – Verlag Berlin Heidelberg, New York, 2019.		
References:		
1.R.C.Duggan “Electric Power Systems Quality”, Tata MC Graw Hill Publishers, Third Edition, 2012.		
2.Arrillaga “Power System Harmonics”, John Wiley and Sons, 2003 2 nd Edition.		
3.Derek A.Paice “Power Electronic Converter Harmonics” IEEE Press, 1995, Wiley – IEE Press 1999, 18 th Edition.		
Course Outcomes:		Blooms Taxonomy
CO1: Use various definitions of power quality for power quality issues		Analyze(K4)
CO2: Describe the concepts related with single phase / three phase, linear / nonlinear loads and single phase / three phase sinusoidal, non-sinusoidal source		Analyze(K4)
CO3: Solve problems related with mitigation of Power System Harmonics		Apply(K3)
CO4: Use DSTATCOM for load compensation		Analyze(K4)

CO5: Demonstrate the role of DVR, SAFs UPQC in power distribution systems													Analyze(K4)						
CO-PO Mapping																			
Particular 23EEE007	PO1	PO2	PO3	PO4	PO5 SMART	PO6 GRID	PO7	PO8	PO9	PO10	PO11	PO12 L	Category : PEC PSO1 PSO2 PSO3						
CO1	3	3	3	3	-	-	3	3	-	3	-	3	3	3	0	3	0	3	3
Prerequisites CO2	3	3	3	3	-	-	3	3	-	3	-	3	3	3	3	3	3	3	3
Course Objectives: CO3	3	3	3	3	-	-	3	3	-	3	-	3	3	3	3	3	3	3	3
CO4	To understand the evolution of Smart and Interconnected energysystems													3	3	3			
CO5	To understand the various challenges and benefits of smart grid and the national and international initiatives taken													3	3	3	3		
- To understand the concepts related with transmission and distribution in smart grid technologies. - To get an insight of the various smart measurement technologies. - To understand the various computing technologies for Smart Operation of the Grid.																			
Unit I		INTRODUCTION																9	
Evolution of Energy Systems, Concept, Definitions and Need, Difference between Conventional & Smart Grid, Drivers, structures, functions, opportunities, challenges and benefits of Smart Grid, Basics of Micro grid, National and International Initiatives in Smart Grid.																			
Unit II		SMART METERING																9	
Introduction to Advanced Metering infrastructure (AMI) - drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Real time management and control, Phasor Measurement Unit (PMU).																			
Unit III		SMART GRID TECHNOLOGIES (Transmission)																9	
Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, Wide area Monitoring, Protection and control.																			
Unit IV		SMART GRID TECHNOLOGIES (Distribution)																9	
DMS, Volt/VAR control, Fault Detection, Isolation and service restoration, Outage management, High- Efficiency Distribution Transformers, Phase Shifting Transformers, Electric Vehicles.																			
Unit V		HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS																9	
Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Computing technologies for Smart Grid applications (Web Service to CLOUD Computing), Role of big data and IoT, Cyber Security for Smart Grid.																			
TOTAL : 45 PERIODS																			

LIST OF EXPERIMENTS:																
1.Assignment-Familiarization of National and International Initiatives in Smart Grid																
2.Simulation of smart meter using (MATLAB/ ETAP/SCILAB/ LABVIEW/ Proteus/Equivalent open source software).																
3.Visit to a substation for analysing the Automation Technologies like Monitoring, Protection and control.																
4.Awareness about High- Efficiency Distribution Transformers, Phase Shifting Transformers in a substation.																
5.Introduction to recent technologies in electric vehicles and understanding the operation of EV,HEV and PHEV.																
6.Simulation of IoT based digital communication system for smart grid applications.																
TEXT BOOK:																
1.Smart Grids Advanced Technologies and Solutions, Second Edition, Edited by Stuart Borlase,CRC, 2018.																
2.Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, John Wiley,2012																
3.James Momoh ,Smart Grid Fundamentals of Design and Analysis, IEEE press 2012.																
4.Stuart Borlase “Smart Grid : Infrastructure, Technology and Solutions”, CRC Press 2012.																
References:																
1.Ahmed F. Zobaa, Trevor J. Bihl, Big data analytics in future power systems, 1st Edition, CRC press 2018.																
2.C. Gungor et al., "Smart Grid Technologies: Communication Technologies and Standards," in IEEE Transactions on Industrial Informatics, vol. 7, no. 4, pp. 529-539, Nov. 2011.doi: 10.1109/TII.2011.2166794.																
3.X. Fang, S. Misra, G. Xue and D. Yang, "Smart Grid — The New and Improved Power Grid: A Survey," in IEEE Communications Surveys & Tutorials, vol. 14, no. 4, pp. 944- 980, Fourth Quarter 2012. doi: 10.1109/SURV.2011.101911.00087.																
4.Stuart Borlase “Smart Grid : Infrastructure, Technology and Solutions”, CRC Press 2012																
.																
Course Outcomes:														Blooms Taxonomy		
CO 1: Understand the importance and objectives of Power System Grid.														Understand(K2)		
CO2: Analyze to know and understand the concept of a smart grid														Analyze(K4)		
CO3: Analyze and identify and discuss smart metering devices and associated technologies.														Analyze(K4)		
CO4: Understand by able to get an overview of Microgrid and Electric Vehicle Technology.														Understand(K2)		
CO5: Understand by able to have an up to date knowledge on the various computing technologies; to understand the role of Big Data and IoT for effective and efficient operation of Smart Grid.														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	3	3	-	-	1	-	-	-	2	3	3	-
CO2	3	3	2	3	3	-	-	1	-	-	-	2	3	3	-
CO3	3	3	2	3	3	-	-	1	-	-	-	2	3	3	-
CO4	3	3	2	3	3	-	-	1	-	-	-	2	3	3	-
CO5	3	3	2	3	3	-	-	1	-	-	-	2	3	3	-

23EEE008	RESTRUCTURED POWER MARKET	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: Students will be able to: - Describe various types of deregulated markets in power system. - Describe the technical and non-technical issues in deregulated power industry. - Classify different market mechanisms and summarize the role of various entities in the market. - Analyze the energy and ancillary services management in deregulated power industry. - Understand the restructuring framework US and Indian power sector.					
Unit I	INTRODUCTION				9
Reasons for restructuring - Understanding the restructuring process - objectives of deregulation of various power systems across the world - Consumer behavior - Supplier behavior - Market equilibrium - Short-run and Long-run costs - Various costs of production. The Philosophy of Market Models: Market models based on contractual arrangements - Market architecture .					
Unit II	TRANSMISSION CONGESTION MANAGEMENT				9
Importance of congestion management in deregulated environment - Classification of congestion management methods - Calculation of ATC - Non-market methods - Market based methods - Nodal pricing - Inter-zonal Intra-zonal congestion management - Price area congestion management - Capacity alleviation method.					
Unit III	LOCATIONAL MARGINAL PRICES(LMP) AND FINANCIAL TRANSMISSION RIGHTS				9
Fundamentals of locational marginal pricing - Lossless DCOPF model for LMP calculation - Loss compensated DCOPF model for LMP calculation - ACOPF model for LMP calculation - Risk Hedging Functionality Of financial Transmission Rights - FTR issuance process - Treatment of revenue shortfall - Secondary trading of FTRs - Flow Gate rights - FTR and market power.					
Unit IV	ANCILLARY SERVICE MANAGEMENT AND PRICING OF TRANSMISSION NETWORK				9

Types of ancillary services - Load-generation balancing related services - Voltage control and reactive power support services - Black start capability service - Mandatory provision of ancillary services - Markets for ancillary services - Co-optimization of energy and reserve services - International comparison. Pricing of transmission network: wheeling - principles of transmission pricing - transmission pricing methods - Marginal transmission pricing paradigm - Composite pricing paradigm - loss allocation methods.																
Unit V		MARKET EVOLUTION												9		
JUS markets: PJM market - The Nordic power market - Reforms in Indian power sector: Framework of Indian power sector - Reform initiatives - availability based tariff (ABT) - The Electricity Act 2012 - Open Access issues - Power exchange.																
TOTAL :45 PERIODS																
LIST OF EXPERIMENTS:																
1.Analysis of ATC calculations using any one of the relevant software tool.																
2.DCOPF based LMP calculations using any one of the relevant software tool.																
3.ACOPF based LMP calculations using any one of the relevant software tool.																
4.Analysis of social welfare maximization with different objectives.																
5.Analysis of ABT components.																
TEXT BOOK:																
1.Mohammad Shahidehpour, Muwaffaq Alomoush, “Restructured electrical power systems: operation, trading and volatility” Marcel Dekker Pub., 2001, 1 st Edition.																
2.Kankar Bhattacharya, MathH.J.Boolen, and Jaap E.Daadler, "Operation of restructured power systems”, Kluwer Academic Pub.,2001, 1 st Edition.																
References:																
1.Sally Hunt, "Making competition work in electricity”, JohnWiley and Sons Inc. 2002.																
2.Steven Stoft, Power System Economics: Designing Markets for Electricity”, Wiley-IEEE Press, 2002.																
3.Allen. J. Wood and Bruce F. Wollen berg, ‘Power Generation, Operation and Control’, John Wiley & Sons, Inc., 2016, 3 rd Edition.																
Course Outcomes:													Blooms Taxonomy			
CO 1:describe the requirement for deregulation of the electricity market and the philosophy of various market models													Apply(K3)			
CO2:Analyze the various methods of congestion management in deregulated power system													Analyze(K4)			
CO3:Analyze the various methods of congestion management in deregulated power system													Analyze(K4)			
CO4: Analyze the ancillary service management													Analyze(K4)			
CO5: Analyze transmission pricing paradigm understand the evolution of deregulation in Indian power sector.													Analyze(K4)			
CO-PO Mapping :																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	-	-	-	-	3	2	-	-	-	-	-	2	-	2	
CO2	3	2	1	-	-	3	-	-	-	-	2	-	2	-	2	
CO3	3	2	1	-	-	3	-	-	-	-	2	-	2	-	2	

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

VERTICAL II : CONVERTERS AND DRIVES

23EEE009	SPECIAL ELECTRICAL MACHINES	Category: PEC			
		L	T	P	C
		2	0	2	3
Prerequisites					
•					
Course Objectives:					
- To understand the working of special machines like stepper motor, switched reluctance motor, BLDC motor & PMSM - To derive torque equation and study the characteristics of special machines - To design the controller for special machines - To study the working principle of synchronous reluctance motor - To simulate closed loop operation of BLDC motor					
Unit I	STEPPER MOTORS				6
Constructional features –Principle of operation –Types – Torque predictions – Linear and Non-linear analysis – Characteristics – Drive circuits – Closed loop control –Applications					
Unit II	SWITCHED RELUCTANCE MOTORS				6
Constructional features –Principle of operation- Torque prediction–Characteristics–Power controllers – Control of SRM drive- Speed control-current control-design procedures-Sensor less operation of SRM — Current sensing-rotor position measurement and estimation methods- sensor less rotor position estimation-inductance based estimation – applications.					
Unit III	PERMANENT MAGNET BRUSHLESS DC MOTORS				6
Fundamentals of Permanent Magnets- Types- Principle of operation- Magnetic circuit analysis EMF and Torque equations- Characteristics- Controller design-Transfer function –Machine, Load and Inverter-Current and Speed Controller.					
Unit IV	PERMANENT MAGNET SYNCHROUNOUS MOTORS				6
Permanent Magnet ac Machines, Machine Configurations, PMSM - Principle of operation — EMF and Torque equations - Phasor diagram - Torque speed characteristics –evaluation of control characteristics- design of current and speed controllers- Constructional features, operating principle and characteristics of synchronous reluctance motor.					
Unit V	STUDY OF OTHER SPECIAL ELECTRICAL MACHINES				6
Principle of operation and characteristics of Hysteresis motor – AC series motors – Linear motor – Applications.					

LIST OF EXPERIMENTS																
1	Simulation of BLDC motor															
2	Simulation of SRM motor															
3	Simulation of stepper motor															
4	Simulation of PMSM motor															
5	Simulation of any other special machines															
TOTAL: 30+30 = 60 PERIODS																
Text Books:																
1.																
References:																
1.Jacek F. Gieras, Dr. Rong-Jie Wang, Professor Maarten J. Kamper - Axial Flux Permanent Magnet Brushless Machines-Springer Netherlands 2008.																
2.Bilgin, Berker Emadi, Ali Jiang, James Weisheng - Switched reluctance motor drives: fundamentals to applications-CRC 2019.																
3.Ramu Krishnan - Permanent Magnet Synchronous and Brushless DC Motor Drives - CRC Press, Marcel Applications -CRC Press 2009																
4.T.Kenjo, ‘ Stepping motors and their microprocessor controls’, Oxford University press, New Delhi, 2000 Dekker 2009																
5.T.J.E. Miller, ‘Brushless magnet and Reluctance motor drives’, Clarendon press, London, 1989																
6.R. Krishnan - Switched Reluctance Motor Drives Modeling, Simulation, Analysis, Design, and Applications -CRC Press 2017.																
Course Outcomes:At the end of this course, the students will have the ability to														Blooms Taxonomy		
CO 1:Analyze to model and analyze power electronic systems and equipment using computational software.														Analyze(K4)		
CO2: Analyze to optimally design magnetics required in special machines based drive systems using FEM based software tools.														Analyze(K4)		
CO3: Analyze the dynamic performance of special electrical machines														Analyze(K4)		
CO4: Understand the operation and characteristics of other special electrical														Understand(K2)		
CO5:Design and conduct experiments towards research.														Understand(K2)		
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	-	-	-	-	-	-	1	-	1	-	1	3	2	1	

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

23EEE010	ANALYSIS OF ELECTRICAL MACHINES		Category: PEC			
			L	T	P	C
			2	0	2	3
Prerequisites						
•						
Course Objectives:						
- To model & simulate all types of DC machines - To develop reference frame equations for various elements like R, L and C - To model an induction (three phase and ‘n’ phase) and synchronous machine - To drive reference frame equations for induction and synchronous machine - To study the need and working of multiphase induction and synchronous machine						
Unit I	MODELING OF BRUSHED-DC ELECTRIC MACHINERY					6
Fundamentals of Operation – Introduction – Governing equations and modeling of Brushed DC-Motor – Shunt, Series and Compound – State model derivation – Construction of Model of a DC Machine using state equations- Shunt, Series and Compound..						
Unit II	REFERENCE FRAME THEORY					6
Historical background – phase transformation and commutator transformation – transformation of variables from stationary to arbitrary reference frame .						
Unit III	INDUCTION MACHINES					6
Three phase induction machine - equivalent circuit– free acceleration characteristics – voltage and torque equations in machine variables and arbitrary reference frame variables – Simulation under no- load and load conditions- Machine variable form, arbitrary reference variable form.						
Unit IV	SYNCHRONOUS MACHINES					6
Three phase synchronous machine - voltage and torque equations in machine variables and rotor reference frame variables (Park’s equations).						
Unit V	MULTIPHASE (MORE THAN THREE-PHASE) MACHINES CONCEPTS					6
Preliminary Remarks - Necessity of Multiphase Machines - Evolution of Multiphase Machines-Advantages of Multiphase Machines - Working Principle - Multiphase Induction Machine, Multiphase Synchronous Machine -Modeling of ‘n’ phase machine. Applications of Multiphase Machines						
LIST OF EXPERIMENTS						
1	1.Modeling of DC machines.					
2	2.Simulation under no-load and loaded conditions for a PMDC motor					
3	3.Simulation of smooth starting for DC motor.					

4	4.Simulation under no-load and load conditions of a three phase induction machine in machine variable form and arbitrary reference variable form.														
5	5.Simulation under no-load and load conditions of a three phase synchronous machine in machine variable form and arbitrary reference variable form.														
TOTAL: 30+30 = 60															
Text Books:															
1.															
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, 1 st Edition.															
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.R. Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Pearson Education, 1 st Imprint, 2015, 1 st Edition.															
5.R.Ramanujam, Modeling and Analysis of Electrical Machines, I.k.International Publishing House Pvt.Ltd,2018.															
6.hee Mun Ong, Dynamic Simulation of Electric Machinery using MATLAB, Prentice Hall, 1997, 1st Edition.															
7.Atif Iqbal,Shaikh Moinoddin, Bhimireddy Prathap Reddy, Electrical Machine Fundamentals with Numerical Simulation using MATLAB/SIMULINK, Wiley,2021,1 st Edition															
Course Outcomes:At the end of this course, the students will have the ability to													Blooms Taxonomy		
CO 1:.Find the modeling for a brushed DC-Motor(Shunt, Series, Compound and separately excised motor) and to simulate DC motors using state models													Analyze(K4)		
CO2:Apply reference frame theory for, resistive and reactive elements (three phase)													Apply(K3)		
CO3:Compute the equivalent circuit and torque of three phase induction motor and synchronous motor in machine variable arbitrary reference frame variable													Understand(K2)		
CO4:.Find the need and advantages of multiphase machines													Analyze(K4)		
CO5:Demonstrate the working of multiphase induction and synchronous machine.Compute the model of three phase and multiphase induction and synchronous machine.													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	3	-	2	1	-	3	-	2	3	3	3

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

23EEE011	MULTILEVEL POWER CONVERTERS			Category: PEC			
				L	T	P	C
				2	0	2	3
Prerequisites							
Course Objectives: - To learn multilevel topology (Symmetry & Asymmetry) with common DC bus link. - To study the working of cascaded H Bridge, Diode Clamped and Flying Capacitor MLI. - To study the working of MLI with reduced switch count. - To simulate three level diode clamped MLI and three level flying capacitor based MLI with resistive and reactive load - To simulate the MLI with reduced switch count.							
Unit I	MULTILEVEL TOPOLOGIES					6	
Introduction – Generalized Topology with a Common DC bus – Converters derived from the generalized topology – symmetric topology without a common DC link – Asymmetric topology.							
Unit II	CASCADED H-BRIDGE MULTILEVEL INVERTERS					6	
Introduction -H-Bridge Inverter, Bipolar Pulse Width Modulation, Unipolar Pulse Width Modulation. Multilevel Inverter Topologies, CHB Inverter with Equal DC Voltage, H-Bridges with Unequal DC Voltages – PWM, Carrier-Based PWM Schemes, Phase-Shifted Multicarrier Modulation, Level- Shifted Multicarrier Modulation, Comparison Between Phase- and Level-Shifted PWM Schemes- Staircase Modulation							
Unit III	DIODE CLAMPED MULTILEVEL CONVERTER					6	
Introduction – Converter structure and Functional Description – Modulation of Multilevel converters – Voltage balance Control – Effectiveness Boundary of voltage balancing in DCMC converters – Performance results.							
Unit IV	FLYING CAPACITOR MULTILEVEL CONVERTER					6	
Introduction – Flying Capacitor topology – Modulation scheme for the FCMC – Dynamic voltage balance of FCMC.							
Unit V	MULTILEVEL CONVERTER WITH REDUCED SWITCH COUNT					6	
Multilevel inverter with reduced switch count-structures, working principles and pulse generation methods.							
LIST OF EXPERIMENTS							
1	Simulation of Fixed PWM, Sinusoidal PWM for an inverter,						

2	Simulation of H bridge inverter with R load .														
3	Simulation of three level diode clamped MLI with R load.														
4	Simulation of three level capacitor clamped MLI with R load														
5	Simulation of MLI with reduced switch configuration.														
Total periods:30+30=60															
Text Books:															
1.															
References:															
1.Thomas A. Lipo, Pulse Width Modulation for Power Converters: Principles and Practice, D.Grahame Holmes, John Wiley & Sons, Oct-2003, 1 st Edition.															
2.Fang Lin Luo, Hong Ye,Advanced DC/AC Inverters: Applications in Renewable Energy, CRC Press, 22-Jan-2013, 2017, 1 st Edition.															
3.Hani Vahedi, Mohamed Trabelsi, Single-DC-Source Multilevel Inverters, Springer, 2019, 1 st Edition.															
4.Ersan Kabalcı, Multilevel Inverters Introduction and Emergent Topologies, Academic Press Inc,2021, 1 st Edition.															
5.Iftekhar Maswood, Dehghani Tafti,Advanced Multilevel Converters and Applications in Grid Integration, Wiley, 2018, 1 st Edition.															
Course Outcomes:At the end of this course, the students will have the ability to														Blooms Taxonomy	
CO 1:.Examine the different topologies of multilevel inverters (MLIs) with and without DC link capacitor.														Analyze(K4)	
CO2:Examine the performance of MLIs with Bipolar Pulse Width Modulation (PWM) Unipolar PWM Carrier-Based PWM Schemes Phase Level Shifted Multicarrier Modulation														Analyze(K4)	
CO3:Demonstrate the working principles of Cascaded H-Bridge MLI, diode clamped MLI, flying capacitor MLI and MLI with reduced switch count														Analyze(K4)	
CO4: Analyze the voltage balancing performance in Diode clamped MLI.														Analyze(K4)	
CO5: Simulate three level, capacitor clamed and diode clamped MLI with R and RL load. Simulate MLI with reduced switch configuration using fundamental switching scheme														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	3	-	-	2	1	-	3	-	3	3	3	3
CO2	3	2	2	3	-	-	2	1	-	3	-	3	3	3	3
CO3	3	2	2	3	-	-	2	1	-	3	-	3	3	3	3
CO4	3	3	3	3	-	-	2	1	-	3	-	3	3	3	3

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

23EEE012	ELECTRICAL DRIVES	Category: PEC			
		L	T	P	C
		2	0	2	3
Prerequisites					
•					
Course Objectives:					
At the end of the course, students should have the:					
To understand steady state operation and transient dynamics of a motor load system.					
• To study and analyze the operation of the converter / chopper fed dc drive, both qualitatively and quantitatively.					
• To study and understand the operation and performance of AC Induction motor drives.					
• To study and understand the operation and performance of AC Synchronous motor drives.					
• To analyze and design the current and speed controllers for a closed loop solid state DC motor drives.					
Unit I	DRIVE CHARACTERISTICS				6
Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, starting & stopping – typical load torque characteristics – Selection of motor.					
Unit II	CONVERTER / CHOPPER FED DC MOTOR DRIVE				6
Steady state analysis of the single and three phase converter fed separately excited DC motor drive – continuous and discontinuous conduction – Time ratio and current limit control – 4 quadrant operation of converter / chopper fed drive.					
UNIT III	INDUCTION MOTOR DRIVES				6
Stator voltage control – energy efficient drive – v/f control – constant air gap flux – field weakening mode – voltage / current fed inverter – closed loop control,					
Unit IV	SYNCHRONOUS MOTOR DRIVES				6
V/f control and self-control of synchronous motor: Margin angle control and power factor control – permanent magnet synchronous motor.					
Unit V	DESIGN OF CONTROLLERS FOR DRIVES				6
Transfer function for DC motor / load and converter – closed loop control with current and speed feedback – armature voltage control and field weakening mode – design of controllers; current controller and speed controller-converter selection and characteristics.					
TOTAL=30 PERIODS					

LIST OF EXPERIMENTS															
1	Simulation of converter and chopper fed DC drive														
2	Simulation of closed loop operation of stator voltage control of induction motor drive														
3	Simulation of closed loop operation of v/f control of induction motor drive														
4	Simulation of synchronous motor drive														
Total periods:30+30=60															
Text Books:															
1.Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 2 nd Edition January 2010.															
2.Bimal K.Bose. Modern Power Electronics and AC Drives, Pearson Education, 2002 1 st Edition.															
References:															
1.S.K.Pillai, A First course on Electrical Drives, Wiley Eastern Limited, 3 rd Edition 2012.															
2.Murphy J.M.D and Turnbull, Thyristor Control of AC Motor, Pergamon Press, Oxford 1988, 1 st Edition.															
3.Gopal K.Dubey, Power semiconductor controlled Drives, Prentice Hall Inc., New Jersey,1989, 1 st Edition.															
Course Outcomes:At the end of this course, the students will have the ability to													Blooms Taxonomy		
CO 1:. Understand the basic requirements of motor selection for different load profiles.													Understand(K2)		
CO2: Analyse the steady state behavior and stability aspects of drive systems.													Analyze(K4)		
CO3:Analyse the dynamic performance of the DC drive using converter and chopper control.													Analyze(K4)		
CO4: Simulate the AC drive.													Analyze(K4)		
CO5:Design the controller for electrical drives.													Analyze(K4)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	-	-	1	-	-	-	2	3	3	2
CO2	3	2	2	3	3	-	-	1	-	-	-	2	3	3	2
CO3	3	2	2	3	3	-	-	1	-	-	-	2	3	3	3
CO4	3	2	2	3	3	-	-	1	-	-	-	2	3	3	3
CO5	3	2	2	3	3	-	-	1	-	-	-	2	3	3	3

23EEE013	SMPS AND UPS		Category: PEC			
			L	T	P	C
			2	0	2	3
Prerequisites						
•						
Course Objectives:						
- To learn the working of isolated & non-isolated DC-DC converters - To design isolated & non-isolated DC-DC converters. - To drive the equations related with converter dynamics. - To design and simulate P, PI & PID controller for buck, boost and buck-boost converters. - To identify and study different configurations of the UPS.						
Unit I	ANALYSIS OF NON-ISOLATED DC-DC CONVERTERS					6
Basic topologies: Buck, Boost and Buck-Boost - Principles of operation – Continuous conduction mode– Concepts of volt-sec balance and charge balance – Analysis and design based on steady- state relationships – Introduction to discontinuous conduction mode.						
Unit II	ANALYSIS OF ISOLATED DC-DC CONVERTERS					6
Introduction - classification- forward- flyback- pushpull – half bridge – full bridge topologies- C’uk converter as cascade combination of boost followed by buck – isolated version of C’uk converter - design of SMPS – Introduction to design of magnetic components for SMPS, using relevant software- Simulation of bidirectional DC DC converter (both non-isolated and isolated) considering EV as an example application.						
Unit III	CONVERTER DYNAMICS					6
AC equivalent circuit analysis – State space averaging – Circuit averaging – Transfer function model for buck, boost and buck-boost converters – Simulation of basic topologies using state space model derived – Comparison with the circuit model based simulation already carried out.						
Unit IV	CONTROLLER DESIGN					6
Review of P, PI, and PID control concepts – gain margin and phase margin – Bode plot based analysis – Design of controller for buck, boost and buck-boost converters						
Unit V	POWER CONDITIONERS AND UPS					6
Introduction – Power line disturbances – Power conditioners – UPS: Offline and On-line – Need for filters – Filter for PWM VSI – Front-end battery charger – boost charger.						
LIST OF EXPERIMENTS						

1	Simulation of Basic topologies.														
2	Simulation of bidirectional DC DC converter (both non-isolated and isolated) considering.														
3	Simulation of basic topologies using state space model derived — Comparison with the circuit model based simulation already carried out.														
4	Simulation study of controller design for basic topologies.														
5	Simulation of battery charger for EV applications.														
Total periods:30+30=60															
Text Books:															
1.Robert W. Erickson & Dragon Maksimovic, ” Fundamentals of Power Electronics”, Third Edition, 2020															
2.Ned Mohan,” Power Electronics: A First Course”, Johnwiley, 2013.															
3.Marian K. Kazimierczuk and Agasthya Ayachit,”Laboratory Manual for Pulse-Width Modulated DC— DC Power Converters”, Wiley 2016.															
4.Power Electronics handbook, Industrial Electronics series, S.K.Varenina, CRC press, 2002.															
5.Power Electronic Converters, Teuvo Suntio, Tuomas Messo, Joonas Puukko, First Edition 2017.															
References:															
1.															
Course Outcomes:At the end of this course, the students will have the ability to													Blooms Taxonomy		
CO 1:.Demonstratethe working of buck boost and buck- boostconverters in continuous and discontinuous conduction mode.													Analyze(K4)		
CO2:Build buck/boost converters using suitable design method.													Apply(K3)		
CO3:Analyze the behaviors of isolated DC-DC converters and to design SMPS for battery operated vehicle.													Analyze(K4)		
CO4: Compute state space averaged model and transfer function for buck, boost and buck- boost converters.													Apply(K3)		
CO5:Demonstrate the P, PI and PID controller performance analytically and by simulation for buck boost and buck- boost converters. Compare the different topologies of UPS and also simulate them.													Analyze(K4)		
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	3	3	3
CO2	3	3	3	3	-	-	3	3	-	2	-	3	3	3	3
CO3	3	3	3	3	-	-	3	-	-	3	-	3	3	3	3

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

23EEE014	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	Category: PEC			
		L	T	P	C
		2	0	2	3
Prerequisites					
•					
Course Objectives:					
- To learn the various types of renewable sources of energy. - To understand the electrical machines to be used for wind energy conversion systems. - To learn the principles of power converters used in solar PV system. - To study the principle of power converters used in Wind system. - To simulate the AC-DC, AC-AC Converters, Matrix Converters and PWM Inverters.					
Unit I	INTRODUCTION TO RENEWABLE ENERGY SYSTEMS				6
Classification of Energy Sources – Importance of Non-conventional energy sources – Advantages and disadvantages of conventional energy sources - Environmental aspects of energy - Impacts of renewable energy generation on the environment - Qualitative study of renewable energy resources: Ocean energy, Biomass energy, Hydrogen energy, - Solar Photovoltaic (PV), Fuel cells: Operating principles and characteristics, Wind Energy: Nature of wind, Types, control strategy, operating area.					
Unit II	ELECTRICAL MACHINES FOR WIND ENERGY CONVERSION SYSTEMS 6 (WECS)				6
Construction, Principle of operation and analysis: Squirrel Cage Induction Generator (SCIG), Doubly Fed Induction Generator (DFIG) - Permanent Magnet Synchronous Generator (PMSG).					
Unit III	POWER CONVERTERS AND ANALYSIS OF SOLAR PV SYSTEMS				6
Power Converters: Line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing. Simulation of line commutated converters, buck/boost converters. Analysis: Block diagram of the solar PV systems - Types of Solar PV systems: Stand-alone PV systems, Grid integrated solar PV Systems - Grid Connection Issues.					
Unit IV	POWER CONVERTERS FOR WIND SYSTEMS				6
Power Converters: Three-phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid-Interactive Inverters - Matrix converter.					
Unit V	HYBRID RENEWABLE ENERGY SYSTEMS				9
Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Diesel-PV, Wind- PV, Micro hydel-PV, Biomass-Diesel systems - Maximum Power Point Tracking (MPPT).					
LIST OF EXPERIMENTS					
1	Simulation on modelling of Solar PV System- V I Characteristics				

2	Simulation on Modelling of fuel cell- V I Characteristics														
3	Simulation of self- excited Induction Generator.														
4	Simulation of DFIG/ PMSG based Wind turbine.														
5	Simulation on Grid integration of RES.														
Total periods:30+30=60															
Text Books:															
1.															
References:															
1.S.N.Bhadra, D. Kastha, & S. Banerjee “Wind Electrical Systems”, Oxford University Press, 2009, 7 th impression.															
2.Rashid .M. H “Power electronics Hand book”, Academic press,2 nd Edition, 2006 4 th Edition, 2017															
3.Rai. G.D, “Non-conventional energy sources”, Khanna publishers, 6 th Edition, 2017.															
4.Rai. G.D,” Solar energy utilization”, Khanna publishers, 5 th Edition, 2008.															
5.Gray, L. Johnson, “Wind energy system”, prentice hall of india, 2 nd Edition, 2006.															
6.H.Khan "Non-conventional Energy sources ",Tata McGraw-hill Publishing Company, New Delhi, 2017, 3 rd Edition.															
Course Outcomes:At the end of this course, the students will have the ability to															
CO 1:. Examine the available renewable energy sources.													Blooms Taxonomy		
CO2:Demonstrate the working principles of electrical machines and power converters used for wind energy conversion system													Analyze(K4)		
CO3:Demonstrate the principles of power converters used for solar PV systems													Analyze(K4)		
CO4: Examine the available hybrid renewable energy systems.													Analyze(K4)		
CO5:Simulate AC-DC converters, buck/boost converters, AC-AC converters and PWM inverters.													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	-	2	3	3	3
CO2	3	-	2	-	-	-	-	-	-	2	-	2	3	3	3
CO3	3	-	2	-	-	-	-	-	-	2	-	2	3	3	3
CO4	3	-	3	-	-	-	-	-	-	2	-	2	3	3	3
CO5	3	3	2.2	3	3	-	-	3	-	2	-	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23EEE015	CONTROL OF POWER ELECTRONICS CIRCUITS	Category: PEC			
		L	T	P	C
		2	0	2	3
Prerequisites					
Course Objectives: - To learn the basics of control system simulation. - To do symbolic calculation. - To study the principles of sliding mode control and the way of apply smc for buck converter. - To learn the concept of power factor correction. - To design simulate smc for buck converter and power factor correction circuit with controller.					
Unit I	SIMULATION BASICS IN CONTROL SYSTEMS				6
Transfer Function-How to build transfer function, identify Poles, zeros, draw time response plots, bode plot (Bode Plots for Multiplication Factors, Constant, Single and Double Integration Functions, Single and Double Differentiation Functions, Single Pole and Single Zero Functions, RHP Pole and RHP Zero Functions), state space modelling-transfer function from state space Model.					
Unit II	SYMBOLIC CALCULATIONS				6
Symbolic Variables - Symbolic Vector Variables, Commands for Handling Polynomial Expressions-Extracting Parts of a Polynomial -. Factorization and Roots of Polynomials, Symbolic Matrix Algebra - Operations with Symbolic Matrices - Other Symbolic Matrix Operations.					
Unit III	SLIDING MODE CONTROL BASICS				6
Introduction- Introduction to Sliding-Mode Control- Basics of Sliding-Mode Theory- Application of Sliding-Mode Control to DC-DC Converters—Principle-Sliding mode control of buck converter.					
Unit IV	POWER FACTOR CORRECTION CIRCUITS				6
Introduction, Operating Principle of Single-Phase PFCs, Control of boost converter based PFCs, Designing the Inner Average-Current-Control Loop, Designing the Outer Voltage-Control Loop, Example of Single-Phase PFC Systems.					
Unit V	CONTROLLER DESIGN FOR PFC CIRCUITS				6
Power factor correction circuit using other SMPS topologies: C’uk and SEPIC converter - PFC circuits employing bridgeless topologies.					
LIST OF EXPERIMENTS					

1	Simulation exercises on zero, first and second order basic blocks														
2	Simulation exercises based on symbolic calculations.														
3	Simulation of Sliding mode control based buck converter.														
4	Simulation of Single-Phase PFC circuit employing boost converter.														
5	Simulation of Single-Phase PFC circuit employing C’uk converters.														
Total periods:30+30=60															
Text Books:															
1.Feedback Control problems using MATLAB and the Control system tool box By Dean Frederick and Joe Chow, 2000, 1 st Edition, Cengage Learning.															
2.Ned Mohan,”Power Electronics: A First Course”, Johnwiley, 2013, 1 st Edition															
3.Marian K. Kazimierczuk and AgasthyaAyachit,”Laboratory Manual for Pulse-Width Modulated DC-DC Power Converters”, Wiley 2016, 1 st Edition.															
4.Power Electronics handbook, Industrial Electronics series, S.K.Varenina, CRC press, 2002, 1 st Edition.															
References:															
1.Sliding mode control for Switching Power Converters:, Techniques and Implementation, Slew-Chong Tan, Yuk Ming Lai Chi-Kong Tse, 1 st Edition, CRC Press.															
2.Andre Kislovski, “Dynamic Analysis of Switching-Mode DC/DC Converters”, Springer 1991.															
3.MATLAB Symbolic Algebra and Calculus Tools, Lopez Cesar, Apress, 2014.															
Course Outcomes:At the end of this course, the students will have the ability to													Blooms Taxonomy		
CO 1:Calculate transfer function for constant, differential, integral, First order and Second order factors.													Analyze(K4)		
CO2:Illustrate the effect of poles and zero’s in the ‘s’ plane.													Understand(K2)		
CO3:Select Symbolic equations for solving problems related with Matrices, Polynomial and vectors.													Understand(K2)		
CO4:Compute the control expression for DC – DC buck converter using sliding mode control theory.													Apply(K3)		
CO5:Determine the controller expression for power factor correction circuits.`													Analyze(K4)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	-	1	-	2	-	3	3	3	3
CO2	3	3	3	3	3	-	-	1	-	2	-	3	3	3	3
CO3	3	3	3	3	3	-	-	1	-	2	-	3	3	3	3
CO4	3	3	3	3	3	-	-	1	-	2	-	3	3	3	3
CO5	3	3	3	3	3	-	-	1	-	2	-	3	3	3	3

VERTICAL III : EMBEDDED SYSTEMS

23EEE016	EMBEDDED SYSTEM DESIGN	Category: PEC			
		L	T	P	C
		2	0	2	3
Prerequisites					
Course Objectives: - To introduce the Building Blocks of an embedded System and Software Tools - To emphasize the role of Input/output interfacing with Bus Communication protocol. - To illustrate the ISR and scheduling for the multitasking process. - To explain the basics of a Real-time operating system - To analyze the applications based on embedded design approaches					
Unit I	INTRODUCTION TO EMBEDDED SYSTEMS				6
Introduction to Embedded Systems –Structural units in Embedded processor, selection of processor & memory devices- DMA — Memory management methods- Timer and Counting devices, Real Time Clock, In-circuit emulator, Target Hardware Debugging.					
Unit II	EMBEDDED NETWORKING				6
Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols RS232 standard – RS485 – CAN Bus- Serial Peripheral Interface (SPI) – Inter- Integrated Circuits (I2C).					
Unit III	INTERRUPTS THE SERVICE MECHANISM AND DEVICE DRIVER				6
Programmed-I/O busy-wait approach without interrupt service mechanism-ISR concept-interrupt sources – multiple interrupts – context and periods for context switching, interrupt latency and deadline – Introduction to Device Drivers.					
Unit IV	RTOS-BASED EMBEDDED SYSTEM DESIGN				6
Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication- shared memory, message passing- Interprocess Communication- Introduction to process synchronization using semaphores.					
Unit V	EMBEDDED SYSTEM APPLICATION DEVELOPMENT				6
Embedded Product Development Life Cycle - Case Study: Precision Agriculture- Autonomous car.					
LIST OF EXPERIMENTS					

1	Laboratory exercise: Use any Embedded processor/IDE/open source platform to give hands-on training on basic concepts of embedded system design: a) Introduction to IDE and Programming Environment. b) Configure timer block for signal generation (with given frequency). c) Interrupts programming example using GPIO. d) I²C communication with peripherals e) Master-slave communication between processors using SPI. f) Networking of processor using Wi-Fi. Basic RTOS concept and programming														
2	Assignment: Introduction to VxWorks, μC/OS-II, RT Linux														
3	Embedded systems-based Mini project.														
TOTAL PERIODS :30															
Text Books:															
1.Rajkamal, ‘Embedded system-Architecture, Programming, Design, McGraw-Hill Edu, 3 rd edition 2017															
2.Peckol, “Embedded system Design”, John Wiley & Sons,2010.															
References:															
1.Shibu. K.V, “Introduction to Embedded Systems”, TataMcgraw Hill, 2 nd edition 2017.															
2.Lya B.Das,” Embedded Systems” ,Pearson Education, 1 st edition 2012.															
3.Parag H.Dave,Himanshu B.Dave,” Embedded Systems-Concepts ,Design and Programming, Pearson Education,2015, 1 st edition.															
4.Elicia White, “Making Embedded systems”, O’Reilly Series ,SPD,2011, 1 st edition.															
5.Jonathan W. Valvano, ‘Embedded Microcomputer Systems Real-time Interfacing’, Cengage Learning , 3 rd edition 2010.															
6.Tammy Noergaard, “Embedded Systems Architecture”, Newnes, 2 nd edition, 2013.															
Course Outcomes: At the end of this course, the students will have the ability to														Blooms Taxonomy	
CO 1: Hardware functionals and software strategies required to develop various Embedded systems														Understand(K2)	
CO2: Understand the basic differences between various Bus communication standards														Understand(K2)	
CO3: Incorporation of the interface as Interruptservices														Analyze(K4)	
CO4: Various scheduling algorithms through a Real-time operating system.														Understand(K2)	
CO5: Various embedded concepts for developing automation applications.														Analyze(K4)	
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	-	-	-	-	-	-	-	2	2	3

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

23EEE017	EMBEDDED C- PROGRAMMING	Category: PEC			
		L	T	P	C
		2	0	2	3
Prerequisites					
Course Objectives: - To expose the students to the fundamentals of embedded Programming - To Introduce the GNU C Programming Tool Chain. - To study the basic concepts of embedded C. - To teach the basics of 8051 Programming - To involve Discussions/ Practice/Exercise in revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.					
Unit I	BASIC C PROGRAMMING				6
Typical C Program Development Environment - Introduction to C Programming - Structured Program Development in C - Data Types and Operators - C Program Control - C Functions - Introduction to Arrays.					
Unit II	EMBEDDED C				6
Adding Structure to ‘C’ Code: Object-oriented programming with C, Header files for Project and Port, Examples. Meeting Real-time constraints: Creating hardware delays - Need for timeout mechanism - Creating loop timeouts - Creating hardware timeouts.					
Unit III	8051 Programming in C				6
Data types and time delay in 8051, I/O programming in 8051, Logic operations in 8051, Data conversion program in 8051 Accessing code ROM space in 8051, Data serialization using 8051					
Unit IV	8051 SERIAL PORT AND INTERRUPT PROGRAMMING IN C				6
Basics of serial communication, 8051 interface to RS232- serial port programming in 8051. 8051 interrupts and programming, Programming for timer configuration.					
Unit V	8051 INTERFACING				6
8051: ADC interfacing , DAC interfacing, Sensor interfacing, LCD interfacing, Stepper motor interfacing.					
LIST OF EXPERIMENTS					

1	1. Laboratory exercise: Use 8051 microcontroller/Embedded processor/IDE/open source platform to give hands-on training on Embedded C- programming. a. Introduction to IDE (like code blocks, vscode ,etc)and Programming Environment (like Keililu vision, Proteus) b. Configuring an I/O port using bitwise programming. c. Configuring timer for generating hardware delay. d. Flashing an LED using an interrupt e. Serial communication using UART port of 8051 f. Interfacing an ADC with 8051 g. Interfacing an analog sensor with 8051 h. Interfacing 16x2 LCD with 8051 i. configuring timer for generating PWM signal j. Interfacing a stepper motor with 8051
2	Assignment: Introduction to Arduino IDE, Raspberry Pi
3	Embedded C-Programming -based Mini project.
Total periods:30	
Text Books:	
1.Paul Deitel and Harvey Deitel, “C How to Program”, 9th Edition, Pearson Education Limited, 2022, 1 st edition.	
2.Michael J Pont, "Embedded C", Addison-Wesley, An imprint of Pearson Education, 2002.	
3.William von Hagen, "The Definitive Guide to GCC", 2nd Edition, Apress Inc., 2006.	
4.Gowrishankar S and Veena A, "Introduction to Python Programming", CRC Press, Taylor & Francis Group, 2019.	
References:	
1.Noel Kalicharan, "Learn to Program with C", Apress Inc., 2015, 1 st edition.	
2.Steve Oualline, "Practical C programming", O'Reilly Media, 1997, 3 rd edition.	
3.Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, ‘The 8051 Microcontroller and Embedded Systems’ Prentice Hall, 2 nd Edition 2007.	
4.Myke Predko, “Programming and customizing the 8051 microcontrollers”,McGraww Hill 2000, 1 st edition.	
Course Outcomes: At the end of this course, the students will have the ability to	
CO 1: Deliver insight into embedded C programming and its salient features for embedded systems.	Blooms Taxonomy Analyze(K4)
CO2: llustrate the software and hardware architecture for distributed computing in embedded systems	Analyze(K4)
CO3: Develop a solution for problems by using the concep tlearnednt in programming using the embedded controllers	Analyze(K4)
CO4: Develop simple applications with 8051 by using its various features and interfacing with various external hardware.	Analyze(K4)
CO5: Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded programming skills.	Understand(K2)
CO-PO Mapping	

Particulars	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23EEE018 CO1	1	1	2	EMBEDDED PROCESSORS						-	-	Category: PEC			
				L	T	P	C								
				2	0	1	3	3							
CO2	1	1	2	2	1	-	-	-	-	-	-	2	0	1	3
Prerequisites															
CO3	2	2	3	2	3	-	-	-	-	-	-	-	2	3	3
Course Objectives:	2	3	2	3	-	-	-	-	-	-	-	-	1	1	1
CO4	3	2	1	2	1	-	-	-	-	-	-	-	2	3	2
CO5	• To introduce the architecture of the ARM processor. • To train students in ARM programming. • To discuss memory management, append location development with an ARM processor. • To involve Discussions/ Practice/Exercise in revising & familiarizing the concepts • To impart the knowledge on single board embedded processors.														
Unit I	ARM ARCHITECTURE														6
Architecture – Memory Organization – addressing modes -Registers – Pipeline - Interrupts – Coprocessors – Interrupt Structure															
Unit II	ARM MICROCONTROLLER PROGRAMMING														6
ARM general Instruction set – Thumb instruction set –Introduction to DSP on ARM- basic programming.															
Unit III	PERIPHERALS OF ARM														6
ARM: I/O Memory – EEPROM – I/O Ports – SRAM –Timer –UART - Serial Communication with PC – ADC/DAC Interfacing-stepper motor interfacing															
Unit IV	ARM COMMUNICATION														6
ARM With CAN, I2C, and SPI protocols															
Unit V	INTRODUCTION TO SINGLE BOARD EMBEDDED PROCESSOR														6
Raspberry Pi Architecture - Booting Up RPi- Operating System and Linux Commands -Working with RPi using Python and Sensing Data using Python-programming - GPIO and interfacing peripherals With Raspberry Pi.															
TOTAL=30 PERIODS															
LIST OF EXPERIMENTS (30)															
1	Laboratory exercise: a) Programming with IDE - ARM microcontroller b) Advanced Timer Features, PWM Generator. c) RTC interfacing with ARM using Serial communication														

	programming, Stepper motor control. d) ARM-Based Wireless Environmental Parameter Monitoring System displayed through Mobile device.														
2	Seminar: e) ARM and GSM/GPS interfacing f) Introduction to ARM Cortex Processor														
3	Raspberry Pi based Mini project.														
Total periods:30+30=60															
Text Books:															
1.Steve Furber, ‘ARM system on chip architecture’,Addisonn Wesley,2 nd Edition,2015.															
2.Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield’s ARM System Developer’s Guide Designing and Optimizing System Software’, Elsevier 2004, 1 st Edition.															
References:															
1.William Hohl, ‘ ARMAseembly Language’ Fundamentals and Techniques, CRC Press, 2 nd Edition 2014.															
2.Rajkamal,” Microcontrollers Architecture, Programming, Interfacing, & System Design, Pearson,2012, 2 nd Edition.															
3.ARM Architecture Reference Manual, LPC214x User Manual www.Nuvoton .com/websites on Advanced ARM Cortex Processors															
4.ARM System Developer’s Guide: Designing and Optimizing System Software 1st Edition (Designing and Optimizing System Software) Publisher: Morgan Kaufmann Publishers, 2011.															
Course Outcomes: At the end of this course, the students will have the ability to													Blooms Taxonomy		
CO 1: .Interpret the basics and functionality of processor functional blocks.													Analyze(K4)		
CO2: Observe the specialty of RISC processor Architecture.													Analyze(K4)		
CO3: Incorporate the I/O hardware interface of processor with peripherals.													Understand(K2)		
CO4: Emphasis the communication features of the processor.													Understand(K2)		
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in commercial embedded processors.													Apply(K3)		
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	-	-	-	-	-	-	-	2	1	2
CO2	1	1	2	2	1	-	-	-	-	-	-	-	1	2	2
CO3	3	2	3	2	3	-	-	-	-	-	-	-	3	3	3
CO4	3	2	3	2	3	-	-	-	-	-	-	-	2	3	3
CO5	3	2	1	2	1	-	-	-	1	-	-	-	1	2	2

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

23EEE019	EMBEDDED CONTROL FOR ELECTRIC DRIVES	Category: PEC			
		L	T	P	C
		2	0	2	3
Prerequisites					
Course Objectives: - To provide the control concept for electrical drives - To emphasize the need of embedded systems for controlling the electrical drives - To provide knowledge about various embedded system-based control strategies for electrical drives - To Impart the knowledge of optimization and machine learning techniques used for electrical drives - To familiarize the high-performance computing for electrical drives.					
Unit I	INTRODUCTION TO ELECTRIC DRIVES				6
Electric drives and its classification-Four-quadrant drive-Solid State Controlled Drives-Machine learning and optimization techniques for electrical drives.					
Unit II					6
Embedded Processors choice for motor control- Sensors and interface modules for Electric drives-IoT for Electrical drives applications					
Unit III	INDUCTION MOTOR CONTROL				6
Speed control methods-PWM techniques- VSI fed three-phase induction motor- Fuzzy logic Based speed control for three-phase induction motor- Embedded processor based three phase induction motor speed control.					
Unit IV	BLDC MOTOR CONTROL				6
Overview of BLDC Motor -Speed control methods -PWM techniques- Embedded processor based BDLc motor speed control.					
Unit V	SRM MOTOR CONTROL				6
Overview of SRM Motor -Speed control methods -PWM techniques- Embedded processor based SRM motor speed control.					
LIST OF EXPERIMENTS					
1	Laboratory exercise: Use any System level simulator/MATLAB/open				

	source platform to give hands-on training on simulation study on Electric drives and control. a. Simulation of four quadrant operation and speed control of DC motor b. Simulation of 3-phase inverter. c. Simulation of Speed control of Induction motor using any suitable software package. d. Simulation of Speed control of BLDC motor using any suitable software package. e. Simulation of Speed control of SRM using any suitable software package														
2	Seminar: IoT-based Control and Monitoring for DC Motor/ any Electric drives.														
TOTAL PERIODS :30+30=60															
Text Books:															
1.R.Krishnan, “Electric Motor Drives – Modeling, Analysis and Control”,Prentice-Hall of India Pvt. Ltd., New Delhi,2010, 1 st Edition.															
2.Steve Kilts, "Advanced FPGA Design: Architecture, Implementation, and Optimization" Willey, 2007, 1 st Edition.															
References:															
1.VedamSubramanyam, “Electric Drives – Concepts and Applications”, Tata McGraw- Hill publishing company Ltd., New Delhi, 2002, 2 nd Edition.															
2.K. Venkataratnam ,Special Electrical Machines, Universities Press, 2014, 1 st Edition.															
3.Steve Furber, ‘ARM system on chip architecture’, Addison Wesley, 2 nd Edition 2015.															
4.Ron Sass and AnderewG.Schmidt, “ Embedded System design with platform FPGAs: Principles and Practices”, Elsevier, 2010, 1 st Edition.															
5.Tim Wescott , Applied Control Theory for Embedded Systems , Elsevier, 2006, 1 st Edition.\															
Course Outcomes: At the end of this course, the students will have the ability to													Blooms Taxonomy		
CO 1:Interpret the significance of embedded control of electrical drive:													Analyze(K4)		
CO2:Deliver insight into various control strategies for electrical drives.													Understand(K2)		
CO3:: Developing knowledge of Machine learning and optimization techniques for motor control													Understand(K2)		
CO4:Develop embedded system solutions for real-time application such as Electric vehicles and UAVs.													Apply(K3)		
CO5:: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded system skills required for motor control strategy.													Understand(K2)		
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	-	-	-	-	-	-	-	2	1	2
CO2	2	1	3	2	1	-	-	-	-	-	-	-	2	1	2
CO3	3	2	3	3	3	-	-	-	-	-	-	-	1	3	3
CO4	3	2	3	3	3	-	-	-	-	-	-	-	3	3	3
CO5	3	2	1	2	1	-	-	-	1	-	-	-	2	2	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23EEE020	SMART SYSTEM AUTOMATION	Category: PEC			
		L	T	P	C
		2	0	2	3
Prerequisites					
•					
Course Objectives:					
- To introduce the smart system technologies and its role in real time applications - To teach the architecture and requirements of Home Automation. - To provide an insight into smart appliances and energy management concepts. - To familiarize the design and needs of smart wearable devices - To teach the basics of robotics and its role for automation.					
Unit I	INTRODUCTION				6
Overview of a smart system - Hardware and software selection - Smart sensors and Actuators – Communication protocols used for smart systems.					
Unit II	HOME AUTOMATION				6
Home Automation – System Architecture - Essential Components- Design Considerations: Control Unit, Sensing Requirements, Communication, Data Security.					
Unit III	SMART APPLIANCES AND ENERGY MANAGEMENT				6
Significance of smart appliances for energy management -Smart Meters: Significance, Architecture & Energy Measurement Technique – Security Considerations.					
Unit IV	SMART WEARABLE DEVICES				6
Body Area Networks - Sensors– communication protocol for Wearable devices- Application of Smart Wearable in Healthcare & Activity Monitoring.					
Unit V	EMBEDDED SYSTEMS AND ROBOTICS				6
Fundamental concepts in Robotics- Robots and Controllers components - Embedded processor based: pick and place robot- Mobile Robot Design- UAV.					
LIST OF EXPERIMENTS					
1	Laboratory exercise: Use Arduino/ R pi/ any other Embedded processors to give hands on training to understand concepts related to smart automation.				
	a) Hands on experiments based on Ubidots & Thing				

	speak / Open-source Analytics Platform b) Design and implementation of a smart home system . c) Bluetooth Based Home Automation Project using Android Phone d) GSM Based Home Devices Control e) Pick and place robots using Arduino/ any suitable Embedded processor
2	Assignment: Revolution of Smart Automation system across the world and its current scope available in India
3	Mini project: Design of a Smart Automation system (for any application of students choice)

Total periods:30+30=60

Text Books:

- 1.Grimm, Christoph, Neumann, Peter, Mahlknecht and Stefan, Embedded Systems for Smart Appliances and Energy Management, Springer 2013, 1st Edition.
- 2.KazemSohraby, Daniel Minoli and TaiebZnati, Wireless Sensor Networks Technology, Protocols, and Applications, John Wiley & Sons, 2007, 1st Edition.
- 3.ilanjanDey, Amartya Mukherjee, Embedded Systems and Robotics with Open-Source Tools, CRC press, 2016, 1st Edition.

References:

- 1.Thomas Bräunl, Embedded Robotics, Springer, 2003.
- 2.Raj Kamal, Embedded Systems - Architecture, Programming and Design, McGraw-Hill, 2008
- 3.Karim Yaghmour, Embedded Android, O'Reilly, 2013.
- 4.Steven Goodwin, Smart Home Automation with Linux and Raspberry Pi, Apress , 2013
- 5.C.K. Toh, AdHoc mobile wireless networks, Prentice Hall, Inc, 2002.
- 6.Anna Ha'c, Wireless Sensor Network Designs, John Wiley & Sons Ltd, 2003.
- 7.J. J. Craig, "Introduction to Robotics Mechanics and Control", Pearson Education.
- 8.Y. Koren, "Robotics for Engineers", McGraw-Hill.
- 9.Robert Faludi, Wireless Sensor Networks, O'Reilly, 2011.

Course Outcomes: At the end of this course, the students will have the ability to	Blooms Taxonomy
CO 1: Understand the concepts of smart system design and its present developments.	Understand(K2)
CO2: Illustrate different embedded open-source and cost-effective techniques for developing solution for real time applications.	Analyze(K4)
CO3: Acquire knowledge on different platforms and Infrastructure for Smart system design.	Analyze(K4)
CO4: Infer about smart appliances and energy management concepts.	Understand(K2)
CO5: Improve Employability and entrepreneurship capacity due to knowledge upgradation on embedded system technologies.	Apply(K3)

CO-PO Mapping

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

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

23EEE021	EMBEDDED SYSTEM FOR AUTOMOTIVE APPLICATIONS	Category: PEC			
		L	T	P	C
		2	0	2	3
Prerequisites					
•					
Course Objectives:					
- To expose the students to the fundamentals and building of Electronic Engine Control systems. - To teach on sensor functional components for vehicles. - To discuss on programmable controllers for vehicles management systems. - To teachlogics of automation & communication techniques for vehicle communication. - To introduce the infotainment system development.					
Unit I	INTRODUCTION TO AUTOMOTIVESYSTEMS				6
Overview of Automotive systems,fuel economy,air-fuel ratio, emission limits and vehicle performance; Electronic control Unit– open-source ECU.					
Unit II	SENSORSANDACTUATORSFORAUTOMOTIVES				6
Review of automotive sensors- sensors interface to the ECU, Smart sensor and actuators for automotive applications.					
Unit III	VEHICLEMANAGEMENTSYSTEMS				6
Energy Management system-Adaptive cruise control-anti-locking braking system-Safety and Collision Avoidance.					
Unit IV	ONBOARDDIAGONSTICSANDCOMMUNICATION				6
OBD,Vehicle communication protocols-Bluetooth, CAN,LIN, FLEXRAYand MOST.					
Unit V	RECENTTRENDS				6
Navigation-Autonomous car-Role of IoT in Automotive systems.					
LIST OF EXPERIMENTS:					

1	Laboratory exercise: UseMATLABSIMULINK/equivalentssimulation/opensource tools a) Simulation studyofautomotivesensorsandactuatorscomponents b) Adaptivecruisecontrol,Anti-LockBrakingSystem c) CANConnectivityinanAutomotiveApplicationusingvehiclenetworktoolbo x d) Interfacingasensorusedincarwithmicrocontroller. e) EstablishingconnectionbetweenBluetoothmoduleandmicrocontroller.		
2	Assignment: AUTOSAR		
3	Miniproject:BatteryManagementsystemforEVbatteries		
		Lecture :30	Practical :30
		Total periods:60	
Text Books:			
1.William B.Ribbens,”Understanding Automotive Electronics”,Elseiver,8 th Edition,2017.			
2.Jurgen,R.,Automotive Electronics HandBook,McGrawHill,2 nd Edition,1999.			
3.L.Vlacic,M.Parent,F.Harahima,”Intelligent Vehicle Technologies”,SAE International, 2001, 1 st Edition, 2017.			
References:			
1.Ali Emedi, Mehrdedehsani, John M Miller , “Vehicular Electric power system- land, Sea, Airand Space Vehicles” Marcel Decker, 2004, 1 st Edition.			
2.Jack Erjavec,JeffArias,”Alternate Fuel Technology-Electric ,Hybrid& Fuel Cell Vehicles”,Cengage ,2012, 2 nd Edition.			
3.Electronic Engine Control technology–RonaldKJurgenChilton’sguideto FuelInjection–Ford2 nd Edition,2004.			
4.Automotive Electricals/ Electronics System and Components,TomDenton,5 th Edition,2017.			
5.UweKiencke,LarsNielsen,“Automotive Control Systems:For Engine,Driveline,and Vehicle”, Springer; 1 st Edition, 2005.			
6.Automotive Electricals Electronics System and Components,Robert BoschGmbh,5 2014.			
7.Automotive Hand Book, RobertBosch, BentlyPublishers,10 th Edition, 2018.			
Course Outcomes: At the end of this course,the students will have the ability in			Blooms Taxonomy
CO1: Insight int the significance of the role of embedded system for automotive applications.			Understand(K2)
CO2: Illustrate the need, selection of sensors and actuators and interfacing with ECU			Analyze(K4)
CO3: Develop the Embedded concepts for vehicle management and control systems.			Analyze(K4)

CO4: Demonstrate the need of Electrical vehicle and able to apply the embedded system technology for various aspects of EVs													Apply(K3)		
CO5: Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded systems design and its application in automotive systems													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	2	2	1	-	-	-	-	-	-	-	2	1	3
CO2	2	3	3	2	2	-	-	-	-	-	-	-	2	2	2
CO3	3	3	3	3	3	-	-	-	-	-	-	-	2	1	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	1	3	2
CO5	3	3	1	2	1	-	-	-	-	-	-	-	2	2	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23EEE022	VLSI DESIGN	Category: PEC			
		L	T	P	C
		2	0	2	3
Prerequisites					
•					
Course Objectives:					
- To explain the basic concepts of CMOS - To introduce the IC fabrication methods - To introduce the Reconfigurable Processor technologies - To introduce the basics of analog VLSI design and its importance. - To learn about the programming of Programmable device using Hardware description Language.					
Unit I	CMOSBASICS				6
MOSFET Scaling-CMOS logic design-Dynamic CMOS–Transmission Gates-Bi CMOS					
Unit II	ICFABRICATION				6
CMOSIC Fabrications:nwell,pwell,twintub,SoI-Design Rules and Layout.					
Unit III	PROGRAMABLELOGICDEVICES				6
PAL,PLA,CPLD architecture and application.					
Unit IV	RECONFIGURABLEPROCESSOR				6
FPGA-Architecture,FPGAbased application development-Introduction to FPAA.					
Unit V	HDLPROGRAMMING				6
Verilog HDL- Overview - structural and behavioural modeling concepts-Design examples- Carry Look ahead adders, ALU, Shift Registers.					

LIST OF EXPERIMENTS:			
1	Laboratory exercise: Use any FPGA Board/IDE/opensource package/platform to give hands on training on CMOS design/ reconfigurable processor based applications. a) CMOS logic circuits simulation using any opensource software package b) Experiments: structural and behavioural modeling based Verilog HDL programs c) Experiment: Combinational and sequential Digital logic implementation with FPGA. d) Implementation of carry lookahead adder with FPGA e) Implementation of ALU with FPGA		
2	Assignment: Low Power VLSI.		
3	FPGA based Mini project .		
Lecture :30		Practical :30	Total periods:60
Text Books:			
1.M.J.S Smith, “Application Specific integrated circuits”,Addition Wesley Longman Inc. 1 st Edition2010.			
2.Kamran Eshraghian,Douglas A.pucknell andSholeh Eshraghian,”Essentials of VLSI circuitsand system”, Prentice Hall India,2005, 1 st Edition.			
References:			
1.DonaldG.Givone,“DigitalprinciplesandDesign”,TataMcGrawHill2002,1 st Edition.			
2.CharlesH.RothJr.,“Fundamentals of Logic design”,Thomson Learning,7 th Edition2013.			
3.Nurmi,Jari(Ed.)"Processor Design System-On-Chip ComputingforASICsandFPGAs" Springer, 2007, 1 st Edition.			
4.JoaoCardoso,MichaelHübner,"Reconfigurable Computing:FromFPGAsto Hardware/Software Codesign" Springer, 2011, 1 st Edition.			
5.Pierre-Emmanuel Gaillardon,Reconfigurable Logic:Architecture, Tools,and Applications, 1 st Edition, CRC Press , 2018.			
Course Outcomes:At the end of this course,the students will have the ability to			Blooms Taxonomy
CO1: Develop CMOS design techniques.			Understand(K2)
CO2:Learn and build ICfabrication			Understand(K2)
CO3:Explain the need of reconfigurable computing with PLDs.			Understand(K2)
CO4 :Design and development of reprogrammable FPGA.			Analyze(K4)
CO5:Illustrate and develop HDL computaion processes with improved design			Analyze(K4)

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

23EEE023	MEMS AND NEMS	Category: PEC			
		L	T	P	C
		2	0	2	3
Prerequisites					
Course Objectives: - To introduce the diverse technological and functional approaches of MEMS/NEMS and applications. - To understand the microstructures and fabrication methods. - To provide an insight of micro and nano sensors, actuators. - To emphasis the need for NEMS technology. - To update the ongoing trends and real time applications of MEMS and NEMS technology.					
Unit I	INTRODUCTION TO MEMS and NEMS				6
Overview of Micro electro mechanical systems and Nano Electro mechanical systems, devices and technologies, Laws of scaling- Materials for MEMS and NEMS - Applications of MEMS and NEMS.					
Unit II	MICRO-MACHINING AND MICROFABRICATION TECHNIQUES				6
Photolithography- Micro manufacturing, Bulk micro machining, surface micro machining, LIGA.					
Unit III	MICRO SENSORS AND MICRO ACTUATORS				6
Micromachining : Capacitive Sensors- Piezoresistive Sensors- Piezoelectric actuators.					
Unit IV	NEMS TECHNOLOGY				6

Atomic scale precision engineering- Nano Fabrication techniques – NEMS for sensors and actuators.		
Unit V	MEMS and NEMS APPLICATION	6
Bio MEMS- Optical NEMS- Micro motors- Smart Sensors - Recent trends in MEMS and NEMS.		
LIST OF EXPERIMENTS		
1	1.Laboratory experiment: Simulation of MEMS sensors and actuators using Multi physics tool a) Simulation of a typical piezo resistive sensor b) Simulation of a typical Piezoelectric actuator c) Simulation study of a bio sensor d) Simulation study of a micro motor	
2	2.Assignment: Role of MEMS AND NEMS devices for Industry Standard 5.0.	
3	3.Mini project : Design and analysis of any MEMS/NEMS device using multi physics tool.	
Lecture :30 Practical :30 Total periods:60		
Text Books:		
1.Chang Liu, “Foundations of MEMS”, Pearson International Edition, 2011, 2 nd Edition.		
2.Tai.-Ran Hsu, “MEMS and Microsystems: design , manufacture, and Nanoscale”- 2nd Edition, John Wiley & Sons, Inc., Hoboken, New Jersey, 2008.		
3.Lyshevski, S.E. “ Nano- and Micro-Electromechanical Systems: Fundamentals of Nano-and Microengineering “ (2nd ed.). CRC Press,2005.		
4.Julian W Gardner and Vijay K Varadan, “ Microsensors, MEMS and Smart Devices”, John Wiley and Sons Ltd, 2001, 1 st Edition.		
References:		
1.Marc F madou“ Fundamentals of micro fabrication” CRC Press 2002 2nd Edition Marc Madou.		
2.M.H.Bao “Micromechanical transducers :Pressure sensors, accelerometers and gyroscopes”,Elsevier, Newyork, 16 Oct 2000, 1 st Edition.		
3.Maluf, Nadim “An introduction to Micro Electro-mechanical Systems Engineering “AR Tech house, Boston, June 30 2004, 2nd Edition.		
4.Mohamed Gad – el – Hak “MEMS Handbook” Edited CRC Press 2001, 1 st Edition.		
Course Outcomes:At the end of this course, the students will have the ability to		Blooms Taxonomy
CO1: Explain the material properties and the significance of MEMS and NEMS for industrial automation.		Understand(K2)
CO2:Demonstrate knowledge delivery on micromachining and micro fabrication.		Understand(K2)
CO3: Apply the fabrication mechanism for MEMS sensor and actuators.		Apply(K3)
CO4: Apply the concepts of MEMS and NEMS to models ,simulate and process		Apply(K3)

the sensors and actuators.															
CO5: Design Employability and entrepreneurship capacity due to knowledge up gradation on MEMS and NEMS technology.													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	1	1	1	-	-	-	-	-	-	-	1	3	2
CO2	2	1	2	2	1	-	-	-	-	-	-	-	1	1	2
CO3	2	2	2	1	3	-	-	-	-	-	-	-	2	3	3
CO4	3	2	2	2	3	-	-	-	-	-	-	-	2	2	3
CO5	3	2	3	3	3	-	-	-	-	-	-	-	2	1	2
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23EEE024	DIGITAL SIGNAL PROCESSING SYSTEM DESIGN	Category: PEC			
		L	T	P	C
		2	0	2	3
Prerequisites					
Course Objectives: - To introduce the concept of analyzing discrete time signals & systems in the time and frequency domain through mathematical representation. - To study the various time to frequency domain transformation techniques. - To Understand the computation algorithmic steps for Fourier Transform. - To study about filters and their design for digital implementation. - To introduce the programmable digital signal processor & its application.					
Unit I	INTRODUCTION				9
Classification of systems: Continuous, discrete, linear, causal, stable, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error,					
Unit II	DISCRETE TIME SYSTEM ANALYSIS				9
Z-transform and its properties, inverse z-transforms; difference equation – Solution by z-transform, application to discrete systems - Stability analysis, frequency response – Convolution – Introduction to Fourier Transform– Discrete time Fourier transform.					
Unit III	DISCRETE FOURIER TRANSFORM & COMPUTATION				9
DFT properties, magnitude and phase representation - Computation of DFT using FFT algorithm – DIT & DIF - FFT using radix 2 – Butterfly structure.					
Unit IV	DESIGN OF DIGITAL FILTERS				9

FIR & IIR filter realization – Parallel & cascade forms. FIR design: Windowing Techniques – Need and choice of windows – Linear phase characteristics. IIR design: Analog filter design - Butterworth and Chebyshev approximations; digital design using impulse invariant and bilinear transformation - Warping, prewarping -Frequency transformation.		
Unit V	DIGITAL SIGNAL PROCESSORS	9
Introduction – Architecture of one DSP processor for motor control – Features –Addressing Formats– Functional modes - Introduction to Commercial Processors		
LIST OF EXPERIMENTS:		
1	Laboratory exercise : Use any DSP processor/MATLAB/open source platform to give hands on training on basic concepts of Digital Signal Processing a) To determine impulse and step response of two vectors b) To perform convolution between two vectors . c) To compute DFT and IDFT of a given sequence. d) To perform linear convolution of two sequence using DFT e) Design and Implementation of FIR Filter f) Design and Implementation of IIR Filter g) To determine z-transform from the given transfer function and its ROC	
2	Assignment : Implementation of FIR/IIR filter with FPGA.	
3	DSP processors based Mini project.	
Lecture :30 Practical :30 Total periods:60		
Text Books:		
1.J.G. Proakis and D.G. Manolakis, ‘Digital Signal Processing Principles, Algorithms and Applications’, Pearson Education, New Delhi, 4 th Edition 2007.		
2.Robert J.Schilling & Sandra L.Harris ,’ Introduction to Digital Signal Processing using MATLAB’, Cengage Learning, 2nd Edition 2013.		
References:		
1.Emmanuel C Ifeachor and Barrie W Jervis ,”Digital Signal Processing – A Practical approach” Pearson Education, Second edition, 2002.		
2.Alan V. Oppenheim, Ronald W. Schafer and John R. Buck, ‘Discrete – Time Signal Processing’, Pearson Education, New Delhi, 2 nd Edition 2012.		
3.SenM.kuo, Woonseng...s.gan, “Digital Signal Processors, Architecture, Implementations & Applications, Pearson, 1 st Edition 2004.		
4.S.K. Mitra, ‘Digital Signal Processing – A Computer Based Approach’, Tata McGraw Hill, New Delhi, 4 th Edition 2013.		
5.B. Venkataramani, M. Bhaskar, ‘Digital Signal Processors, Architecture, Programming and Applications’, Tata McGraw Hill, New Delhi, 2003, 1 st Edition.		

Course Outcomes: At the end of this course, the students will have the ability to													Blooms Taxonomy		
CO1: Explain the concepts of digital signal processing													Understand(K2)		
CO2: Illustrate the system representation using transforms													Analyze(K4)		
CO3: Learn the transformation techniques for time to frequency conversion													Analyze(K4)		
CO4: Design suitable digital FIR, IIR algorithm for the given specification													Apply(K3)		
CO5: Apply the digital signal processor for application development													Apply(K3)		
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	1	-	-	-	-	-	-	-	1	2	1
CO2	2	3	3	2	2	-	-	-	-	-	-	-	2	3	1
CO3	3	3	3	3	3	-	-	-	-	-	-	-	2	2	2
CO4	3	3	3	3	3	-	-	-	-	-	-	-	2	2	3
CO5	3	3	3	2	1	-	-	-	-	-	-	-	2	2	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

VERTICAL IV : ELECTRIC VEHICLE TECHNOLOGY

23EEE025	ELECTRIC VEHICLE ARCHITECTURE	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives:					
- To learn the structure of Electric Vehicle, Hybrid Electric Vehicle - To study about the EV conversion components - To know about the details and specifications for Electric Vehicles - To understand the concepts of Plug-in Hybrid Electric Vehicle - To model and simulate all types of DC motors					
Unit I	VEHICLE ARCHITECTURE and SIZING				(7+2 Skill) 9
Electric Vehicle History, and Evolution of Electric Vehicles. Series, Parallel and Series parallel Architecture, Micro and Mild architectures. Mountain Bike - Motorcycle- Electric Cars and Heavy Duty EVs. -Details and Specifications.					
Unit II	VEHICLE MECHANICS				(7+2 Skill) 9

Vehicle mechanics- Roadway fundamentals, Laws of motion, Vehicle Kinetics, Dynamics of vehicle motion, propulsion power, velocity and acceleration, Tire –Road mechanics, Propulsion System Design		
Unit III	POWER COMPONENTS AND BRAKES	(7+2 Skill) 9
Power train Component sizing- Gears, Clutches, Differential, Transmission and Vehicle Brakes. EV power train sizing, HEV Powertrain sizing, Example.		
Unit IV	HYBRID VEHICLE CONTROL STRATEGY	(7+2 Skill) 9
Vehicle supervisory controll, Mode selection strategy, Modal Control strategies.		
Unit V	PLUG-IN HYBRID ELECTRIC VEHICLE	(7+2 Skill) 9
Introduction-History-Comparison with electrical and hybrid electrical vehicle-Construction and working of PHEV-Block diagram and components-Charging mechanisms-Advantages of PHEVs.		
Total periods: 45 PERIODS		
Text Books:		
1.		
References:		
1.Mehrdad Ehsani, YiminGao, Sebastian E. Gay, Ali Emadi, 'Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design', CRC Press, 2004.		
2.Build Your Own Electric Vehicle,Seth Leitman , Bob Brant, McGraw Hill, Third Edition 2013.		
3.Advanced Electric Drive Vehicles, Ali Emadi, CRC Press, First edition 2017.		
4.The Electric Vehicle Conversion Handbook: How to Convert Cars, Trucks, Motorcycles, and Bicycles -- Includes EV Components, Kits, and Project Vehicles Mark Warner, HP Books, 2011.		
5.Heavy-duty Electric Vehicles from Concept to Reality, Shashank Arora, Alireza Tashakori Abkenar, Shantha Gamini Jayasinghe, Kari Tammi, Elsevier Science, 2021		
6.Electric Vehicles Modern Technologies and Trends, Nil Patel, Akash Kumar Bhoi, Sanjeevikumar Padmanaban, Jens Bo Holm-Nielsen Springer, 2020		
7.Hybrid Electric Vehicles: A Review of Existing Configurations and Thermodynamic Cycles, Rogelio León , Christian Montaleza , José Luis Maldonado , Marcos Tostado-Véliz and Francisco Jurado, Thermo, 2021 , 1, 134–150. https://doi.org/10.3390/thermo1020010 .		
Course Outcomes: Upon completion of the course, students will be able to:		Blooms Taxonomy
CO1: Summarize the History and Evolution of EVs, Hybrid and Plug-In Hybrid		Analyze(K4)

EVs															
CO2: Describe the various EV components													Understand(K2)		
CO3: Describe the concepts related in the Plug-In Hybrid Electric Vehicles													Understand(K2)		
CO4: Analyse the details and Specifications for the various EVs developed.													Analyze(K4)		
CO5: Describe the hybrid vehicle control strategy.													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	-	-	-	-	1	-	-	-	2	3	-	-
CO2	3	-	2	-	-	-	-	1	-	-	-	2	3	3	3
CO3	3	-	2	-	-	-	-	1	-	-	-	2	3	-	-
CO4	3	-	2	-	-	-	-	1	-	-	-	2	3	-	-
CO5	3	-	3	3	3	-	-	1	-	-	-	2	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23EEE026	DESIGN OF MOTOR AND POWER CONVERTERS FOR ELECTRIC VEHICLES	Category: PEC			
		L	T	P	C
		2	0	2	3
Prerequisites					
•					
Course Objectives:					
• To review the drive cycles and requirements of EVs • To know the working of motors used in Electric Vehicle • To analyze and model the buck/boost converter operation and to design the same • To learn the simulation basics of control systems • To derive transfer functions for DC-DC converters.					
Unit I	ELECTRIC VEHICLE DYNAMICS				6
Standard drive cycles-Dynamics of Electric Vehicles-Tractive force-Maximum speed, torque, power, energy requirements of EVs.					
Unit II	MOTORS FOR ELECTRIC VEHICLES				6

Introduction – Speed And Torque control of above and below rated speed-Speed control of EV in the constant power region of electric motors. DC Motors, Induction Motor, Permanent Magnet Synchronous Motors (PMSM), Brushless DC Motors, Switched Reluctance Motors (SRMs). Synchronous Reluctance Machines-Choice of electric machines for EVs.		
Unit III	BASICS OF SIMULATION IN CONTROL SYSTEMS	6
Transfer Function-How to build transfer function, identify Poles, zeros, draw time response plots, bode plot (Bode Plots for Multiplication Factors, Constant, Single and Double Integration Functions, Single and Double Differentiation Functions, Single Pole and Single Zero Functions, RHP Pole and RHP Zero Functions), state space modelling-transfer function from state space Model.		
Unit IV	MODELING OF DC-DC CONVERTERS	6
Overview of PWM Converter Modelling -Power Stage Modelling - PWM Block Modelling - Voltage Feedback Circuit and Small-Signal Model of PWM Converter - Averaging Power Stage Dynamics - Average Models for buck/boost Converter - Small-Signal Model of Converter Power Stage - Frequency Response of Converter		
Unit V	POWER STAGE TRANSFER FUNCTIONS OF DC – DC CONVERTERS	6
LIST OF EXPERIMENTS:		
1	Simple simulation exercises of basic control systems	
2	Bode plots and calculation of Gain margin and Phase margin for power stage transfer function via simulation.	
3	Design of buck converter	
4	Design of boost converter	
5	Simulation of buck, boost and buck boost converter-open loop (With power circuit and Transfer function).	
Lecture :30 Practical :30 Total periods:60		
Text Books:		
1.		
References:		
1.Power Electronic Converters, Teuvo Suntio, Tuomas Messo, Joonas Puukko, First Edition 2017.		
2.Fundamentals of Power Electronics with MATLAB, Randall Shaffer, 2 nd Edition, 2013, Lakshmi publications		
3.Feedback Control problems using MATLAB and the Control system tool box, Dean Frederick and Joe Cho, 2000, 1 st Edition, Cengage learning.		
4.Handbook of Automotive Power Electronics and Motor Drives, Ali Emadi, Taylor & Francis, 2005,1 st Edition.		
5.Electrical Machine Fundamentals with Numerical Simulation using MATLAB/SIMULINK, Atif Iqbal,		

Shaikh Moinoddin, Bhimireddy Prathap Reddy, Wiley,2021, 1 st Edition.															
6.Emerging Power Converters for Renewable Energy and Electric Vehicles Modeling, Design, and Control, Md. Rabiul Islam,Md. Rakibuzzaman Shah, Mohd. Hasan Ali, CRC Press,2021, 1 st Edition.															
7.Iqbal Hussain, “Electric and Hybrid Vehicles: Design Fundamentals, Second Edition” CRC Press, Taylor & Francis Group, Third Edition 2021.															
Course Outcomes: Upon completion of the course, students will be able to:													Blooms Taxonomy		
CO1: Explain appropriate electric machine for electric vehicle application													Apply(K3)		
CO2: Compute transfer function with factors such as constant, integral, differential, first order factor and second order factor (both numerators & denominators)													Understand(K2)		
CO3: Compute transfer function from state models CO4: To design buck, boost and buck-boost converter.													Analyze(K4)		
CO4: Compute a power stage transfer functions for DC-DC converters													Understand(K2)		
CO5: Simulate DC-DC converters and to obtain gain margin and phase margin.													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	-	3	-	3	3	-	1
CO2	3	3	3	3	3	-	-	1	-	3	-	3	3	3	3
CO3	3	3	3	3	3	-	-	1	-	3	-	3	3	3	3
CO4	3	3	3	3	3	-	-	1	-	3	-	3	3	3	3
CO5	3	3	3	3	3	-	-	1	-	3	-	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23EEE027	ELECTRIC VEHICLE DESIGN, MECHANICS AND CONTROL	Category: PEC			
		L	T	P	C
		2	0	2	3
Prerequisites					
•					
Course Objectives:					
• To learn the basics of EV and vehicle mechanics • To know the EV architecture • To study the energy storage system concepts					

- To derive model for batteries and to know the different types of batteries and its charging methods - To learn the control preliminaries for DC-DC converters.		
UNIT I	INTERNAL COMBUSTION ENGINES	6
IC Engines, BMEP and BSFC, Vehicle Fuel Economy, Emission Control Systems, Treatment of Diesel Exhaust Emissions.		
UNIT II	ELECTRIC VEHICLES AND VEHICLE MECHANICS	6
Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings- Comparisons of EV with internal combustion Engine vehicles- Fundamentals of vehicle mechanics.		
UNIT III	BATTERY MODELING, TYPES AND CHARGING	6
Batteries in Electric and Hybrid Vehicles - Battery Basics -Battery Parameters. Types- Lead Acid Battery - Nickel-Cadmium Battery - Nickel-Metal-Hydride (NiMH) Battery - Li-Ion Battery - Li-Polymer Battery, Zinc-Air Battery, Sodium-Sulphur Battery, Sodium-Metal-Chloride, Research and Development for Advanced Batteries. Battery Modelling, Electric Circuit Models. Battery Pack Management, Battery Charging.		
UNIT IV	CONTROL PRELIMINARIES	6
Control Design Preliminaries - Introduction - Transfer Functions — Bode plot analysis for First order and second order systems - Stability - Transient Performance- Power transfer function for boost converter - Gain margin and Phase margin study-open loop mode.		
UNIT V	CONTROL OF AC MACHINES	6
Introduction- Reference frame theory, basics-modeling of induction and synchronous machine in various frames-Vector control- Direct torque control.		
LIST OF EXPERIMENTS		
1	Develop a model that could estimate Soc and SoH of Li-Ion Battery.	
2	Modelling and thermal analysis of Li-Ion Battery.	
3	Simulation of boost converter and calculating gain and phase margin from the transfer function.	
4	Simulation of vector control of induction motor	
Lecture :30 Practical :30 Total periods:60		
Text Books:		
1.		
References:		
1.Electric and Hybrid Vehicles, Design Fundamentals, Third Edition, Iqbal Husain, CRC Press, 2021.		

2.Power Electronic Converters,: Dynamics and Control in Conventional and Renewable Energy Applications, Teuvo Suntio, Tuomas Messo, Joonas Puukko, 1 st Edition, Wiley - VCH.															
3.Ali Emadi, Mehrdad Ehsani, John M.Miller, “Vehicular Electric Power Systems”, Special Indian Edition, Marcel dekker, Inc 2003, 1 st Edition.															
4.C.C. Chan and K.T. Chau, 'Modern Electric Vehicle Technology', OXFORD University Press, 2001, 1 st Edition.															
5.Wie Liu, “Hybrid Electric Vehicle System Modeling and Control”, Second Edition, John Wiley & Sons, 2017, 2 nd Edition.															
6.Dynamic Simulation of Electric Machinery using MATLAB, Chee Mun Ong, Prentice Hall,1997, 1 st Edition.															
7.Electrical Machine Fundamentals with Numerical Simulation using MATLAB/ SIMULINK, Atif Iqbal, Shaikh Moinoddin, Bhimireddy Prathap Reddy, Wiley, 2021, 1 st Edition.															
Course Outcomes: Upon completion of the course, students will be able to													Blooms Taxonomy		
CO1: Describe the concepts related with EV, HEV and to compare the same with internal combustion engine vehicles													Understand(K2)		
CO2: Find gain margin & phase margin for various types of transfer functions of boost converter													Understand(K2)		
CO3: Demonstrate the Control of A C Machines													Analyze(K4)		
CO4: Explain the concepts related with batteries and parameters of battery													Analyze(K4)		
CO5: Design battery and to study the research and development for batteries													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	3	-	3
CO2	3	-	-	-	-	-	-	-	1	3	-	2	3	-	3
CO3	3	-	-	-	-	-	3	-	1	2	-	2	3	-	3
CO4	3	-	-	-	-	-	3	-	1	2	-	2	3	-	3
CO5	3	-	-	-	-	-	3	-	1	2	-	2	3	2	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23EEE028	DESIGN OF ELECTRIC VEHICLE CHARGING SYSTEM	Category: PEC			
		L	T	P	C
		2	0	2	3
Prerequisites					
•					
Course Objectives:					
• To know the charging station and standards • To learn the concepts of power converters in charging • To find the charging scheme in renewable based EV charging • To demonstrate the wireless power transfer technique • To design & simulate power factor correction circuits					
UNIT I	CHARGING STATIONS AND STANDARDS				6
Introduction-Charging technologies- Conductive charging, EV charging infrastructure, International standards and regulations - Inductive charging, need for inductive charging of EV, Modes and operating principle, Static and dynamic charging, Bidirectional power flow, International standards and regulations					
UNIT II	POWER ELECTRONICS FOR EV CHARGING				6
Layouts of EV Battery Charging Systems-AC charging-DC charging systems- Power Electronic Converters for EV Battery Charging- AC-DC converter with boost PFC circuit, with bridge and without bridge circuit - Bidirectional DC-DC Converters- Non-isolated DC-DC bidirectional converter topologies- Half-bridge bidirectional converter.					
UNIT III	EV CHARGING USING RENEWABLE AND STORAGE SYSTEMS				6
Introduction- - EV charger topologies , EV charging/discharging strategies - Integration of EV charging-home solar PV system , Operation modes of EVC-HSP system , Control strategy of EVC- HSP system - fast-charging infrastructure with solar PV and energy storage.					
UNIT IV	WIRELESS POWER TRANSFER				6
Introduction - Inductive, Magnetic Resonance, Capacitive types. Wireless Chargers for Electric Vehicles - Types of Electric Vehicles - Battery Technology in EVs -Charging Modes in EVs - Benefits of WPT. - WPT Operation Modes - Standards for EV Wireless Chargers, SAE J2954, IEC 61980. ISO 19363					
UNIT V	POWER FACTOR CORRECTION IN CHARGING SYSTEM				6
Need for power factor correction- Boost Converter for Power Factor Correction, Sizing the Boost Inductor, Average Currents in the Rectifier and calculation of power losses-					
LIST OF EXPERIMENTS					
1	Simulation and analysis for bi-directional charging V2G and G2V.				

2	Design and demonstrate solar PV based EV charging station.		
3	Simulate and infer wireless power charging station for EV charging.		
4	Simulation of boost converter based power factor correction.		
Lecture :30		Practical :30	Total periods:60
Text Books:			
1.			
References:			
1.Mobile Electric Vehicles Online Charging and Discharging, Miao Wang Ran Zhang Xuemin (Sherman) Shen, Springer 2016, 1 st Edition.			
2.Alicia Triviño-Cabrera, José M. González-González, José A. Aguado, Wireless Power Transferor Electric Vehicles: Foundations and Design Approach, Springer Publisher 1 st Edition. 2020.			
3.Nil Patel, Akash Kumar Bhoi, Sanjeevikumar Padmanaban, Jens Bo Holm-Nielsen, Electric Vehicles Modern Technologies and Trends. Springer Publisher 1 st Edition, 2021.			
4.Cable Based and Wireless Charging Systems for Electric Vehicles, Technology and control, management and grid integration, Rajiv Singh, Sanjeevikumar Padmanaban, Sanjeet Dwivedi, Marta Molinas and Frede Blaabjerg, IET 2021, 1 st Edition.			
4.Electric and Hybrid Electric Vehicles, James D Halderman, Pearson, 2022, 1 st Edition.			
5.Handbook of Automotive Power Electronics and Motor Drives, Ali Emadi, Taylor & Francis, 2005.			
6.Mobile Electric Vehicles Online Charging and Discharging, Miao Wang Ran Zhang Xuemin (Sherman) Shen, Springer 2016, 1 st Edition.			
Course Outcomes:			Blooms Taxonomy
CO1: Illustrate various charging techniques and to know charging standards and regulations.			Understand(K2)
CO2: Demonstrate the working o DC-DC converters used for charging systems and principles.			Analyze(K4)
CO3: Illustrate the advantages of renewable system based charging systems.			Understand(K2)
CO4: Demonstrate the principles of wireless power transfer.			Understand(K2)
CO6: Design and simulate boost converter based power factor correction.			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	3	3	-	-	2	2	-	3	-	3	3	--	-
CO2	3	3	3	3	-	-	2	2	-	3	-	3	3	3	3
CO3	3				-	-			-		-		3	3	3
CO4	3	3	3	3	-	-	2	2	-	2	-	1	3	3	3
CO5	3	3	3	3	3	-	2	2	-	3	-	2	3	3	3
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23EEE029	TESTING OF ELECTRIC VEHICLES	Category: PEC			
		L	T	P	C
		2	0	2	3
Prerequisites					
Course Objectives:					
- To know various standardization procedures - To learn the testing procedures for EV & HEV components - To know the functional safety and EMC - To realize the effect of EMC in EVs - To study the effect of EMI in motor drives and in DC-DC converter system					
UNIT I	EV STANDARDIZATION				6
Introduction - Current status of standardization of electric vehicles, electric Vehicles and Standardization - Standardization Bodies Active in the Field — Standardization activities in countries like Japan. The International Electro Technical Commission - Standardization of Vehicle Components.					
UNIT II	TESTING OF ELECTRIC MOTORS AND CONTROLLERS FOR ELECTRIC AND HYBRID ELECTRIC VEHICLES				6
Test Procedure Using M-G Set, electric motor, controller, application of Test Procedure, Analysis of Test Items for the Type Test - Motor Test and Controller Test (Controller Only). - Test Procedure Using Eddy Current Type Engine Dynamometer, Test Strategy, Test Procedure, Discussion on Test Procedure. Test Procedure Using AC Dynamometer.					
Unit III	FUNDAMENTALS OF FUNCTIONAL SAFETY AND EMC				6
Functional safety life cycle - Fault tree analysis - Hazard and risk assessment – software development - Process models - Development assessments - Configuration management – Reliability- Reliability block diagrams and redundancy - Functional safety and EMC - Functional safety and quality -					

Standards - Functional safety of autonomous vehicles.		
Unit IV	EMC IN ELECTRIC VEHICLES	6
Introduction - EMC Problems of EVs, EMC Problems of Motor Drive, EMC Problems of DC-DC Converter System, EMC Problems of Wireless Charging System, EMC Problem of Vehicle Controller, EMC Problems of Battery Management System, Vehicle EMC Requirements-		
UNIT V	EMI IN MOTOR DRIVE AND DC-DC CONVERTER SYSTEM	6
Overview -EMI Mechanism of Motor Drive System, Conducted Emission Test of Motor Drive System, IGBT EMI Source, EMI Coupling Path, EMI Modelling of Motor Drive System. EMI in DC-DC Converter, EMI Source, The Conducted Emission High-Frequency, Equivalent Circuit of DC-DC Converter System, EMI Coupling Path		
LIST OF EXPERIMENTS		
1	Design and simulate motor controller for hybrid electric vehicle applications	
2	Simulation of EMC analysis for Wireless power transfer EV charging.	
3	Design and simulation of EMI filter	
Lecture :30 Practical :30 Total periods:60		
Text Books:		
1.		
References:		
1.Handbook of Automotive Power Electronics and Motor Drives, Ali Emadi, Taylor & Francis, 2005, 1 st Edition.		
2.Electromagnetic Compatibility of Electric Vehicle, Li Zhai, Springer 2021, 1 st Edition.		
3.EMC and Functional Safety of Automotive Electronics, Kai Borgeest, IET 2018, 1 st Edition.		
4.EMI/EMC Computational Modeling Handbook, Druce Archam beault, colin branch, Omar M.Ramachi ,Springer 2012, 2 nd Edition.		
4.Automotive EMC, Mark Steffika, Springer 2013, 1 st Edition.		
5.Electric Vehicle Systems Architecture and Standardization Needs, Reports of the PPP European Green Vehicles Initiative, Beate Müller, Gereon Meyer, Springer 2015, 1 st Edition.		
Course Outcomes: Upon completion of the course, students will be able to		Blooms Taxonomy
CO1: Describe the status and other details of standardization of EVs		Understand(K2)
CO2: Illustrate the testing protocols for EVs and HEV components		Understand(K2)
CO3: Aalyze the safety cycle and need for functions safety for EVs		Analyze(K4)

CO4: Analyze the problems related with EMC for EV components.													Analyze(K4)		
CO5: Evaluate the EMI in motor drive and DC-DC converter system.													Apply(K3)		
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	-	-	-	-	-	3	-	2
CO2	3	1	1	-	-	-	1	-	-	-	-	-	3	-	2
CO3	3	1	1	-	-	-	2	-	-	-	-	-	3	-	2
CO4	3	1	1	-	-	-	1	-	-	-	-	-	3	-	2
CO5	3	1	1	-	-	-	2	-	-	-	-	-	3	-	3

23EEE030	GRID INTEGRATION OF ELECTRIC VEHICLES	Category: PEC			
		L	T	P	L
		3	0	0	3
Prerequisites •					
Course Objectives: • To know the basic details of V2G • To study the benefits & challenges of V2G • To learn EV & V2G on the smart grids renewable energy systems • To know the grid integration					
UNIT I	DEFINITION, And STATUS Of V2G				(7+2 Skill) 9
Defining Vehicle to Grid (V2G) - History and Development of V2G. Incorporating V2G to the EV, Auditing and Metering, V2G in Practice , V2G - Power Markets and Applications . Electricity Markets and V2G Suitability , Long-Term Storage, Renewable Energy, and Other Grid Applications , Beyond the Grid: Other Concepts Related to V2G.					
UNIT II	BENEFITS AND CHALLENGES OF V2G				(7+2 Skill) 9
Benefits of V2G, Technical Benefits: Storage Superiority and Grid Efficiency, Economic Benefits: EV Owners and Societal Savings, Environment and Health Benefits: Sustainability in Electricity and Transport, Other Benefits					
UNIT III	CHALLENGES TO V2G				(7+2 Skill) 9

Technical Challenges-Battery Degradation, Charger Efficiency, Aggregation and Communication, V2G in a Digital Society. The Economic and Business Challenges to V2G - Evaluating V2G Costs and Revenues , EV Costs and Benefits , Adding V2G Costs and Benefits , Additional V2G Costs , The Evolving Nature of V2G Costs and Benefits. Regulatory and Political Challenges to V2G , V2G and Regulatory Frameworks , Market Design Challenges. Other V2G Regulatory and Legal Challenges.		
UNIT IV	IMPACT OF EV AND V2G ON THE SMART GRID AND RENEWABLE ENERGY SYSTEMS	(7+2 Skill) 9
Introduction - Types of Electric Vehicles - Motor Vehicle Ownership and EV Migration - Impact of Estimated EVs on Electrical Network - Impact on Drivers and the Smart Grid - Standardization and Plug-and-Play - IEC 61850 Communication Standard and IEC 61850-7-420 Extension.		
UNIT V	GRID INTEGRATION AND MANAGEMENT OF EVS	(7+2 Skill) 9
Introduction - Machine to Machine (M2M) in distributed energy management systems - M2M communication for EVs - M2M communication architecture (3GPP) - Electric vehicle data logging - Scalability of electric vehicles -M2M communication with scheduling.		
Total periods:60		
Text Books:		
1.		
References:		
1.Advanced Electric Drive Vehicles, Ali Emadi, CRC Press 2017, 1 st Edition.		
2.Plug In Electric Vehicles in Smart Grids, Charging Strategies, Sumedha Rajakaruna , Farhad Shahnia and Arindam Ghosh, Springer, 2015, 1 st Edition.		
3.ICT for Electric Vehicle Integration with the Smart Grid, Nand Kishor ¹ ; Jesus Fraile-Ardanuy, IET 2020, 1 st Edition.		
4.Vehicle-to-Grid: Linking Electric Vehicles to the Smart Grid, Junwei Lu and Jahangir Hossain, IET 2015, 1 st Edition.		
5.Lance Noel · Gerardo Zarazua de Rubens Johannes Kester · Benjamin K. Sovacool, Vehicle- to-Grid A Sociotechnical Transition Beyond Electric Mobility, 2019, 1 st Edition.		
Course Outcomes: Upon completion of the course, students will be able to		Blooms Taxonomy
CO1 : Explain the concepts related with V2G		Understand(K2)
CO2 : Study the grid connection of 3 phase Q inverter		Understand(K2)
CO3 : Explain the technical, economics. business, regulatory & political challenges related with V2G		Understand(K2)

CO4 : Impact of EV and V2G on smart grid and renewable energy system													Apply(K3)		
CO5 : Explain the concept of grid integration and management of EVs.													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	1	-	2	-	-	3	3	1
CO2	3	3	-	-	3	-	2	1	-	2	-	-	3	-	-
CO3	3	-	-	-	-	-	2	1	-	2	-	-	3	-	-
CO4	3	-	-	-	-	-	2	1	-	2	-	-	3	-	2
CO5	3	-	-	-	-	-	2	1	-	2	-	-	3	-	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23EEE031	INTELLIGENT CONTROL OF ELECTRIC VEHICLES	Category: PEC			
		L	T	P	C
		2	0	2	3
Prerequisites					
Course Objectives: - To design and drive the mathematical model of a BLDC motor and its characteristics - To learn the different control schemes for BLDC motor - To study the basics of fuzzy logic - To study the FPGA & VHDL basics - To implement fuzzy logic control of BLDC motor in real time					
Unit I	MATHEMATICAL MODEL AND CHARACTERISTICS ANALYSIS OF THE BLDC MOTOR				6
Structure and Drive Modes - Basic Structure, General Design Method, Drive Modes. Mathematical Model, Differential Equations, Transfer Functions, State-Space Equations. Characteristics Analysis, Starting Characteristics, Steady-State Operation, Dynamic Characteristics, Load Matching Commutation Transients					
Unit II	SPEED CONTROL FOR ELECTRIC DRIVES				6
Introduction -PID Control Principle, Anti windup Controller, Intelligent Controller. Vector Control. Control applied to BLDC motor-.					
Unit III	FUZZY LOGIC				6

Membership functions: features, fuzzification, methods of membership value assignments Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle - fuzzy measures - measures of fuzziness -fuzzy integrals - fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems, overview of fuzzy expert system-fuzzy decision making.		
Unit IV	FPGA AND VHDL BASICS	6
Introduction – FPGA Architecture-Advantages-Review of FPGA family processors- Spartan 3, Spartan 6 and Spartan 7. VHDL Basics- Fundamentals-Instruction set-data type-conditional statements- programs like arithmetic, sorting, PWM generation, Speed detection.		
Unit V	REAL TIME IMPLEMENTATION	6
Inverter design, identifying rotor position via hall effect sensors, open loop and fuzzy logic control of 48 V BLDC motor using FPGA.		
LIST OF EXPERIMENTS		
1	Design and simulate speed controller for induction motors in EV for both dynamic and steady state performance	
2	Simulate a fuzzy logic controller based energy storage system for EV.	
3	Fuzzy logic control of BLDC motor using FPGA in real time	
Lecture :30		Practical :30
		Total periods:60
References:		
1.Electric Powertrain Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, John G. Hayes, G. Abas Goodarzi, Wiley 1 st Edition 2018.		
2.VHDL Primer, A (3rd Edition), Jayaram Bhasker, Prentice Hall, 1 st Edition 2015.		
3.Iqbal Hussain, “Electric and Hybrid Vehicles: Design Fundamentals, Third Edition” CRC Press, Taylor & Francis Group, 2021, 1 st Edition.		
4.Chang-liang, Permanent Magnet Brushless DC Motor Drives and Controls, Xia Wiley 2012, 1 st Edition.		
5.M.N. Cirstea, A. Dinu, J.G. Khor,M. McCormick, Neural and Fuzzy Logic Control of Drives and Power Systems, Newnes publications, 1 st Edition, 2002.		
6.Wei Liu, Hybrid Electric Vehicle System Modeling and Control, Wiley 2017, 2 nd Edition		
7.Electric and Plug-in Hybrid Vehicle Networks Optimization and Control, Emanuele Crisostomi • Robert Shorten, Sonja Stüdli • Fabian Wirth, CRC Press, 1 st Edition. 2018.		
MAPPING OF COs WITH POs AND PSOs		
Course Outcomes: Upon the successful completion of the course, students will be able to:		Blooms Taxonomy

CO 1: design the mathematical model of a BLDC motor and to discuss about its characteristics													Analyze(K4)		
CO2: demonstrate the PID control, ant windup controller, Intelligent Controller and Vector Control. Control applied to BLDC motor.													Understand(K2)		
CO3: Illustrate the basics of fuzzy logic system													Analyze(K4)		
CO4: describe the basics of VHDL & FPGA applied to control of EVs.													Understand(K2)		
CO5: design and implement of fuzzy logic control scheme for BLDC motor using FPGA in real time.													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	3	3	-	-	-	3	-	2	-	3	3	3	-
CO2	3	3	3	3	-	-	-	3	-	2	-	3	3	3	3
CO3	3	3	3	3	-	-	-	-	-	2	-	3	3	3	3
CO4	3	3	3	3	3	-	-	3	-	2	-	3	3	3	3
CO5	3	3	2.6	2.6	3	-	-	3	-	2	-	3	3	2.4	2.8
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

VERTICAL V : ADVANCED CONTROL

23EEE032	PROCESS MODELLING AND SIMULATION	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To understand the important of mathematical models for Industrial processes - To acquaint students with different forms of mathematical models. - To develop and simulate mathematical models for different Industrial processes. - To apply Mathematical tools while developing mathematical models. - To analyze the graphical response of developed mathematical models.					
Unit I	GENERAL PRINCIPLES OF MODELLING				9
Introduction to mathematical modeling; Advantages and limitations of models and applications of process models of stand-alone unit operations and unit processes; Classification of models: Linear vs Nonlinear, Lumped parameter vs. Distributed parameter; Static vs. Dynamic, Continuous vs. Discrete; Numerical Methods: Iterative convergence methods, Numerical integration of ODE- IVP and ODEBVP					

Unit II	MODELLING OF DISTRIBUTED PROCESSES	9
Steady state models giving rise to differential algebraic equation (DAE) systems; Rate based Approaches for staged processes; Modeling of differential contactors — distributed parameter models of packed beds; Packed bed reactors; Modeling of reactive separation processes; Review of solution strategies for Differential Algebraic Equations (DAEs), Partial Differential Equations (PDEs), and available numerical software libraries.		
Unit III	INTRODUCTION TO PROCESS MODELLING	9
Concept of degree of freedom analysis: System and its subsystem, System interaction, Degree of freedom in a system e.g. Heat exchanger, Equilibrium still, Reversal of information flow, Design variable selection algorithm, Information flow through subsystems, Structural effects of design variable selection, Persistent Recycle. ¹		
Unit IV	MODELLING OF INDUSTRIAL PROCESSES	9
Simple examples of process models; Models giving rise to nonlinear algebraic equation (NAE) systems, -steady state models of flash vessels, equilibrium staged processes distillation columns, absorbers, strippers, CSTR, heat exchangers, etc.; Review of solution procedures and available numerical software libraries		
Unit V	SIMULATION OF MATHEMATICAL MODELLING	9
Simulation and their approaches, Modular, Sequential, Simultaneous and Equation solving approach, Simulation softwares and their applications, Review of solution techniques and available numerical software libraries.- Case Studies.		
Total periods: 45 PERIODS		
Text Books:		
1. Denn M. M., "Process Modeling", Longman, 1986, 1st Edition.		
2. Aris R., "Mathematical Modeling, A Chemical Engineering Perspective (Process System Engineering)", Academic Press, 1999, Volume 1.		
References:		
1. Luyben W.L., "Process Modeling, Simulation, and Control for Chemical Engineering", McGraw Hill, 2nd Edition, 1990.		
2. D. F. Rudd and C. C. Watson, "Strategy of Process Engineering", Wiley international, 1st Edition, 1968.		
3. M.M. Denn, "Process Modelling", Wiley, New York, 1st Edition, 1986.		
5. C.D. Holland, "Fundamentals of Modelling Separation Processes", Prentice Hall, 1st Edition, 1975.		
6. Hussain Asghar, "Chemical Process Simulation", Wiley Eastern Ltd., New Delhi, 1st Edition, 1986.		
Course Outcomes:		Blooms Taxonomy

CO 1: Understand different methods of developing models for industrial processes.													Analyze(K4)		
CO2: Build mathematical models by applying relevant mathematics.													Understand(K2)		
CO3: Implement mathematical models using relevant software.													Analyze(K4)		
CO4: Perform analysis and subsequent conclusion for the developed mathematical models.													Apply(K3)		
CO5: Interpret the results obtained from the mathematical model in terms of original real world problem													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	1	-	1	1	1	1	1	1	2	2
CO2	3	1	2	-	-	1	-	1	1	1	1	1	1	2	2
CO3	1	-	2	3	-	1	-	1	1	1	1	1	1	2	2
CO4	1	-	3	-	-	1	2	1	1	1	1	1	1	2	2
CO5	1	2	-	3	-	1	-	1	1	1	1	1	1	2	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23EEE033	COMPUTER CONTROL OF PROCESSES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To represent the linear time invariant System in discrete State Space form - To analyze the controllability, observability and stability of a Discrete time System. - To estimate model parameters from input/output measurements - To Design Digital Controllers - To Design Multi-loop and Multivariable Controllers for multivariable system					
Unit I	DISCRETE STATE-VARIABLE TECHNIQUE				9
State equation of discrete data system with sample and hold — State transition equation — Methods of computing the state transition matrix – Decomposition of discrete data transfer functions — State diagrams of discrete data systems — System with zero-order hold — Controllability and observability of linear time invariant discrete data system– Stability tests of discrete-data system.					

Unit II	SYSTEM IDENTIFICATION	9
Identification of Non-Parametric Input-Output Models: -Transient analysis–Frequency analysis–Correlation analysis– Spectral analysis – Identification of Parametric Input-Output Models: - Least Squares Method – Recursive Least Square Method		
Unit III	DIGITAL CONTROLLER DESIGN	9
Review of z-transform – Modified of z-transform – Pulse transfer function – Digital PID controller – Dead-beat controller and Dahlin’s controller – Kalman’s algorithm, Pole Placement Controller		
Unit IV	MULTI-LOOP REGULATORY CONTROL	9
Multi-loop Control - Introduction — Process Interaction — Pairing of Inputs and Outputs -The Relative Gain Array (RGA) – Properties and Application of RGA - Multi-loop PID Controller – Biggest Log Modulus Tuning Method – De-coupler.		
Unit V	MULTIVARIABLE REGULATORY CONTROL	9
Introduction to Multivariable control –Multivariable PID Controller – Multivariable Dynamic Matrix Controller – Case Studies: - Distillation Column, CSTR and Four-tank system.		
Total periods:45 PERIODS		
Text Books:		
1.Stephanopoulos, G., “Chemical Process Control -An Introduction to Theory and Practice”, Prentice Hall of India, 1st Edition, 2015		
2.Sigurd Skogestad, Ian Postlethwaite, “Multivariable Feedback Control: Analysis and Design”, John Wiley and Sons, 2005, 2nd Edition.		
References:		
1.Thomas E. Marlin, Process Control – Designing Processes and Control systems for Dynamic Performance, Mc-Graw-Hill,2000, 2nd Edition.		
2.Gopal, M., “Digital Control and State Variable Methods”, Tata Mc Graw Hill, 4th Edition, 2017.		
3.P. Albertos and A. Sala, “Multivariable Control Systems An Engineering Approach”, Springer Verlag, 1st Edition, 2004		
Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, “Process Dynamics and Control”, Wiley John and Sons, 4th Edition, 2016		
Course Outcomes:		Blooms Taxonomy
CO 1:Develop mathematical models for discrete time systems using state variable techniques and analyze the stability of the systems. L4		Apply(K3)
CO2:Construct models from input-output data by least square and recursive least square method. L5		Understand(K2)
CO3:Design different digital controllers to satisfy the required criterion. L5		Analyze(K4)

CO4: Design multi-loop controller and multivariable controller for multi-variable systems. L5													Understand(K2)		
CO5: Design multivariable dynamic matrix controller for industrial processes. L5													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	2	1	1	1	1	1	1	1	1	2	2	2
CO2	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO3	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO4	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO5	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23EEE034	SYSTEM IDENTIFICATION		Category: PEC			
			L	T	P	C
			3	0	0	3
Prerequisites •						
Course Objectives: • To elaborate the concept of estimating the state variables of a system using state estimation algorithms. • To elaborate the concept of estimating the parameters of the Input-output models using parameter estimation algorithms. • To make the student understand the various closed loop system identification techniques. • To make the student understand the various closed loop system identification techniques. • To provide the background on the practical aspects of conducting experiments for real time system identification.						
Unit I	NON PARAMETRIC METHODS					9
Nonparametric methods: Transient analysis - frequency analysis - Correlation analysis - Spectral analysis.						
Unit II	PARAMETRIC METHODS					9
Parametric model structures: ARX, ARMAX, OE, BJ models - The Least square estimate - Best linear unbiased estimation under linear constraints - Updating the Parameter estimates for linear regression models - Prediction error methods: Description of Prediction error methods - Optimal Prediction — Relationships between prediction error methods and other identification methods - theoretical analysis. Instrumental variable methods: Description of Instrumental variable methods - Theoretical analysis - covariance matrix of IV estimates - Comparison of optimal IV and prediction error methods.						
Unit III	RECURSIVE IDENTIFICATION METHODS					9
The recursive least squares method - Recursive Instrumental variable method-the recursive prediction error method-model validation and model structure determination. Identification of systems operating in closed loop: Identifiability considerations - Direct identification - Indirect identification - Joint input — Output identification.						
Unit IV	CLOSED- LOOP IDENTIFICATION					9

Identification of systems operating in closed loop: direct identification and indirect identification — Subspace Identification methods: classical and innovation forms — Relay feedback identification of stable processes															
Unit V		NONLINEAR SYSTEM IDENTIFICATION											9		
Modeling of nonlinear systems using ANN- NARX & NARMAX - Training Feed-forward and Recurrent Neural Networks – TSK model – Adaptive Neuro-Fuzzy Inference System (ANFIS) - Introduction to Support Vector Regression.															
Total periods:45 PERIODS															
Text Books:															
1.Lennart Ljung, “System Identification: Theory for the user”, 2 nd Edition, Prentice Hall, 1999															
2. Dan Simon, “Optimal State Estimation Kalman, H-infinity and Non-linear Approaches”, John Wiley and Sons, 2006,															
3. Tangirala, A.K., “Principles of System Identification: Theory and Practice”, CRC Press, 2014, 1 st Edition.															
References:															
1.Cortes, C., and Vapnik, V., “Support-Vector Networks, Machine Learning”, 1995, 1 st Edition.															
2. Miller, W.T., Sutton, R.S., and Webrose, P.J., “Neural Networks for Control”, MIT Press, 1996, 1 st Edition.															
3. Van der Heijden, F., Duin, R.P.W., De Ridder, D., and Tax, D.M.J., “Classification, Parameter Estimation and State Estimation”, An Engineering Approach Using MATLAB, John Wiley & Sons Ltd., 2017, 2 nd Edition															
4. Karel J. Keesman, “System Identification an Introduction”, Springer, 2011, 1 st Edition.															
5. Tao Liu and Furong Gao, “Industrial Process Identification and control design, Step-test and relay-experiment-based methods”, Springer- Verlag London Ltd., 2012, 1 st Edition.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Design and implement state estimation schemes. L5													Analyze(K4)		
CO2: Develop various models (Linear & Nonlinear) from the experimental data. L5													Understand(K2)		
CO3: Choose a suitable model and parameter estimation algorithm for the identification of systems. L3													Analyze(K4)		
CO4: Verification and validation of identified model. L3													Understand(K2)		
CO5: Develop the model for prediction and simulation purposes using suitable control schemes. L5													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	1	1	1	1	1	1	1	1	2	2	2
CO2	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO3	3	2	2	2	1	1	1	1	1	1	1	1	2	2	2
CO4	3	2	2	2	1	1	1	1	1	1	1	1	2	2	2
CO5	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23EEE035	MODEL BASED CONTROL	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites •					
Course Objectives: - To introduce the Knowledge about Multivariable and Multiloop systems. - To understand the Model predictive control schemes and its elements. - Get exposed to state space MPC along with case studies. - To acquire knowledge on various constrained MPC. - To make the student understand the principles of STR, MRAC and Gain scheduling - To make the student design simple adaptive controllers for linear systems.					
Unit I	INTRODUCTION TO MIMO CONTROL				9
Introduction to MIMO Systems-Multivariable control-Multiloop Control-Multivariable IMC-IMCPID- Case studies					
Unit II	MODEL PREDICTIVE CONTROL SCHEMES				9
Introduction to Model Predictive Control - Model Predictive Control Elements - Generalized Predictive Control Scheme — Multivariable Generalized Predictive Control Scheme — Multiple Model based Model Predictive Control Scheme Case Studies					
Unit III	STATE SPACE BASED MODEL PREDICTIVE CONTROL SCHEME				9
State Space Model Based Predictive Control Scheme - Review of Kalman Update based filters – State Observer Based Model Predictive Control Schemes – Case Studies					
Unit IV	CONSTRAINED MODEL PREDICTIVE CONTROL SCHEME				9
Constraints Handling: Amplitude Constraints and Rate Constraints –Constraints and Optimization – Constrained Model Predictive Control Scheme – Case Studies.					
Unit V	ADAPTIVE CONTROL SCHEME				9
Introduction to Adaptive Control-Gain Scheduling-Self tuning regulators–MARS-Adaptive Model Predictive Control Scheme –Case Studie					
Total periods:45 PERIODS					
Text Books:					
1.Coleman Brosilow, Babu Joseph, “Techniques of Model-Based Control”, Prentice Hall PTR Pub 2002, 1 st Edition.					
2.E. F. Camacho, C. Bordons ,“Model Predictive Control”,Springer-Verlag London Limited 2007, 2 nd Edition					
3.K.J. Astrom and B. J. Wittenmark, “Adaptive Control”, Second Edition, Pearson Education Inc., second Edition 2013.					
References:					
1.Paul Serban Agachi, Zoltan K. Nagy, Mircea Vasile Cristea, and Arpad Imre-Lucaci Model Based Control Case Studies in Process Engineering,WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim 2007.1 st Edition.					

2.Ridong Zhang, Anke Xue Furong Gao, "Model Predictive Control Approaches Based on the Extended State Space Model and Extended Non-minimal State Space Model", Springer Nature Singapore Pte Ltd. 2019, 1st Edition.

3.J.A. ROSSITER "Model-Based Predictive Control A Practical Approach" Taylor & Francis e-Library, 2005, 1st edition.

Course Outcomes:													Blooms Taxonomy		
CO 1:Apply engineering knowledge to understand the control schemes on MIMO systems L3.													Understand(K2)		
CO2:Design controller for MIMO systemL5.													Understand(K2)		
CO3:Analyze the control schemes available in industries L4.													Analyze(K4)		
CO4:Design MPC, Adaptive controllers for practical engineering problems L5.													Analyze(K4)		
CO5:Choose suitable controllers for the given problems L5.													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	2	2	1	1	1	1	1	1	1	1	2	2	2
CO2	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO3	3	3	3	2	1	1	1	1	1	1	1	1	2	2	2
CO4	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO5	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23EEE036	NON LINEAR CONTROL	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To provide knowledge on design in state variable form - To provide knowledge in phase plane analysis. - To give basic knowledge in describing function analysis. - To study the design of optimal controller. - To study the design of optimal estimator including Kalman Filter					
Unit I	STATE VARIABLE DESIGN				9
Introduction to state Model- effect of state Feedback- Necessary and Sufficient Condition for Arbitrary Pole-placement- pole placement Design- design of state Observers- separation principle- servo design: -State Feedback with integral control					
Unit II	PHASE PLANE ANALYSIS				9

Features of linear and non-linear systems - Common physical non-linearities – Methods of linearization Concept of phase portraits – Singular points – Limit cycles – Construction of phase portraits – Phase plane analysis of linear and non-linear systems – Isocline method.		
Unit III	DESCRIBING FUNCTION ANALYSIS	9
Basic concepts, derivation of describing functions for common non-linearities – Describing function analysis of non-linear systems – limit cycles – Stability of oscillations.		
Unit IV	OPTIMAL CONTROL	9
Introduction - Time varying optimal control – LQR steady state optimal control – Solution of Ricatti's equation – Application examples.		
Unit V	OPTIMAL ESTIMATION	9
Optimal estimation – KalmanBucy Filter-Solution by duality principle-Discrete systems- Kalman Filter-Application examples.		
Total periods: 45		
Text Books:		
1. G. J. Thaler, "Automatic Control Systems", Jaico Publishing House 1993.		
2. M.Gopal, Modern Control System Theory, New Age International Publishers, 2002, 2 nd Edition.		
3. K. P. Mohandas, "Modern Control Engineering", Sanguine Technical Publishers, 2006, 1 st Edition.		
References:		
1. Ashish Tewari, 'Modern Control Design with Matlab and Simulink', John Wiley, New Delhi, 2002, 1 st Edition.		
2. K. Ogata, 'Modern Control Engineering', 5th Edition, PHI, New Delhi, 2009.		
3. T. Glad and L. Ljung,, "Control Theory –Multivariable and Non-Linear Methods", Taylor & Francis, 2002, 1 st Edition.		
4. D.S.Naidu, "Optimal Control Systems" First Indian Reprint, CRC Press, 2009, 1 st Edition.		
5. William S Levine, "Control System Fundamentals," The Control Handbook, CRC Press, Tayler and Francies Group, 2011, 2 nd Edition		
Course Outcomes:		Blooms Taxonomy
CO 1: Apply the knowledge gained on state feedback control and nonlinear control. (L3)		Understand(K2)
CO2: Carryout analysis for common nonlinearities in a system. (L4)		Understand(K2)
CO3: Apply advanced control theory to practical engineering problems. (L3)		Analyze(K4)
CO4: Design optimal controller. (L5)		Apply(K3)
CO5: Understand the basics and Importance of Kalman filter. (L2)		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	PS O3
CO1	3	2	2	2	1	1	1	3	1	3	1	1	2	2	2
CO2	3	3	3	2	1	1	1	3	1	3	1	1	2	2	2
CO3	3	2	2	2	1	1	1	3	1	3	1	1	2	2	2
CO4	3	3	3	3	1	1	1	3	1	3	1	1	2	2	2
CO5	2	1	2	1	1	1	1	2	1	2	1	1	2	2	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23EEE037	OPTIMAL CONTROL	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To provide an exposure to different type of optimal control problems such as time- optimal, fuel optimal, energy optimal control problems. - To impart knowledge and skills needed to design Linear Quadratic Regulator for Time-invariant and Time-varying Linear system (Continuous time and Discrete-time systems). - To introduce concepts needed to design optimal controller using Dynamic Programming Approach and H-J-B equation. - To provide an exposure to various types of fault tolerant control schemes such as Passive and active approaches. - To introduce concepts needed to design optimal controller in the presence of state constraints and time optimal controller.					
Unit I	CALCULUS OF VARIATIONS AND OPTIMAL CONTROL				9
Introduction – Performance Index- Constraints – Formal statement of optimal control system – Calculus of variations – Function, Functional, Increment, Differential and variation and optimum of function and functional – The basic variation problem Extrema of functions and functional with conditions – variational approach to optimal control system					
Unit II	LINEAR QUADRATIC OPTIMAL CONTROL SYSTEM				9

Problem formulation – Finite time Linear Quadratic regulator – Infinite time LQR system: Time Varying case- Time-invariant case – Stability issues of Time-invariant regulator – Linear Quadratic Tracking system: Fine time case and Infinite time case		
Unit III	DISCRETE TIME OPTIMAL CONTROL SYSTEMS	9
Variational calculus for Discrete time systems – Discrete time optimal control systems:- Fixed final state and open-loop optimal control and Free-final state and open-loop optimal control - Discrete time linear state regulator system – Steady state regulator system		
Unit IV	PONTRYAGIN MINIMUM PRINCIPLE	9
Pontryagin Minimum Principle – Dynamic Programming:- Principle of optimality, optimal control using Dynamic Programming – Optimal Control of Continuous time and Discrete-time systems – Hamilton-Jacobi-Bellman Equation – LQR system using H-J-B equation		
Unit V	CONSTRAINED OPTIMAL CONTROL SYSTEMS	9
Time optimal control systems – Fuel Optimal Control Systems- Energy Optimal Control Systems – Optimal Control Systems with State Constraints		
Total periods: 45 PERIODS		
Text Books:		
1. Donald E. Kirk, Optimal Control Theory – An Introduction, Dover Publications, Inc. Mineola, New York, 2012, 10 th Edition.		
References:		
1. D. Subbaram Naidu, Optimal Control Systems, CRC Press, New York, 2003, 1 st Edition.		
2. Frank L. Lewis, Draguna Vrabie, Vassilis L. Syrmos, Optimal Control, 3rd Edition, Wiley Publication, 2012, 3 rd Edition.		
3. Yan Wang, Cheng-Lin Liu, Zhi-Cheng Ji, <u>Quantitative Analysis and Optimal Control of Energy Efficiency in Discrete Manufacturing System</u> , Springer, 2020, 1 st Edition.		
Course Outcomes:		Blooms Taxonomy
CO 1: Explain different type of optimal control problems such as time-optimal, fuel optimal, energy optimal control problems		Understand(K2)
CO2: Design Linear Quadratic Regulator for Time-invariant and Time-varying Linear system (Continuous time and Discrete-time systems)		Understand(K2)
CO3: Design optimal controller using Dynamic Programming Approach and H-J-B equation.		Analyze(K4)
CO4: Explain the Pontryagin Minimum Principle.		Analyze(K4)
CO5: Design optimal controller in the presence of state constraints and time optimal controller.		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	2	-	1		1	-	1	1	1	1	1	1	2	2	2
CO2	-	2	2	2	1	2	1	1	1	1	1	1	2	2	2
CO3	2	2	2	-	1	1	1	1	1	1	1	1	2	2	2
CO4	2	2	2	-	1	1	1	1	1	1	1	1	2	2	2
CO5	-	1	2	1	1	1	1	1	1	1	1	1	2	2	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23EEE038	ADAPTIVE CONTROL	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives:					
- To impart knowledge on how to recursively estimate the parameters of discrete input — output models using recursive parameter estimation methods - To make the student understand the principles of STR, MRAC and Gain scheduling. - To make the student design simple adaptive controllers for linear systems using STR, MRAC and Gain scheduling					
Unit I	INTRODUCTION				9
Introduction - Adaptive Schemes - The adaptive Control Problem – Applications-Parameter estimation:-LS, RLS: and ERLS					
Unit II	GAIN SCHEDULING				9
Introduction- The principle - Design of gain scheduling controllers- Nonlinear transformations - application of gain scheduling - Auto-tuning techniques: Methods based on Relay feedback.					
Unit III	DETERMINISTIC SELF-TUNING REGULATORS				9
Introduction- Pole Placement design - Indirect Self-tuning regulators - direct self-tuning regulators – Disturbances with known characteristics.					
Unit IV	STOCHASTIC AND PREDICTIVE SELF-TUNING REGULATORS				9

Introduction – Design of minimum variance controller - Design of moving average controller - stochastic self-tuning regulators.															
Unit V		MODEL – REFERENCE ADAPTIVE SYSTEM												9	
Introduction- MIT rule – Determination of adaptation gain - Lyapunov theory –Design of MRAS using Lyapunov theory – Relations between MRAS and STR.															
Total periods: 45 PERIODS															
Text Books:															
1. K.J. Astrom and B. J. Wittenmark, “Adaptive Control”, Second Edition, Pearson Education Inc., second Edition 2013.															
References:															
1. T. Soderstorm and Petre Stoica, “System Identification”, Prentice Hall International(UK) Ltd., 1989, 1 st Edition.															
2. Lennart Ljung, “System Identification: Theory for the User”, Second Edition, Prentice Hall, 1999.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Apply the estimation algorithm to estimate the parameters of the process.(L3)													Apply(K3)		
CO2: Apply the adaptive control concepts to control a process. (L3)													Apply(K3)		
CO3: Use appropriate software tools for design of adaptive controllers and analysis of the process. (L5)													Understand(K2)		
CO4: Identify, formulate, carry out research by designing suitable adaptive schemes for complex instrumentation problem. (L5)													Understand(K2)		
CO5: Choose the techniques for self and lifelong learning to keep in pace with the new technology(L3)													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	1	1	1	3	1	1	1	1	2	2	2
CO2	3	2	2	2	1	1	1	3	1	1	1	1	2	2	2
CO3	3	3	3	3	1	1	1	3	1	3	1	1	2	2	2
CO4	3	3	3	3	1	1	1	3	1	3	1	1	2	2	2
CO5	3	2	2	2	1	1	1	3	1	1	1	1	2	2	2
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23EEE039	MACHINE MONITORING SYSTEM	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To make the students familiarize with the concept of condition-based maintenance for effective utilization of machines. - To Impart the knowledge of artificial intelligence for machinery fault diagnosis. - To give basic knowledge on vibration monitoring. - To study the machinery vibrations using signal processing techniques. - To provide knowledge on FMECA.					
Unit I	INTRODUCTION TO MACHINE CONDITION MONITORING				9
Machinery condition monitoring - Present status - Fault prognosis - Future needs.					
Unit II	MACHINERY MAINTENANCE				9
Maintenance strategies – Reactive, Preventive, and Predictive – Benefits of planned maintenance – Bath tub curve – Failure Modes Effects and Criticality Analysis (FMECA).					
Unit III	INTRODUCTION TO MACHINERY VIBRATION AND MONITORING				9
Characteristics of Vibration systems – Mode shapes & operational deflection shapes – Experimental modal analysis – Principles of vibration monitoring – Machinery faults diagnosed by vibration analysis.					
Unit IV	SIGNAL PROCESSING IN MACHINERY MONITORING				9
FFT analysis – Time domain analysis – Time-frequency analysis – Signal filtering – Cepstrum analysis – Health condition of compressor & engine.					
Unit V	MACHINE LEARNING FOR CONDITION MONITORING				9
Machine Learning: Feature extraction and feature selection methods – Feature reduction – Classification techniques – Case studies of condition monitoring in Nuclear plant components, Distillation column.					
Total periods: 45 PERIODS					
Text Books:					
1. Cornelius Scheffer and Paresh Girdhar, “Practical Machinery Vibration Analysis and Predictive Maintenance”, Elsevier, 2004, 1 st Edition.					

2. A. R. Mohanty, “Machinery Condition Monitoring: Principles and Practices” , CRC Press, Taylor & Francis, 1 st Edition, 2017.															
References:															
1. Stephen Marsland, Machine Learning: An Algorithmic Perspective, 2 nd Edition, 2014, CRC, Press.															
2. Collacot, “Mechanical Fault Diagnosis and Condition Monitoring”, Chapman- Hall, 1 st Edition, 2011															
3. Davies, “Handbook of Condition Monitoring – Techniques and Methodology”, Springer, 1 st Edition, 2011.															
4. Ian H. Witten, Eibe Frank, Mark A. Hall, Data Mining: Practical Machine Learning Tools and Techniques, Elsevier, 3rd Edition 2011.															
5. Ferdinand van der Heijden, Robert Duin, Dick de Ridder, David M. J. Tax, Classification, Parameter Estimation and State Estimation: An Engineering Approach Using MATLAB, John Wiley & Sons, 2 nd Edition, 2017.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Ability to identify the faults in machinery L1													Understand(K2)		
CO2: Choose the proper maintenance strategies and condition monitoring techniques for identification of failure in a machine L3.													Understand(K2)		
CO3: Construct a classifier model for machine learning based fault diagnosis L5.													Analyze(K4)		
CO4: Predict the faulty component in a machine by analyzing the acquired vibration signals L2.													Apply(K3)		
CO5: Analyze & build a model using modern tools L4.													Analyze(K4)		
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	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2
CO2	3	2	2	2	1	1	1	1	1	1	1	1	1	2	2
CO3	3	3	3	3	1	1	1	1	1	1	1	1	1	2	2
CO4	2	2	1	2	1	1	1	1	1	1	1	1	1	2	2
CO5	3	3	3	2	1	1	1	1	1	1	1	1	1	2	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

VERTICAL VI - (DIVERSIFIED COURSES)

23EEE040	ENERGY STORAGE SYSTEMS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives:					
Students will be able to:					
- understand the various types of energy storage Technologies. - analyze thermal storage system. - analyze different battery storage technologies - analyze the thermodynamics of Fuel Cell - study the various applications of energy storage systems.					
Unit I	INTRODUCTION				9
Necessity of energy storage – types of energy storage – comparison of energy storage technologies – Applications					
Unit II	THERMAL STORAGE SYSTEM				9
Thermal storage – Types – Modeling of thermal storage units – Simple water and rock bed storage system – pressurized water storage system – Modelling of phase change storage system – Simple units, packed bed storage units - Modelling using porous medium approach, Use of TRNSYS.					
Unit III	ELECTRICAL ENERGY STORAGE				9
Fundamental concept of batteries – measuring of battery performance, charging and discharging, power density, energy density, and safety issues. Types of batteries – Lead Acid, Nickel – Cadmium, Zinc Manganese dioxide, Li-ion batteries - Mathematical Modelling for Lead Acid Batteries – Flow Batteries.					
Unit IV	FUEL CELL				9
Fuel Cell – History of Fuel cell, Principles of Electrochemical storage – Types – Hydrogen oxygen cells, Hydrogen air cell, Hydrocarbon air cell, alkaline fuel cell, detailed analysis – advantages and disadvantages.					
Unit V	ALTERNATE ENERGY STORAGE TECHNOLOGIES				9
Flywheel, Super capacitors, Principles & Methods – Applications, Compressed air Energy storage, Concept of Hybrid Storage – Applications, Pumped Hydro Storage – Applications.					
Total periods:45 PERIODS					
Text Books:					

1. Ibrahim Dincer and Mark A. Rosen, 'Thermal Energy Storage Systems and Applications', John Wiley & Sons, 3 rd Edition, 2021.															
2. Ru-shi Liu, Lei Zhang and Xueliang sun, 'Electrochemical technologies for energy storage and conversion', Wiley publications, 2 nd Volume set, 2012.															
3. James Larminie and Andrew Dicks, 'Fuel cell systems Explained', Wiley publications, 3 rd Edition, 2018.															
References:															
1. Lunardini.V.J, 'Heat Transfer in Cold Climates', John Wiley and Sons 1981, 1 st Edition.															
2. Schmidt.F.W. and Willmott.A.J., 'Thermal Energy Storage and Regeneration', Hemisphere Publishing Corporation, 1981, 1 st Edition															
Course Outcomes:													Blooms Taxonomy		
CO 1: Understand different types storage technologies													Understand(K2)		
CO2: Design a thermal storage system													Understand(K2)		
CO3: Model battery storage system													Understand(K2)		
CO4: Analyze the thermodynamics of fuel cell													Analyze(K4)		
CO5: Analyze the appropriate storage technologies for different applications													Analyze(K4)		
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	1		-	-	-	-	-	-	-	-	-	2	-	3
CO2	3	-	2	-	-	-	-	-	-	-	-	-	2	-	3
CO3	3	-	2	-	-	-	-	-	-	-	-	-	2	-	3
CO4	3	-	2	-	-	-	-	-	-	-	-	-	2	-	3
CO5	3	-	2	-	-	-	-	-	-	-	-	-	2	-	3
1 - Low, 2 - Medium, 3 - High , '- ' No correlation															

23EEE041	HYBRID ENERGY TECHNOLOGY	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
•					

Course Objectives:		
*To provide knowledge about different types of hybrid energy systems. *To analyze the various electrical Generators used for the Wind Energy Conversion Systems. *To design the power converters used in SPV Systems. *To analyze the various power converters used in hybrid energy systems and to understand the importance of standalone and grid-connected operation in Hybrid renewable energy systems. *To analyze the performance of the various hybrid energy systems		
Unit I	INTRODUCTION TO HYBRID ENERGY SYSTEMS	9
Hybrid Energy Systems — Need for Hybrid Energy Systems — Solar-Wind-Fuel Cell-Diesel, Wind- Biomass-Diesel, Micro-Hydel-PV, Ocean and geyser energy - Classification of Hybrid Energy systems – Importance of Hybrid Energy systems — Advantages and Disadvantages - Environmental aspects of renewable energy - Impacts of renewable energy generation on the environment - Present Indian and international energy scenario of conventional and RE sources - Ocean energy, Hydel Energy - Wind Energy, Biomass energy, Hydrogen energy - Solar Photovoltaic (PV) and Fuel cells: Operating principles and characteristics.		
Unit II	ELECTRICAL MACHINES FOR WIND ENERGY CONVERSION SYSTEMS (WECS)	9
Review of reference theory fundamentals –Construction, Principle of operation and analysis: Squirrel Cage Induction Generator (SCIG), Doubly Fed Induction Generator (DFIG) - Permanent Magnet Synchronous Generator (PMSG).		
Unit III	POWER CONVERTERS AND ANALYSIS OF SOLAR PV SYSTEMS	9
Power Converters for SPV Systems - Line commutated converters (inversion-mode) Boost and buck- boost converters- selection of inverter, battery sizing, array sizing - Analysis of SPV Systems - Block diagram of the solar PV systems - Types of Solar PV systems: Stand-alone PV systems.		
Unit IV	ANALYSIS OF POWER CONVERTERS FOR HYBRI ENERGY SYSTEMS	9
Introduction to Power Converters – Stand-alone Converters -AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters - Bi-Directional Converters - Grid-Interactive Inverters - Matrix converter — Merits and Limitations		
Unit V	CASE STUDIES FOR HYBRID RENEWABLE ENERGY SYSTEMS	9
Hybrid Systems- Range and type of Hybrid systems — Performance Analysis — Cost Analysis - Case studies of Diesel-PV, Wind-PV-Fuel-cell, Micro-hydel-PV, Biomass-Diesel-Fuel-cell systems.		
Total periods: 45 PERIODS		
LIST OF EXPERIMENTS:		
1.Simulation of Wind energy conversion system		

2.Simulation of power converters															
3.Simulations of AC-DC-AC converters, PWM inverters and Matrix Converters with Resistive and dynamic loads															
Text Books:															
1. Bahman Zohuri, “Hybrid Energy Systems”, Springer, First Edition, 2018.															
2. S.M. Muyeen, “Wind Energy Conversion Systems”, Springer First Edition, 2012															
3. Md. Rabiul Islam, Md. Rakibuzzaman Shah, Mohd Hasan Ali, "Emerging Power Converters for Renewable Energy and Electric Vehicles", CRC Press, First Edition, 2021															
References:															
1. Ernst Joshua, Wind Energy Technology, PHI, India, 2018, 3 rd Edition.															
2. S.N.Bhadra, D. Kastha, & S. Banerjee “Wind Electrical Systems”, Oxford University Press, 7 th Impression, 2005.															
3. Rashid.M. H “Power electronics Hand book”, Academic press,4 th Edition, 2018.															
4. Rai. G.D, “Non-conventional energy sources”, Khanna publishers, 6 th Edition, 2017.															
5. Rai. G.D, “Solar energy utilization”, Khanna publishers, 3 rd Edition, 1987.															
6. Gray, L. Johnson, “Wind energy system”, Prentice Hall of India, 2 nd Edition, 2006.															
7. B.H.Khan "Non-conventional Energy sources", Tata McGraw hill Publishing Company, New Delhi, 2017, 3 rd Edition.															
Course Outcomes: Upon completion of the course, students will be able to													Blooms Taxonomy		
CO 1: Analyze the impacts of hybrid energy technologies on the environment and demonstrate them to harness electrical power.													Analyze(K4)		
CO2: : Select a suitable Electrical machine for Wind Energy Conversion Systems and simulate wind energy conversion system.													Understand(K2)		
CO3: Design the power converters such as AC-DC, DC-DC, and AC-AC converters for SPV systems.													Understand(K2)		
CO4: Analyze the power converters such as AC-DC, DC-DC, and AC-AC converters for Hybrid energy systems.													Analyze(K4)		
CO5: Interpret the hybrid renewable energy systems.													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	2	-	-	-	-	-	3	-	3	3	3	3
CO2	3	3	3	2	3	-	-	-	-	3	-	3	3	3	3

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

23EEE042	DESIGN AND MODELLING OF RENEWABLE ENERGY SYSTEMS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To review the renewable energy systems and technology - To learn the Single phase grid-connected photovoltaic systems and three phase photovoltaic systems - To illustrate the small wind energy systems - To simulate the Doubly-fed induction generator based WECS					
Unit I	RENEWABLE ENERGY SYSTEMS: TECHNOLOGY OVERVIEW AND PERSPECTIVES				9
Introduction-State of the Art- Examples of Recent Research and Development Challenges and Future Trends.					
Unit II	SINGLE-PHASE GRID-CONNECTED PHOTOVOLTAIC SYSTEMS				9
Introduction- Demands for Grid-Connected PV Systems-Power Converter Technology for Single- Phase PV Systems, Transformer less AC-Module Inverters (Module-Integrated PV Converters, Transformer less Single-Stage String Inverters, DC-Module Converters in Transformer less Double-Stage PV Systems					
Unit III	THREE-PHASE PHOTOVOLTAIC SYSTEMS: STRUCTURES, TOPOLOGIES				9
Introduction-PV Inverter Structures, Three-Phase PV Inverter Topologies- -Control Building Blocks for PV Inverters, Modulation Strategies for Three-Phase PV Inverters, Implementation of the Modulation Strategies., Grid Synchronization, Implementation of the PLLs for Grid Synchronization, Current Control, Implementation of the Current Controllers, Maximum Power Point Tracking.					
Unit IV	SMALL WIND ENERGY SYSTEMS				9
Introduction-Generator Selection for Small-Scale Wind Energy Systems- Turbine Selection for Wind Energy- Self-Excited Induction Generators for Small Wind Energy Applications-					

Permanent Magnet Synchronous Generators for Small Wind Power Applications- Grid-Tied Small Wind Turbine Systems-Magnus Turbine–Based Wind Energy System															
Unit V		DOUBLY-FED INDUCTION GENERATOR-BASED WECS											9		
Introduction – modelling of induction machine in machine variable form and arbitrary reference frame, modelling of Doubly-fed Induction Generator.															
Total periods: 45 PERIODS															
LIST OF EXPERIMENTS:															
1.Simulation of inverter for PV systems															
2.Simulation of WECS with DFIG.															
Text Books:															
1. Ahmad Azar, Nashwa Kamal, "Design, Analysis and Applications of Renewable Energy Systems", Academic Press, First Edition, 2021															
2. Ahmad Azar, Nashwa Kamal, "Renewable Energy Systems", Academic Press, First Edition, 2021															
3. Nabil Derbel, Quanmin ZhuModeling, "Identification and Control Methods in Renewable Energy Systems" , Springer, First Edition, 2019															
References:															
1. Power Conversion and Control of Wind Energy Systems, Bin Wu, 2011, Wiley-IEEE, 1 st Edition.															
2. Wind Electrical Systems, S.N. Bhadra, 2005, Oxford, 7 th Impression.															
3. Wind Power Integration - Connection and System Operational Aspects, Brendan Fox, 2014, IET, 2 nd Edition															
4. Renewable Energy Devices and Systems with Simulations in MATLAB and ANSYS, Frede Blaabjerg, Dan M. Ionel, CRC press, 2017, 1 st Edition.															
Course Outcomes: Upon completion of the course, students will be able to													Blooms Taxonomy		
CO 1: Review the perspectives of renewable energy systems													Understand(K2)		
CO2: Integrate photovoltaic systems with grid													Understand(K2)		
CO3: Study inverter for PV systems													Analyze(K4)		
CO4: Elaborate the working of small wind power systems													Understand(K2)		
CO5: Study the features of induction machine and doubly fed induction machine													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	2	-	-	-	-	-	-	-	-	3	-	2
CO2	3	2	3	3	-	-	-	-	-	-	-	-	3	3	3

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

23EEE043	GRID INTEGRATING TECHNIQUES AND CHALLENGES	Category: PEC			
		L	T	P	C
		2	0	2	3
Prerequisites					
Course Objectives: - To study about the present power Scenario - To model a micro grid system - To model power converter for grid interconnection - To integrate wind energy conversion system with grid - To simulate power converters like three phase inverters and DC-DC converters					
Unit I	PRESENT POWER SCENARIO IN INDIA				6
Introduction - Thermal Power Plant , Components of Thermal Power Plant , Major Thermal Power Plants in India- Gas-Based Power Generation - Nuclear Power Plants -Hydropower Generation - Pumped Storage Plants - Solar Power - Wind Energy — Power plants India					
Unit II	POWER GRIDS				6
Introduction -Electric Power ,Background , The Construction of a Power Grid System , Basic Concepts of Power Grids -Load Models - Transformers in Electric Power Grids - Modelling a Microgrid System					
Unit III	MODELING OF CONVERTERS IN POWER GRID DISTRIBUTED GENERATION SYSTEMS				6
Introduction - Single-Phase DC/AC Inverters with Two Switches, Three-Phase DC/AC Inverters, Pulse Width Modulation Methods, The Triangular, The Identity Method, Analysis of DC/AC Three-Phase Inverters. Micro grid of Renewable Energy Systems- DC/DC Converters in Green Energy -Pulse Width Modulation -Sizing of an Inverter for Microgrid Operation, Sizing of a Rectifier for Microgrid Operation, The Sizing of DC/DC Converters for Micro grid					
Unit IV	WIND ENERGY SYSTEM GRID INTEGRATION				6
Introduction- Significance of Electrical Power Quality in Wind Power System- Integration Issues in Grid-Connected Wind Energy- Effect of Power Quality Issues, Importance of Custom					

Power Devices- Power Quality Point of View.		
Unit V	GRID INTER CONNECTION	6
Grid Code requirements-Grid integration of WECS-Grid Integration of PV systems		
LIST OF EXPERIMENTS		(30)
1. Develop a model for the control of DC micro grid for non linear loads		
2. Simulation study of three phase inverters with fixed and sine PWM techniques, Simulation and Design of buck/boost converters.		
3. Simulate a Grid Connected Wind Energy System with STATCOM and investigate the improvement in power quality.		
Total periods: 30+30 = 60 PERIODS		
TEXT BOOKS:		
1.Brian D’Andrade “The Power Grid”, Academic Press, 1st Edition, 2017.		
2.Yang Han, "Modeling and Control of Power Electronic Converters for Microgrid Applications", Springer, 1 st Edition 2022.		
3.Siegfried Heier, "Grid Integration of Wind Energy: Onshore and Offshore Conversion Systems", John Wiley & Sons, Ltd, 2014, 3 rd Edition.		
References:		
1. Integration of Renewable Energy Sources with Smart Grid, M. Kathires, A. Mahaboob Subahani, and G.R. Kanaga chidambaresan, Scrivener & Wiley, 2021, 1 st Edition.		
2. Control and Operation of Grid-Connected Wind Energy Systems, Ali M. Eltamaly, Almoataz Y. Abdelaziz, Ahmed G. Abo-Khalil, Springer 2021, 1 st Edition.		
3. Design of smart power grid renewable energy systems, Third Edition, Ali Keyhani, Wiley 2019		
4. Power Electronic Converters, Teuvo Suntio, Tuomas Messo, Joonas Puukko, Wiley 2017, 1 st Edition.		
5. Fundamentals of Power Electronics with MATLAB, Randall Shaffer, Laxmi publications, 2013, 2 nd Edition.		
6. Power Conversion and Control of Wind Energy Systems, Bin Wu, 2011, Wiley-IEEE, 1 st Edition.		
7. Wind Power Integration - Connection and System Operational Aspects, Brendan Fox, 2014, IET, 2 nd Edition.		
8.Renewable Energy Devices and Systems with Simulations in MATLAB and ANSYS, Frede Blaabjerg, Dan M. Ionel, CRC press, 2017, 1 st Edition.		

Course Outcomes: Upon completion of the course, Students able to													Blooms Taxonomy		
CO 1: Review the power sector scenario in India.													Understand(K2)		
CO2: Model a microgrid system.													Analyze(K4)		
CO3: Model a converter for power grid distributed system.													Understand(K2)		
CO4: Integrate wind energy system.													Apply(K3)		
CO5: Simulate three phase inverter with fixed and sine PWM.													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	-	3	3	3	3
CO2	3	-	2	-	3	-	-	-	-	3	-	3	3	3	3
CO3	3	3	3	2	3	-	-	-	-	3	-	3	3	3	3
CO4	3	3	1	3	3	-	-	-	-	3	-	3	3	3	3
CO5	3	3	2	3		-	-	-	-	3	-	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23EEE044	SUSTAINABLE AND ENVIRONMENTAL FRIENDLY HV INSULATION SYSTEM	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives:					
- To Know about the products related with sustainable application. - To learn about Green Gaseous, liquid solid insulators. - To understand the standards for green insulation systems.					
Unit I	SUSTAINABLE AND ENVIRONMENTAL ENERGY AND PRODUCTS				9
Carbon print, global warming potential, environment requirement for any product and system.					
Unit II	ALTERNATE GREEN GASEOUS INSULATORS				9
SF6 gas and its hazardous environmental effects, alternate gases, gaseous mixtures and other sources and it’s properties.					
Unit III	ALTERNATE GREEN LIQUID INSULATORS				9

hazardous effects of existing liquid dielectric materials (such as organic oil), alternate sources of environmental friendly liquid such as ester oil, vegetable oils dielectric and it's properties.																
Unit IV		ALTERNATE GREEN SOLID INSULATORS												9		
hazardous effects of existing solid dielectric materials, alternate sources of environmental friendly solid dielectric and its properties.																
Unit V		EVOLVING STANDARDS FOR GREEN INSULATION SYSTEMS												9		
Requirements, evolving standards of management, testing, usage and disposal of alternate insulation systems, Major applications and standards																
Total periods: 45 PERIODS																
Text Books:																
1.																
References:																
1. https://www.iso.org/standard/79064.html																
2. https://www.ictfootprint.eu/en/iec-tr-627252013-factsheet																
3. https://www.iec.ch/dyn/www/f?p=103:7:0:::FSP_ORG_ID,FSP_LANG_ID:1275,25																
4. https://www.iec.ch/ords/f?p=103:41:628762356646470:::FSP_ORG_ID,FSP_LANG_ID:3237,25																
5. https://www.iec.ch/dyn/www/f?p=103:7:0:::FSP_ORG_ID,FSP_LANG_ID:1299,25																
6. https://www.iec.ch/sdgs/sdg13																
7. http://highperformanceinsulation.eu/wp-content/uploads/2016/08/sustainability_a_guide.pdf																
Course Outcomes: Upon completion of the course, students will be able to														Blooms Taxonomy		
CO 1: Sustainable and environmental energy and products														Understand(K2)		
CO2: Describe the alternate green gaseous insulators														Understand(K2)		
CO3: Describe the alternate green liquid insulators														Analyze(K4)		
CO4: Describe the alternate green solid insulators														Understand(K2)		
CO5: Elaborate the standards for Green insulation systems														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	
CO2	3	-	3	-	-	-	3	-	-	-	-	-	3	-	3	

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

23EEE045	POWER SYSTEM TRANSIENTS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To study the generation of switching transients and their control using circuit – theoretical concept. - To study the mechanism of lightning strokes and the production of lightning surges. - To study the propagation, reflection and refraction of travelling waves. - To study the impact of voltage transients caused by faults, circuit breaker action, load rejection on integrated power system.					
Unit I	INTRODUCTION AND SURVEY				9
Sources of different types of transients - RL circuit transient with sine wave excitation - double frequency transients - basic transforms of the RLC circuit transients - study of transients in system planning - Importance of grounding.					
Unit II	SWITCHING TRANSIENTS				9
Basic concept of switching transients - resistance switching and equivalent circuit for interrupting the resistor current - load switching and equivalent circuit - waveforms for transient voltage across the load and the switch - normal and abnormal switching transients. Current suppression – current chopping - effective equivalent circuit - capacitance switching with a restrike, with multiple restrikes - ferro resonance.					
Unit III	LIGHTNING TRANSIENTS				9
Theories of cloud formation - mechanism of lightning discharges and characteristics of lightning strokes — model for lightning stroke - factors contributing to good line design - protection using ground wires - tower footing resistance - Interaction between lightning and power system.					
Unit IV	TRAVELING WAVES ON TRANSMISSION LINE COMPUTATION OF TRANSIENTS				9
Computation of transients - transient response of systems with series and shunt lumped parameters and distributed lines. Traveling wave concept - step response - Bewely’s lattice diagram - standing waves and natural frequencies - reflection and refraction of travelling waves. Computation of overvoltages using EMTP.					

Unit V	TRANSIENTS IN INTEGRATED POWER SYSTEM												9		
The short line and kilometric fault - distribution of voltages in a power system - Line dropping and load rejection - voltage transients on closing and reclosing lines - overvoltage induced by faults - switching surges on integrated system Qualitative application of EMTP for transient computation.															
Total periods: 45 PERIODS															
LIST OF EXPERIMENTS:															
1.Simulation of circuit transients															
2.Computation of over voltages for switching surges															
3.Computation of over voltages for lightning surges															
4.Computation of transients.															
Text Books:															
1.Allan Greenwood, ‘Electrical Transients in Power Systems’, Wiley Inter Science, New York, 2 nd Edition, 1991.															
2. Pritindra Chowdhari, “Electromagnetic transients in Power System”, John Wiley and Sons Inc., Second Edition, 2009.															
3. C.S. Indulkar, D.P.Kothari, K. Ramalingam, ‘Power System Transients – A statistical approach’, PHI Learning Private Limited, Second Edition, 2010.															
References:															
1. M.S.Naidu and V.Kamaraju, ‘High Voltage Engineering’, Tata McGraw Hill, Fifth Edition, 2013															
2. R.D. Begamudre, ‘Extra High Voltage AC Transmission Engineering’, Wiley Eastern Limited, 1986.															
3. Y.Hase, Handbook of Power System Engineering,” Wiley India, 2012.															
4. J.L.Kirtley, “Electric Power Principles, Sources, Conversion, Distribution and use,” Wiley, 2012.															
Course Outcomes: After completing the course, the students will be above to													Blooms Taxonomy		
CO 1: Explain the principles of transients and its concepts													Understand(K2)		
CO2: Switching transients and the way to draw the necessary equivalent circuit.													Understand(K2)		
CO3: Explain the concepts behind lighting and the way to protect the same													Understand(K2)		
CO4:Compute the transient behavior in transmission line.													Apply(K3)		
CO5: Explain the behavior of the Circuit during switching and to learn the simulation tool.													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	3	3	2	-	2	-	-	-	-	3	3	3	3

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

23EEE046	PLC PROGRAMMING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives:					
- To know about the basics of PLC andAutomation. - To understand the importance of Automation - To explore various types and manufactures of PLCs. - To introduce types of programming languages of PLC and some exercise few programs					
Unit I	INTRODUCTION				9
Programmable Logic Controller (PLC)- Block diagram of PLC- Programming languages of PLC- Basic instruction sets- Design of alarm and interlocks- Networking of PLC- Overview of safety of PLC with case studies- Process Safety Automation: Levels of process safety through use of PLCs- IEC 61131-3 Standard - Application of international standards in process safety control.					
Unit II	IEC 61131-3				9
Rails- Rungs- Relay Logic- Latch switch- Timers- Counters- Boolean logics- Math Instructions- Data manipulation Instructions- Requirement of communication networks for PLC, PLC to PC Communication to computer- FBD equivalent to LL- FBD Programming- IL- SFC-ST.					
Unit III	SCADA				9
Elements of SCADA system- History of SCADA, Remote Terminal Unit- Discrete control- Analog control, Master Terminal Unit- Operator interface.					
Unit IV	HART and Field Bus				9
Introduction- Evolution of signal standards- HART communication protocol- communication modes- HART networks- HART commands- HART and OSI model- Field bus- Architecture- Basic requirements of field Busstandard- Field bus Topology- Interoperability- Interchangeability.					
Unit V	PLC PROGRAMMING				9

Exercise in Programming Languages from IEC 61131-3: Traffic Light Control- Two way- Four way — Water Level Control- Automatic Material Sorting System- Automatic Bottle Filling System, Code Converters- DC motor Control- Alarm Circuit.
Total periods: 45 PERIODS
LIST OF EXPERIMENTS:
1.Taking Local area to implement simple closed loop system for any system using PLC.
2.Making a complete automated control loop with Supervisory and HMI system.
3.Implementing an Alarm based control scheme and run in a simulated environment.
4.Designing an entire PLC logic for filling and draining water tank automatically.
Text Books:
1. Frank D. Petruzella, “Programmable Logic Controllers”, 5th Edition, McGraw- Hill, New York, 2019.
2. Stuart Boyer A, “SCADA: Supervisory control and data Acquisition”, Fourth Edition, ISA- The Instrumentation, Systems, and Automation Society,2010
References:
1. Bolton. W, “Programmable Logic Controllers”, Elsevier Newnes, 6 th Edition 2015
2. https://nptel.ac.in/courses/108105062
3. https://nptel.ac.in/courses/108105088
4. http://www.nitttrc.edu.in/nptel/courses/video/105105201/lec56.pdf
5. https://nptel.ac.in/courses/108106022
6. https://new.siemens.com/global/en/products/automation/systems/industrial/plc/logo/logo-software.html
7. https://componentsearchengine.com/library/proteus?gclid=CjwKCAjw_ISWBhBkEiwAdqxb9okU2ZZHcQoa9fSRK2Uq41Rq0GZxdGUP6_6GlBv77p4JqGt_iDAIjhoCksEQAvD_BwE

Course Outcomes:													Blooms Taxonomy		
CO 1: Understand the basics and need for Automation in industries													Understand(K2)		
CO2: Explain the logic and flow of any particular programming written for a process .													Analyze(K4)		
CO3: Apply the knowledge to design or improve an existing program to increase productivity of any process													Apply(K3)		
CO4: Breakdown SCADA architecture and communication protocols.													Understand(K2)		
CO5: Build and logic in any of the programming languages from IEC- 61131- 3 standard													Analyze(K4)		
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	-	-	-	1	-	1	-	-	-	-	-
CO2	2	2	2	2	-	-	-	1	-	1	-	-	-	-	-
CO3	3	2	2	2	-	-	-	1	-	1	-	-	-	-	-
CO4	3	3	3	2	-	-	-	1	-	1	-	-	-	-	-
CO5	3	2	2	2	-	-	-	1	-	1	-	-	-	-	-
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23EEE047	BIG DATA ANALYTICS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives:					
- To understand big data. - To learn and use NoSQL big data management. - To learn mapreduce analytics using Hadoop and related tools. - To work with map reduce applications - To understand the usage of Hadoop related tools for Big Data Analytics					

Unit I	UNDERSTANDING BIG DATA	5
Introduction to big data – convergence of key trends – unstructured data – industry examples of big data – web analytics – big data applications– big data technologies – introduction to Hadoop – open source technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics – inter and trans firewall analytics		
Unit II	NOSQL DATA MANAGEMENT	7
Introduction to NoSQL – aggregate data models – key-value and document data models – relationships – graph databases – schemaless databases – materialized views – distribution models – master-slave replication – consistency - Cassandra – Cassandra data model – Cassandra examples – Cassandra clients		
Unit III	MAP REDUCE APPLICATIONS	6
MapReduce workflows – unit tests with MRUnit – test data and local tests – anatomy of MapReduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution – MapReduce types – input formats – output formats.		
Unit IV	BASICS OF HADOOP	6
Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures - Cassandra – Hadoop integration		
Unit V	HADOOP RELATED TOOLS	6
Hbase – data model and implementations – Hbase clients – Hbase examples – praxis. Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts. Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries.		
LIST OF EXPERIMENTS		
1	Downloading and installing Hadoop; Understanding different Hadoop modes. Startup scripts, Configuration files.	
2	Hadoop Implementation of file management tasks, such as Adding files and directories, retrieving files and Deleting files	
3	Implement of Matrix Multiplication with Hadoop Map Reduce	
4	Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.	
5	Installation of Hive along with practice examples.	
6	Installation of HBase, Installing thrift along with Practice examples	
7	Practice importing and exporting data from various databases.	
Lecture : 30 Practical : 30 Total periods: 60 PERIODS		
Text Books:		

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013															
2.Eric Sammer, "Hadoop Operations", O'Reilley, 2012.															
3.Sadalage, Pramod J. "NoSQL distilled", 2013															
References:															
1.E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.															
2.Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.															
3.Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.															
4.Alan Gates, "Programming Pig", O'Reilley, 2011.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Describe big data and use cases from selected business domains.													Understand(K2)		
CO2: Explain NoSQL big data management.													Understand(K2)		
CO3: Install, configure, and run Hadoop and HDFS													Analyze(K4)		
CO4: Perform map-reduce analytics using Hadoop.													Analyze(K4)		
CO5: Use Hadoop-related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.													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	-	-	-	2	2	3	1	1	3	3
CO2	3	3	2	3	2	-	-	-	2	2	3	3	2	3	2
CO3	3	3	3	2	3	-	-	-	2	2	1	2	2	3	3
CO4	2	3	3	3	3	-	-	-	2	2	3	2	3	3	2
CO5	3	3	3	3	3	-	-	-	3	1	3	2	3	2	3
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
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 .		
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
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 Cielien, 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
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, <i>Virtual Reality</i> , Cambridge University Press, 2017.															
2. William R. Sherman & Alan B. Craig, <i>Understanding Virtual Reality: Interface, Application, and Design</i> , 2nd Edition, Morgan Kaufmann, 2019.															
3. Doug Bowman, Ernst Kruijff, Joseph J. LaViola, Ivan Poupyrev, <i>3D User Interfaces: Theory and Practice</i> , 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
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CSO009	DATA STRUCTURES IN PROGRAMMING	Category: OEC			
		L	T	P	C
		2	0	2	3
Prerequisites • 23GET101-PROGRAMMING IN C • 23CST201-PROBLEM SOLVING AND PYTHON PROGRAMMING					
Course Objectives: ● To apply the concepts of Linked List in the applications of various linear data structures. ● To demonstrate the understanding of stacks, queues and their applications. ● To apply the concepts of Linked List in the applications of various nonlinear data structures. ● To understand the implementation of graphs and their applications. ● To be able to incorporate various sorting and hashing techniques in real time scenarios					

Unit I	LINEAR DATA STRUCTURES –LIST	6
Self-Referential Structures, Dynamic Memory Allocation, Linked list implementation - Singly Linked List, Doubly Linked List, Circular Linked List, Applications of List.		
Unit II	LINEAR DATA STRUCTURES –STACK AND QUEUE	6
Stack – Operations, Array and Linked list implementation, Applications – Evaluation of Arithmetic Expressions, Queues- Operations, Array and Linked list Implementation.		
Unit III	NONLINEAR DATA STRUCTURES –TREES	6
Tree Terminologies, Binary Tree Representation, Tree Traversals, Binary Search Trees, Binary Heap, Height Balance Trees– AVL Trees.		
Unit IV	NONLINEAR DATA STRUCTURES –GRAPHS	6
Representation of Graphs, Topological Sort, Depth First Search and Breadth-First Search , Minimum Spanning Tree –Prim's Algorithm, Shortest path algorithm – Dijkstra’s Algorithm.		
Unit V	SEARCHING, SORTING AND HASHING TECHNIQUES	6
Sorting Techniques –Insertion Sort, Quick Sort, Merge Sort, Hashing- Hashing functions – Mid square, Division, Folding, Collision Resolution Techniques – Separate Chaining – Open Addressing – Rehashing.		
LIST OF EXPERIMENTS		
1	Implementation of Single Linked List (Insertion, Deletion and Display).	
2	Implementation of Doubly Linked List (Insertion, Deletion and Display).	
3	Implementation of Stack using Array and Linked List implementation.	
4	Implementation of Queue using Array and Linked List implementation.	
5	Implementation of Binary Search Tree and perform Tree Traversal Techniques.	
6	Program to perform Quick Sort	
7	Program to perform Merge Sort	
8	Program to perform Linear Probing.	
9	Program to perform Rehashing.	
10	Mini Project: • Contact book application using Linked List. • Dictionary using Binary search trees. • Snake Game. • Chess Game. • Travel Planner (Shortest Path Algorithm). • Tic-Tac-Toe Game. • Library Management System. • Project Management System. • other projects	
Lecture : 30 Practical : 30 Total periods:30+30 = 60 Periods		
Text Books:		
1.“Data Structures and Algorithm Analysis in C”, Mark Allen Weiss, 2nd Edition, Pearson Education, 2005		
2.“Data Structures and Algorithm Analysis in C++ - Anna University, Mark Allen Weiss, Pearson Education, 2017.		
References:		

1.“Data Structures Using C and C++”, Langsam, Augenstein and Tanenbaum, 2nd Edition, Pearson Education, 2015.																
2.Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, Introduction to Algorithms”, Fourth Edition, Mcgraw Hill/ MIT Press, 2022.																
Course Outcomes: At the end of the course, students will be able to													Blooms Taxonomy			
CO 1: Understand and apply the various concepts of Linear data Structures													Understand(K2)			
CO2: Understand and apply the various concepts of Non Linear data Structures.													Understand(K2)			
CO3: Understand and apply the various sorting and Hashing concepts.													Understand(K2)			
CO4: Analyse and apply the suitable data structure for their research.													Analyze (K4)			
CO5: Choose efficient data structures and apply them to solve real world problems.													Apply (K3)			
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	1	2	1	2	1	-	-	-	-	-	-	1	1	1	1	
CO2	1	1	2	1	1	-	-	-	-	-	-	2	1	1	1	
CO3	1	1	2	1	1	-	-	-	-	-	-	2	1	1	1	
CO4	1	1	2	1	1	-	-	-	-	-	-	2	1	1	1	
CO5	1	1	2	1	1	-	-	-	-	-	-	1	1	1	1	
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	-	-	-
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). Environmental NGOs: Sustainability Stewardship. 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	–

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

23HSO002	PROJECT REPORT WRITING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites •					
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	Writing Skills and Technical vs. General Writing				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	Audience, Plagiarism, and Report Writing in STEM Fields				9
Audience – Plagiarism – Report Writing in STEM fields – Experiment – Statistical Analysis. Project Report – Definition, Structure, Types of Reports, Purpose – Intended					
Unit III	Structure of Project Report – Part 1 (Title, Abstract, Introduction, Research Question, Theoretical Framework)				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	Structure of Project Report – Part 2 (Literature Review, Research Design, Data Analysis, Findings, Recommendations, Conclusion, Bibliography)				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	Proofreading, Formatting, and Oral Presentation Techniques				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															
Text Books:															
1. Gerson, S.J., & Gerson, S.M., 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.															
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		
CO1: Write effective project reports.													Analyze(K4)		
CO2: Use statistical tools with confidence.													Analyze(K4)		
CO3: Explain the purpose and intension of the proposed project coherently and with clarity.													Understand(K2)		
CO4: Create writing texts to suit achieve the intended purpose.													Understand(K2)		
CO5: Master the art of writing winning proposals and projects.													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	-	-	-
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.forgeforward.in/valuation-risk-versus-validation-risk-in-product-innovations49f253ca8624		
3. https://blog.forgeforward.in/product-innovation-rubric-adf5ebdf356		

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-7812cdfe9b85															
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	-	-
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
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.	23EE0002 ELECTRIC AND HYBRID VEHICLES												Category: OEC				
													Apply(K3)				
													L	T	P	C	
Prerequisites																	
Course 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	3	3	3	3	2	3	3	1	1	2	2	2	1		
CO5	3	3	3	3	3	3	-	2	2	-	1	1	2	2	1		
1 - Low, 2 - Medium, 3 - High, - No correlation																	
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
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		Analyze(K4)

systems															
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	-
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.Tephen 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	-	-
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23MGO003	QUALITY ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
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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 process oriented 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- 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, Xchart 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 – Introduction to Statistical Quality Control, <i>8th Edition, Wiley, 2020.</i>															
2. Juran, J.M., & Godfrey, A.B. – Juran’s Quality Handbook, <i>6th Edition, McGraw-Hill, 2016.</i>															
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 manufacturing industries.													Apply(K3)		
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
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CHO001	FIRE SAFETY ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
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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															
Particul ar	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	-	-	-
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 fibroscopes – 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

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. Hstand, “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
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23MEO00 5	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. - To familiarize students with the various Programming and Machine Vision application in robots. - To build confidence among students to evaluate, choose and incorporate robots in engineering systems.					
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 sensors used in robots.														Understand(K2)		
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”-, SSKataria & 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	-	-

23CE0002	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 classificatio																
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	-	-

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): 323–324. 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	-	-

23CE0004	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., “Elememts 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	-	-	-

23CE0002	LEAN CONCEPTS, TOOLS AND PRACTICES	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
•					
Course Objectives:					
1. To impart knowledge about the basics of lean principles, tools and techniques, and implementation in the construction industry.					
Unit I	INTRODUCTION				9
Introduction and overview of the construction project management - Review of Project Management & Productivity Measurement Systems - Productivity in Construction - Daily Progress Report-The state of the industry with respect to its management practices -construction project phases - The problems with current construction management techniques.					
Unit II	LEAN MANAGEMENT				9
Introduction to lean management - Toyota’s management principle-Evolution of lean in construction industry - Production theories in construction –Lean construction value - Value in construction - Target value design - Lean project delivery system- Forms of waste in construction industry - Waste Elimination.					
Unit III	CORE CONCEPTS IN LEAN				9
Concepts in lean thinking – Principles of lean construction – Variability and its impact – Traditional construction and lean construction – Traditional project delivery - Lean construction and workflow reliability – Work structuring – Production control.					
Unit IV	LEAN TOOLS AND TECHNIQUES				9
Value Stream Mapping – Work sampling – Last planner system – Flow and pull based production – Last Planner System – Look ahead schedule – constraint analysis – weekly planning meeting- Daily Huddles – Root cause analysis – Continuous improvement – Just in time.					
Unit V	LEAN IMPLEMENTATION IN CONSTRUCTION INDUSTRY				9
Lean construction implementation- Enabling lean through information technology - Lean in design - Design Structure - BIM (Building Information Modelling) - IPD (Integrated Project Delivery) – Sustainability through lean construction approach					
Total periods:45					
Text Books:					
1. Corfe, C. and Clip, B., Implementing Lean in Construction: Lean and the Sustainability Agenda, CIRIA, 2013.					

2. Shang Gao and Sui Pheng Low, Lean Construction Management: The Toyota Way, <i>Springer</i> , 2014.															
3. Dave, B., Koskela, L., Kiviniemi, A., Owen, R., and Tzortzopoulos, P., Implementing Lean in Construction: Lean Construction and BIM, <i>CIRIA</i> , 2013.															
References:															
1.Corfe, C. and Clip, B., Implementing lean in construction: Lean and the sustainability agenda, CIRIA, 2013.															
2.Shang Gao and Sui Pheng Low, Lean Construction Management: The Toyota Way, Springer, 2014.															
3.Dave, B., Koskela, L., Kiviniemi, A., Owen, R., andTzortzopoulos,P.,Implementing lean in construction: Lean construction and BIM, CIRIA, 2013.															
4.Ballard, G., Tommelein, I., Koskela, L. and Howell, G., Lean construction tools and techniques, 2002.															
5.Salem, O., Solomon, J., Genaidy, A. and Luegring, M., Site implementation and Assessment of Lean Construction Techniques, Lean Construction Journal, 2005															
Course Outcomes:													Blooms Taxonomy		
CO 1: Explains the contemporary management techniques and the issues in present scenario.													Analyze(K4)		
CO2:Apply the basics of lean management principles and their evolution from manufacturing industry to construction industry.													Apply(K3)		
CO3:Develops a better understanding of core concepts of lean construction tools and techniques and their importance in achieving better productivity.													Understand(K2)		
CO4:Apply lean techniques to achieve sustainability in construction projects.													Apply(K3)		
CO5:Apply lean construction techniques in design and modeling.													Apply(K3)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	1	1	1	1	1	-	-	-	3	-	-	-
CO2	3	1	2	1	1	2	1	1	1	-	-	-	-	-	-
CO3	3	1	2	1	1	1	1	1	1	-	-	-	-	-	-
CO4	3	1	1	1	1	2	1	3	3	-	-	-	-	-	-
CO5	3	2	1	1	1	2	1	3	3	-	-	-	-	-	-

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		Analyze(K4)

and Function Block Programming.(L2)															
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						
•						
Course Objectives:						
•						
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:															
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 Gibtl & 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 safe 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.Vijayamohan K. Pillai and MeeraParthasarathy, “Functional Materials: A chemist’s perspective”, Universities Press Hyderabad (2012)															
2. Functional Materials: A Chemist’s Perspective by Vijayamohan 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:															
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.												Blooms Taxonomy			
												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															
Particula	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

r															
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 cultural symbols; importance of food in understanding human culture - variability, diversity, from basic ingredients to food preparation; impact of customs and traditions on food habits, heterogeneity within cultures (social groups) and specific social contexts - festive occasions, specific religious festivals, mourning etc. Kosher, Halal foods; foods for religious and other fasts					
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:					
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, 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.															
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, Physical Principles of Food Preservation, Routledge, 2003.															
2. VanGarde, S.J. and Woodburn, M., Food Preservation and Safety Principles and Practice, 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 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	PSO3
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 indications under IPR.													Understand(K2)		
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	PSO3
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	PSO3
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
Prerequisites					
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	P O 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	PSO3
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.Spinning, 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	PSO3
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	PSO3
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	PSO3
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, bambooing. 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, Plastics Materials and Processes, Van Nostrand Reinhold Company Inc. (1982).		
2. F. Hensen (Ed.), Plastic Extrusion Technology, Hanser Gardner (1997).		
3. W. S. Allen and P. N. Baker, Handbook of Plastic Technology, Volume-1: Plastic Processing Operations [Injection, Compression, Transfer, Blow Molding], CBS Publishers and Distributors (2004).		
References:		
1.S. S. Schwart, S. H. Goodman, Plastics Materials and Processes, Van Nostrad Reinhold Company Inc. (1982).		
2.F. Hensen (Ed.), Plastic Extrusion Technology, Hanser Gardner (1997).		

3.W. S. Allen and P. N. Baker, Hand Book of Plastic Technology, Volume-1, Plastic Processing Operations [Injection, Compression, Transfer, Blow Molding], CBS Publishers and Distributors (2004).															
4.M. Chanda, S. K. Roy, Plastic Technology handbook, 4th Edn., CRC Press (2007).															
5.I. I. Rubin, Injection Molding Theory & Practice, Society of Plastic Engineers, Wiley (1973).															
6.D.V. Rosato, M. G. Rosato, Injection Molding Hand Book, Springer (2012).															
7.M. L. Berins (Ed.), SPI Plastic Engineering Hand Book of Society of Plastic Industry Inc., Springer (2012).															
8.B. Strong, Plastics: Material & Processing, A, Pearson Prentice hall (2005).															
9.D.V Rosato, Blow Molding Hand Book, Carl HanserVerlag 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	P O 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	PSO3
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		Understand(K2)

domains															
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	PSO3
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	PSO3
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 • To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics • To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering					

customer		
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.															
4. 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, 1stedition, 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. - acquire the knowledge of optimality, formulation and computation of dynamic programming problems. - determine the optimum solution for non-linear 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 Theorywith 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 PERIODS					
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. Kumaresan 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

23EE0001	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 know the Indian and global energy scenario • To learn the various solar energy technologies and its applications. • To educate the various wind energy 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,		
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:		
CO1: Discuss the Indian and global energy scenario.	Blooms Taxonomy	
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.	Analyze(K4)	
	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	1	1	2	3	2	2	1	1	3	2	1	2
CO2	3	2	2	1	1	1	3	1	1	1	2	3	2	1	2
CO3	3	2	3	1	2	1	3	1	1	1	1	3	1	1	2
CO4	2	2	2	1	2	1	3	1	1	1	2	3	2	2	2
CO5	2	1	2	1	2	1	3	1	1	1	1	3	2	1	2
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23MAO005	ADVANCED NUMERICAL METHODS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
•					
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

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", 9th 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

CO1: Demonstrate the understandings of common numerical methods for nonlinear equations, system of linear equations and eigenvalue problems;

Apply(K3)

CO2: Understand the interpolation theory;

Understand(K2)

CO3: Understand the concepts of numerical methods for ordinary differential equations

Understand(K2)

CO4: Demonstrate the understandings of common numerical methods for elliptic equations

Apply(K3)

CO5: Understand the concepts of numerical methods for time dependent partial differential equations

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	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

23MAO006	RANDOM PROCESSES	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
•					
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		
Text Books:		
1.Ibe, O.C.," Fundamentals of Applied Probability and Random Processes ", 1 st Indian Reprint, Elsevier, 2007.		
2.Peebles, P.Z., "Probability, Random Variables and Random Signal Principles ", Tata McGraw Hill, 4 th Edition, New Delhi, 2002.		
References:		
1.Cooper. G.R., McGillem. C.D., "Probabilistic Methods of Signal and System Analysis", Oxford University Press, New Delhi, 3 rd 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, 3 rd Edition, 2002.		
5. Yates. R.D. and Goodman. D.J., "Probability and Stochastic Processes", Wiley India		

Pvt. Ltd., Bangalore, 2 nd Edition, 2012.															
Course Outcomes:													Blooms Taxonomy		
CO1: Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.													Understand(K2)		
CO2: Apply the concept random processes in engineering disciplines.													Apply(K3)		
CO3: Understand and apply the concept of correlation and spectral densities.													Understand(K2)		
CO4: Get an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable.													Understand(K2)		
CO5: Analyze the response of random inputs to linear time invariant systems.													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	-	-	2	-	-	-
CO2	3	3	-	-	-	-	-	-	3	-	-	2	-	-	-
CO3	3	3	-	-	-	-	-	-	3	-	-	2	-	-	-
CO4	3	3	-	-	-	-	-	-	3	-	-	2	-	-	-
CO5	3	3	-	-	-	-	-	-	3	-	-	2	-	-	-
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23MAO007	QUEUEING AND RELIABILITY MODELLING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
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															
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", 9 th Edition, Pearson India Education Services, Delhi, 2016.															
3.Trivedi, K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 2 nd Edition, John Wiley and Sons, 2002.															
4.Govil A.K., “Reliability Engineering”, Tata-McGraw Hill Publishing Company Ltd., New Delhi,1983.															
Course Outcomes:															
CO1: Enable the students to apply the concept of random processes in engineering disciplines.														Blooms Taxonomy	
CO2: Students acquire skills in analyzing various queueing models.														Apply(K3)	
CO3: Students can understand and characterize phenomenon which evolve with respect to time in a probabilistic manner.														Analyze(K4)	
CO4: Students can analyze reliability of the systems for various probability distributions.														Understand(K2)	
CO5: Students can be able to formulate problems using the maintainability and availability analyses by using theoretical approach.														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	-	-	-	-	-	-	2	-	-	2	-	-	-
CO2	3	3	2	-	-	-	-	-	2	-	-	2	-	-	-
CO3	3	3	-	2	-	-	-	-	2	-	-	2	-	-	-
CO4	3	3	2	-	-	-	-	-	2	-	-	2	-	-	-
CO5	3	3	3	2	-	-	-	-	2	-	-	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						
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 MANGEMENT					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
V 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

Text Books:

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

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. Palgrave Macmillan (Case Study).2005.

Course Outcomes:

Blooms Taxonomy

CO1: To understand the basics and functions of Production and Operation Management for business owners.

Understand(K2)

CO2: To learn about the Production & Operation Systems.

Understand(K2)

CO3: To acquaint on the Production & Operations Planning Techniques followed by entrepreneurs in Industries.

Understand(K2)

CO4: To know about the Production & Operations Management Processes in organisations.

Analyze(K4)

CO5: To comprehend the techniques of controlling , Production and Operations in industries.

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

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

23MGO005	MULTIVARIATE DATA ANALYSIS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					

•		
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:45 PERIODS		
Text Books:		
1.Joseph F. Hair, Rolph E. Anderson, Ronald L. Tatham & William C. Black, Multivariate Data Analysis, Pearson Education, New Delhi, 2005.		
2. Barbara G. Tabachnick, Linda S. Fidell, Using Multivariate Statistics, 6th Edition, Pearson, 2012.		
3. Richard A. Johnson and Dean W. Wichern, Applied Multivariate Statistical Analysis, Prentice Hall, New Delhi, 2005.		
References:		
1.1.Joseph F Hair, Rolph E Anderson, Ronald L. Tatham & William C. Black, Multivariate Data Analysis, Pearson Education, New Delhi, 2005.		
2.Barbara G. Tabachnick, Linda S.Fidell, Using Multivariate Statistics, 6th Edition, Pearson, 2012.		
3.Richard A Johnson and Dean W.Wichern, Applied Multivariate Statistical Analysis, Prentice Hall, New Delhi, 2005.		
4.David R Anderson, Dennis J Seveency, and Thomas A Williams, Statistics for Business and Economics, Thompson, Singapore, 2002		
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.		Analyze(K4)
CO2: Use advanced techniques to conduct thorough and insightful analysis, and interpret the results correctly with detailed and useful information.		Analyze(K4)

CO3: Show substantial understanding of the real problems; conduct deep analysis using correct methods; and draw reasonable conclusions with sufficient explanation and elaboration.													Understand(K2)		
CO4: Write an insightful and well-organized report for a real-world case study, including thoughtful and convincing details.													Apply(K3)		
CO5: Make better business decisions by using advanced techniques in data analytics.													Apply(K3)		
CO-PO 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	1	3	3	3	2	3	2	3
CO2	3	3	3	2	2	3	2	2	3	3	3	2	3	3	3
CO3	3	2	3	2	2	2	2	1	2	2	2	2	3	2	3
CO4	2	3	2	3	2	3	3	2	3	3	3	2	3	2	2
CO5	3	3	2	3	3	3	2	1	3	2	3	3	3	3	3

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 :45 PERIODS		
Text Books:		
1.1.Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani “Additive manufacturing technologies”. 3rd edition Springer Cham, Switzerland. (2021). ISBN: 978-3-030-56126-0		
2.Andreas Gebhardt and Jan-Steffen Hötter “Additive Manufacturing: 3D Printing for Prototyping and Manufacturing”, Hanser publications, United States, 2015, ISBN: 978-1- 56990-582-1.		
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.Liou, L.W. and Liou, F.W., “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press., United States, 2011, ISBN: 9780849334092.		
Course Outcomes: At the end of this course students shall be able to:.		Blooms Taxonomy
CO 1: Recognize the development of AM technology and how AM technology propagated		Analyze(K4)
CO2: Acquire knowledge on process vat polymerization and material extrusion processes and its applications.		Analyze(K4)
CO3: Elaborate the process and applications of powder bed fusion and binder jetting.		Apply(K3)
CO4: Evaluate the advantages, limitations, applications of material		Understand(K2)

jetting and directed energy deposition processes.															
CO5:Acquire knowledge on sheet lamination and direct write technology.													Analyze(K4)		
CO-PO 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	1	3	3	3	2	3	2	3
CO2	3	3	3	2	2	3	2	2	3	3	3	2	3	3	3
CO3	3	2	3	2	2	2	2	1	2	2	2	2	3	2	3
CO4	2	3	2	3	2	3	3	2	3	3	3	2	3	2	2
CO5	3	3	2	3	3	3	2	1	3	2	3	3	3	3	3

23MEO010	NEW PRODUCT DEVELOPMENT	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - To introduce the fundamental concepts of the new product development - To develop material specifications, analysis and process. - To Learn the Feasibility Studies & reporting of new product development. - To study the New product qualification and Market Survey on similar products of new product development. - To learn Reverse Engineering. Cloud points generation, converting cloud data to 3D model.					
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 Gantt chart, Critical path analysis – Fundamentals of BOM (Bill of Materials), Engg. BOM & Manufacturing BOM. Basics of MIS software and their application in industries like SAP, MS DYnamics, Oracle ERP Cloud – QFD.					
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 programming. 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 results, Lesson Learned & Horizontal deployment in NPD.																
Unit V		REPORTING & FORWARD-THINKING OF NPD												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 : 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																
5.Product Design & Value Engineering – Dr. M.A. Bulsara &Dr. H.R. Thakkar																
Course Outcomes::At the end of the course the students would be able to													Blooms Taxonomy			
CO 1:Discuss the Material specification standards, analysis and fabrication, manufacturing process.													Analyze(K4)			
CO2:Discuss fundamental concepts andcustomer specific requirements of the New Product development													Analyze(K4)			
CO3:Develop Feasibility Studies & reporting of New Product development													Apply(K3)			
CO4:Analyzing the New product qualification and Market Survey on similar products of new product development													Analyze(K4)			
CO5:Develop Reverse Engineering. Cloud points generation, converting cloud data to 3D model													Apply(K3)			
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	1	1	3	1	-	-	-	1	1	-	-	1	1	3	2	

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

Low (1) ; Medium (2) ; High (3)

23MEO011	INDUSTRIAL DESIGN & RAPID PROTOTYPING TECHNIQUES	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
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 :45 PERIODS					
Text Books:					
1.Peter Fiell, Charlotte Fiell, Industrial Design A-Z, TASCHEN America Llc(2003)					

2.Samar Malik, Autodesk Fusion 360 - The Master Guide.

3.Steve Krug, Don't Make Me Think, Revisited: A Common Sense Approach to Web Usability, Pearson,3rd edition(2014).

References:

1. <https://www.adobe.com/products/xd/learn/get-started.html>

2. <https://developer.android.com/guide>

3. <https://help.autodesk.com/view/fusion360/ENU/courses/>

4\ https://help.prusa3d.com/en/category/prusaslicer_204

Course Outcomes:At the end of the course, learners will be able to:

Blooms Taxonomy

CO 1:Create quick UI/UX prototypes for customer needs

Analyze(K4)

CO2:Develop web application to test product traction / product feature

Apply(K3)

CO3:Develop 3D models for prototyping various product ideas

Apply(K3)

CO4:Built prototypes using Tools and Techniques in a quick iterative methodology

Understand(K2)

CO5: Evaluate the performance of electronic circuits and prototypes:

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

23MEO012	MICRO AND PRECISION ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: At the end of this course the student should be able to - 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: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 Manufacturing, New Age International, New Delhi, 2005																
Course Outcomes:													Blooms Taxonomy			
CO 1:Select suitable precision machine tools and operate													Analyze(K4)			
CO2:Apply the macro and micro components for fabrication of micro systems.													Apply(K3)			
CO3:Apply suitable machining process													Apply(K3)			
CO4:Able to work with miniature models of existing machine tools/robots and other instruments.													Analyze(K4)			
CO5:Apply metrology for micro system													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	2	1	1	2	3	1	2	2	3	2	1	1
CO2	3	2	3	1	2	2	1	2	3	1	2	3	3	3	2
CO3	3	3	2	2	2	3	2	2	3	2	2	2	3	3	3
CO4	3	2	3	2	3	1	2	3	3	2	3	3	3	2	3
CO5	3	2	2	2	3	2	1	2	3	1	2	3	3	3	2

23MEO013	COST MANAGEMENT OF ENGINEERING PROJECTS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
•					
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 contracts					
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 problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing					
Unit IV	COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL				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					
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
CO 1: Understand the costing concepts and their role in decision making.	Understand(K2)
CO2: Understand the project management concepts and their various aspects in selection.	Understand(K2)
CO3: Interpret costing concepts with project execution.	Analyze(K4)
CO4: Gain knowledge of costing techniques in service sector and various budgetary control techniques.	Understand(K2)
CO5: Apply to Become familiar with quantitative techniques in cost management.	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	1	1	2	1	2	2	2	1	1	
CO2	2	3	2	2	1	2	1	2	3	1	2	2	2	2	2
CO3	3	3	3	2	3	3	2	3	3	2	3	3	3	2	2
CO4	2	3	2	2	2	1	2	1	2	2	2	2	3	3	2
CO5	3	2	3	3	3	2	3	1	3	2	2	2	3	3	3

23EE0011	BATTERIES AND MANAGEMENT SYSTEM)	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
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. NCR18650B 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 frameworks		
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 Modelling software and Model-Based Design.		
TOTAL :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.		
References:		
1.Developing Battery Management Systems with Simulink and Model-Based Design-whitepaper		
2.Panasonic NCR18650B- DataSheet		
3.bq76PL536A-Q1- IC DataSheet		
4.CC2662R-Q1- IC DataSheet		
Course Outcomes: At the end of this course, students will be able to		Blooms Taxonomy
CO 1: Acquire knowledge of different Li-ion Batteries performance.		Understand(K2)
CO2: Design a Battery Pack and make related calculations.		Analyze(K4)
CO3: Demonstrate a BatteryModel or Simulation.		Analyze(K4)
CO4: Estimate State-of-Charges in a Battery Pack.Approach different BMS		Analyze(K4)

architectures during real world usage															
CO5: Approach different BMS architectures during real world usage.													Understand(K2)		
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	1	2	1	2	2	2	2	3	-	-
CO2	3	3	2	3	3	2	3	2	2	2	3	3	-	-	-
CO3	3	3	3	2	3	2	3	1	3	2	3	3	-	-	-
CO4	3	3	3	2	3	3	3	2	3	3	3	3	-	-	-
CO5	2	2	2	1	2	1	2	1	2	2	3	2	-	-	-

23EEO006	SENSORS AND ACTUATORS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
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 :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: At the end of the course, the student will be able to													Blooms Taxonomy		
CO 1: List common types of sensor and actuators used in vehicles.													Understand(K2)		
CO2: Design measuring equipment’s for the measurement of pressure force, temperature and flow.													Apply(K3)		
CO3: Generate new ideas in designing the sensors and actuators for automotive application													Understand(K2)		
CO4: Understand the operation of thesensors, actuators and electronic control.													Understand(K2)		
CO5: Design temperature control actuators for 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	1	1	1	1	2	1	2	1	2	2	3	2	1
CO2	3	3	2	3	2	2	3	2	2	2	3	3	3	3	3
CO3	3	3	3	2	3	2	3	2	3	2	3	3	3	3	3
CO4	3	3	2	2	3	3	3	2	3	3	3	3	3	2	3
CO5	3	3	2	3	2	2	3	2	2	2	3	3	3	3	3

23ECO005	SPACE VEHICLES	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites •					
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: 45 PERIODS		
Text Books:		
1. ESA Space Transportation Documentation (European Space Agency)		
3. "Introduction to Space Dynamics" – William Tyrrell Thomson		
References:		
1. "Space Vehicle Design" – Michael D. Griffin & James R. French		
2. NASA Systems Engineering Handbook (NASA/SP-2016-6105 Rev2)		
3. Fundamentals of Astrodynamics and Applications" – David A. Vallado.		
Course Outcomes: On successful completion of this course, the student will be able to		Blooms Taxonomy
CO 1: Explain exotic space propulsion concepts, such as nuclear, solar sail, and antimatter.		Understand(K2)
CO2: Apply knowledge in selecting the appropriate rocket propulsion systems		Apply(K3)
CO3: Interpret the air-breathing propulsion suitable for initial stages and fly-back boosters		Analyze(K4)
CO4: Analyze aerodynamics aspect, including boost-phase lift and drag,		Analyze(K4)

hypersonic, and re- entry															
CO5: Adapt from aircraft engineers moving into launch vehicle, spacecraft, and hypersonic vehicle design.													Analyze(K4)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	1	1	2	2	2	2	2	2	3	3	1
CO2	3	3	2	3	3	2	3	2	3	3	3	3	3	3	2
CO3	3	3	2	3	3	2	3	2	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3
CO5	3	3	3	3	2	3	3	2	3	3	3	3	3	3	3

23MGO006	MANAGEMENT SCIENCE	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
•					
Course Objectives:					
• Of this course are • 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- Hertzberg TwoFactor Theory of Motivation- LeadershipStyles,Socialresponsibilities 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 - BusinessProcessReengineering(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, TrainingandDevelopment,WageandSalaryAdministration,Promotion,Transfer,PerformanceAppraisal					

I, 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 : 45 PERIODS		
Text Books:		
1.KanishkaBedi, Production and Operations Management,OxfordUniversityPress,2007.		
2.Stoner,Freeman,Gilbert, Management,6th Ed, PearsonEducation,NewDelhi,2004.		
3.ThomasN.Duening & John M.Ivancevich Management Principles and Guidelines, Biztantra,2007.		
4.P.VijayKumar,N.Appa Rao and Ashnab, Chnalill, CengageLearning India,2012.		
References:		
1.KotlerPhilip and KellerKevinLane: Marketing Management, Pearson, 2012.		
2.KoontzandWeihrich: Essentials of Management, McGrawHill, 2012.		
3.Lawrence RJauch,R.Guptaand William F. Glueck: Business Policy and Strategic Management Science,McGrawHill,2012.		
4.SamuelC.Certo:Modern Management,2012.		
Course Outcomes: Upon completion of the course, Students will be able to		Blooms Taxonomy
CO1:Plan an organizational structure for a given context in the organization to carry out production operations through Work-study		Analyze(K4)
CO2:Survey the markets, customers and competition better and price the given products appropriately.		Analyze(K4)
CO3:Ensurequalityforagivenproduct or service.		Analyze(K4)
CO4::Plan, schedule and control projects through PERTandCPM.		Understand(K2)
CO5:Evaluate strategy for a business or service organisation.		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	2	2	1	3	3	2	3	3	2	3
CO2	3	3	3	3	3	3	2	2	3	2	3	3	3	3	3
CO3	3	3	3	3	2	2	2	2	3	3	3	2	3	3	3
CO4	3	3	2	3	2	3	3	3	3	3	3	3	3	3	2
CO5	3	2	3	2	3	3	2	3	3	3	3	3	3	3	3

23MEO014	PRODUCTION PLANNING AND CONTROL	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
•					
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 PPC	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		
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		
5. Melynk, Denzler, "Operations management – A value driven approach" Irwin McGraw hill.		
6. Norman Gaither, G. Frazier, "Operations Management" 9th Edition, Thomson learning IE, 2007		
7. Samson Eilon, "Elements of Production Planning and Control", Universal Book Corpn.1984		
8. Upendra Kachru, "Production and Operations Management – Text and cases" 1st Edition, Excel books 2007		
Course Outcomes: Upon completion of this course,		Blooms Taxonomy
CO 1: The students can able to prepare production planning and control act work study,		Understand(K2)
CO2: The students can able to prepare product planning,		Analyze(K4)
CO3: The students can able to prepare production scheduling		Understand(K2)
CO4: The students can able to prepare Inventory Control.		Analyze(K4)
CO5: They can plan manufacturing requirements manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).		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	-	-	3	-	1	-	-	-	1	-	3	-	-
CO2	3	2	-	-	3	-	-	-	-	-	-	-	-	2	-
CO3	-	2	-	-	3	-	-	-	-	-	-	-	-	2	-
CO4	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	2	-	-	-	-	-	-	-	-	-	-	1	-
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MGO007	OPERATIONS MANAGEMENT	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
•					
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 MANAGEMENT	9
Materials Management — COURSE OBJECTIVES, Planning, Budgeting and Control. Purchasing – COURSE OBJECTIVES, Functions, Policies, Vendor rating and Value Analysis.		
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.		
Total periods:45		
Text Books:		
1. Richard B. Chase, Ravi Shankar, F. Robert Jacobs, Nicholas J. Aquilano, Operations and Supply 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.		
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. Mahadevan B, Operations Management Theory and practice, Pearson Education, 2007.		
7. 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(K2)	
CO2: The students will obtain sufficient knowledge and skills to forecast demand for Production and Service Systems	Apply(K3)	
CO3: The students will be able to Formulate and Assess Aggregate Planning strategies and Material Requirement Plan.	Analyze(K4)	

CO4: : The students will be able to develop analytical skills to calculate capacity requirements and developing capacity alternatives.													Understand(K2)		
CO5: The students will be able to apply scheduling and Lean Concepts for improving System Performance													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	-	-	-
CO2	-	3	3	-	-	-	-	-	-	-	-	-	-	3	3
CO3	-	2	3	3	-	-	-	-	-	-	-	-	2	3	-
CO4	-	3	3	3	-	-	-	-	-	-	-	-	2	3	-
CO5	-	-	3	2	-	-	-	-	-	-	-	-	-	-	-
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23BMO003	INDUSTRIAL HYGIENE	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 Limit.		
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		
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													Apply(K3)		
CO2: Specify designs that avoid occupation related injuries													Understand(K2)		
CO3: Define and apply the principles of work design, motion economy, and work environment design.													Apply(K3)		
CO4: Identify the basic human sensory, cognitive, and physical capabilities and limitations with respect to human-machine system performance.													Analyze(K4)		
CO5: Acknowledge the impact of workplace design and environment on productivity.													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	-	-	-	-
CO2	-		2		-	-	1	-	-	-	1	-	-	-	-
CO3	-		-		2	-	-	-	-	-	2	-	-	-	-
CO4	-		-		-	-	-	-	2	-	3	-	-	-	-
CO5	-		-		-	-	-	1	-	-	-	-	-	-	-
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23CHO008	CHEMICAL PROCESS SAFETY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
•					
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		
Text Books:		
1. David A Crowl& Joseph F Louvar,"Chemical Process safety", Pearson publication, 3 rd Edition,2014		
2. Maurice Jones .A,"Fire Protection Systems,2 nd 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", 3 rd Edition, Gulf professional publishing, 2006															
6. Ralph King and Ron Hirst, "King's safety in the process industries", Arnold, London, 1998.															
7. Industrial Environment and its Evolution and Control, NIOSH Publication, 1973.															
Course Outcomes:												Blooms Taxonomy			
CO 1: Differentiate between inherent safety and engineered safety and recognize the importance of safety in the design of chemical process plants.												Understand(K2)			
CO2: Develop thorough knowledge about safety in the operation of chemical plants												Analyze(K4)			
CO3: Apply the principles of safety in the storage and handling of gases.												Apply(K3)			
CO4: Identify the conditions that lead to reaction hazards and adopt measures to prevent them.												Understand(K2)			
CO5: Develop thorough knowledge about.												Analyze(K4)			
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	-	1	-	-	1	-	-	-	2	-	-
CO2	-			2	-	-	-	-	1	-		-	-	2	-
CO3	-	3		1	-	-	-	2	-	-	1	-	-	-	-
CO4	-	2	-		-	1	-	-	1	-		-	-	-	2
CO5	-	2	3		-	-	-	1	-	-	1	-	-	-	-
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23EE0007	ELECTRICAL, ELECTRONIC AND MAGNETIC MATERIALS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
•					

Course Objectives:

- The main learning objective of this course is to prepare the students for:
- 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, special 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 specific 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, bimetal 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 - He-Ne, 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		
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 & amp; Sons, Singapore, (2006).

Course Outcomes:

Blooms Taxonomy

CO1: Understand various types of dielectric materials, their properties in various conditions.

Understand(K2)

CO2: Evaluate magnetic materials and their behavior.

Analyze(K4)

CO3: Evaluate semiconductor materials and technologies.

Analyze(K4)

CO4: Select suitable materials for electrical engineering applications.

Understand(K2)

CO5: Identify right material for optical and optoelectronic applications

Analyze(K4)

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

Course Objectives:

- The main learning objective of this course is to prepare the students for:
- 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
- Having knowledge on the different characterisation techniques employed to characterise the nanomaterials
- Acquiring knowledge on different applications of nanomaterials in different disciplines of engineering

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		
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(K2)		
CO2: Recognise the effects of dimensionality of materials on the properties													Understand(K2)		
CO3: Process different nanomaterials and use them in engineering applications													Analyze(K4)		
CO4: Use appropriate techniques for characterising nanomaterials													Analyze(K4)		
CO5: Identify and use different nanomaterials for applications in different engineering fields.													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	1	2	-
CO2	3	1	2	2	-	-	-	-	-	-	-	2	2	2	1
CO3	3	2	1	2	-	-	-	-	-	-	-	2	2	2	-
CO4	3	1	-	2	-	-	-	-	-	-	-	2	2	2	2
CO5	3	2	2	2	-	-	-	-	-	-	-	2	2	2	1
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEO011	HYDRAULICS AND PNEUMATICS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
•					
Course Objectives:					
- To knowledge on fluid power principles and working of hydraulic pumps - To obtain the knowledge in hydraulic actuators and control components - To understand the basics in hydraulic circuits and systems - To obtain the knowledge in pneumatic and electro pneumatic systems - To apply the concepts to solve the trouble shooting					
Unit I	FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS				9

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 Linear and Rotary – Fixed and Variable displacement pumps – Problems.		
Unit II	HYDRAULIC ACTUATORS AND CONTROL COMPONENTS	9
Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors - Control Components : Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Servo and Proportional valves – Applications – Accessories : Reservoirs, Pressure Switches – Applications – Fluid Power ANSI Symbols – Problems.		
Unit III	HYDRAULIC CIRCUITS AND SYSTEMS	9
Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems		
Unit IV	PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS	9
Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – Cascade method – Electro Pneumatic System – Elements – Ladder diagram – Problems, Introduction to fluidics and pneumatic logic circuits		
Unit V	TROUBLE SHOOTING AND APPLICATIONS	9
Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools – Low cost Automation – Hydraulic and Pneumatic power packs		
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. Shanmugasundaram.K, “Hydraulic and Pneumatic Controls”. Chand & Co, 2006.		
2. Majumdar, S.R., “Oil Hydraulics Systems – Principles and Maintenance”, Tata McG Raw Hill, 2001.		
3. Majumdar, S.R., “Pneumatic Systems – Principles and Maintenance”, Tata McGRaw Hill, 2007.		
4. Dudley, A. Pease and John J Pippenger, “Basic Fluid Power”, Prentice Hall, 1987		
5. Srinivasan. R, “Hydraulic and Pneumatic Controls”, Vijay Nicole Imprints, 2008		
6. Joshi.P, Pneumatic Control”, Wiley India, 2008.		
7. Jagadeesha T, “Pneumatics Concepts, Design and Applications “, Universities Press, 2015.		

Course Outcomes:													Blooms Taxonomy		
CO 1: Analyze the methods in fluid power principles and working of hydraulic pumps													Analyze(K4)		
CO2: Recognize the concepts in hydraulic actuators and control components													Analyze(K4)		
CO3: Obtain the knowledge in basics of hydraulic circuits and systems													Understand(K2)		
CO4: Obtain the knowledge in basics of hydraulic circuits and systems													Analyze(K4)		
CO5: Apply the concepts to solve the trouble shooting hydraulic and pneumatics.													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	-	2	2	-	-	-	-	-	1	2	2	1
CO2	3	2	1	-	2	2	-	-	-	-	-	1	2	2	1
CO3	3	2	1	-	2	2	-	-	-	-	-	1	2	2	1
CO4	3	2	1	-	2	2	-	-	-	-	-	1	2	2	1
CO5	3	2	1	-	2	2	-	-	-	-	-	1	2	2	1
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23EEO008	SENSORS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
•					
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				9

	TYPES	
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		
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: Upon successful completion of the course, students should be able to:													Blooms Taxonomy		
CO 1: 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(K2)		
CO2: Analyze and select suitable sensor for displacement, proximity and range measurement.													Analyze(K4)		
CO3: Analyze and select suitable sensor for force, magnetic field, speed, position and direction measurement.													Analyze(K4)		
CO4: Analyze and Select suitable sensor for light detection, pressure and temperature measurement and also familiar with other miniaturized smart sensors.													Analyze(K4)		
CO5: Select and design suitable signal conditioning circuit with proper compensation and linearizing element based on sensor output signal.													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	-	-	-	-	-	-	-	1	2	3	2	1
CO2	3	3	2	1	1	1	-	-	-	-	1	2	3	2	1
CO3	3	3	2	1	1	1	-	-	-	-	1	2	3	2	1
CO4	3	3	2	1	1	1	-	-	-	-	1	2	3	2	1
CO5	3	3	2	1	1	1	-	-	-	-	1	2	3	2	1
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23ECO006	CONCEPTS IN MOBILE ROBOTS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
•					
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.		
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		
Text Books:		
1. Roland Siegwart and IllahR.Nourbakish, “Introduction to Autonomous Mobile Robots” MIT Press, Cambridge, 2004		
References:		
1. Dragomir N. Nenchev, Atsushi Konno, TeppeiTsujiata, “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.													Apply(K3)		
CO2: Create the kinematics for given wheeled and legged robot.													Understand(K2)		
CO3: Analyse the sensors for the intelligence of mobile robotics.													Analyze(K4)		
CO4: Create the localization strategies and mapping technique for mobile robot.													Understand(K2)		
CO5: Create the collaborative mobile robotics for planning, navigation and intelligence for desired applications													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	2	2	3	3	2	3	3	2	3	-	-	-
CO2	3	3	2	3	2	3	2	1	3	2	3	3	-	-	-
CO3	3	3	3	3	2	3	3	2	3	3	3	2	-	-	-
CO4	3	2	3	3	2	3	3	2	3	3	3	3	-	-	-
CO5	3	3	2	2	3	3	3	2	3	3	2	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23MEO015	MARINE PROPULSION	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
•					
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		
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”,4 th Edition,2009		
References:		
1.DJ Eyers and GJ Bruse, “Ship Construction”, 7 th Edition, 2006.		
2. KJ Rawson and EC Tupper, “Basic Ship theory I” Vol. 1,5 th Edition,2001.		
Course Outcomes:	Blooms Taxonomy	

CO 1: Explain the basics of propulsion system and ship dynamic movements													Analyze(K4)		
CO2: Familiarize with various components assisting ship stabilization													Analyze(K4)		
CO3: Demonstrate the performance of the ship													Understand(K2)		
CO4: Classify the Propeller and its types, Materials etc													Understand(K2)		
CO5: Categories the Rudder and its types, design criteria of rudder.													Analyze(K4)		
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	1	-	-	-	-	-	1	1	-	1	1
CO2	1	1	1	-	-	-	-	-	-	-	-	-	-	1	1
CO3	1	-	-	1	1	-	-	-	1	1	1	-	1	1	1
CO4	1	-	1	1	-	-	-	-	-	-	-	-	-	1	1
CO5	1	-	1	1	-	-	-	-	-	-	-	-	-	1	1
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23MEO016	MARINE MERCHANT VESSELS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
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	10
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	8
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		
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
CO 1: Acquire Knowledge on floatation of ships		Understand(K2)

CO2: Acquire Knowledge on features of various ships													Understand(K2)		
CO3: Acquire Knowledge of Shipbuilding Materials													Understand(K2)		
CO4: Acquire Knowledge to identify the different types of marine propeller and rudder													Analyze(K4)		
CO5: Understand the Roles and responsibilities of governing bodies													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	1	-	-	-	-	2	3	2	2
CO2	3	1	2	1	-	2	3	1	-	-	-	2	3	2	2
CO3	3	1	2	2	-	1	3	2	-	-	-	2	3	2	3
CO4	3	3	2	3	1	1	2	1	-	-	-	2	3	3	2
CO5	1	-	-	1	-	3	3	3	-	-	-	2	1	2	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MEO017	ELEMENTS OF MARINE ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
•					
Course Objectives:					
- Understand the role of Marine machinery systems - Be familiar with Marine propulsion machinery system - Acquaint with Marine Auxiliary machinery system - Have acquired basics of Marine Auxiliary boiler system - Be aware of ship propellers and steering 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		
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		
3. Alan L.Rowen, “Introduction to Practical Marine Engineering, Volume 1&2, The Institute of Marine Engineers (India), Mumbai, 2006.		
Course Outcomes:		Blooms Taxonomy
CO 1: Distinguish the role of various marine machinery systems		Analyze(k4)
CO2: Relate the components of marine propulsion machinery system		Apply(K3)
CO3: Explain the importance of marine auxiliary machinery system		Apply(K3)
CO4: Acquire knowledge of marine boiler system		Understand(K2)
CO5: Understand the importance of ship propellers and steering 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	2	-	1	1	-	-	-	-	2	3	2	1
CO2	3	2	2	2	1	1	2	1	-	-	-	2	3	3	2
CO3	3	2	2	2	1	1	2	1	-	-	-	2	3	3	2
CO4	3	1	1	1	-	2	3	2	-	-	-	2	2	2	3
CO5	3	2	2	2	1	2	1	1	-	-	-	2	3	3	2
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23ECO007	DRONE TECHNOLOGIES	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives:					
- To understand the basics of drone concepts - To learn and understand the fundamentals of design, fabrication and programming of drone - To impart the knowledge of an flying and operation of drone - To know about the various applications of drone - To understand the safety risks and guidelines of fly safely					
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															
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. Zavrnsnik, “Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance”, Springer, 2018.															
Course Outcomes:													Blooms Taxonomy		
CO1: Explain the various type of drone technology, drone fabrication and programming.													Analyze(K4)		
CO2: Execute the suitable operating procedures for functioning a drone													Apply(K3)		
CO3: Select appropriate sensors and actuators for Drones													Apply(K3)		
CO4: Develop a drone mechanism for specific applications													Understand(K2)		
CO5: Create the programs for various drone													Apply(K3)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	3	1	3	2	-	-	-	-	-	1	2	1	3
CO2	1	2	3	1	3	2	-	-	-	-	-	1	2	1	3
CO3	1	2	3	1	3	2	-	-	-	-	-	1	2	1	3
CO4	1	2	3	1	3	2	-	-	-	-	-	1	2	1	3
CO5	1	2	3	1	3	2	-	-	-	-	-	1	2	1	3

23CEO005	GEOGRAPHICAL INFORMATION SYSTEM	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
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					
Text Books:					
- Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition, 2011. - 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 :Understand basic idea about the fundamentals of GIS													Understand(K2)		
CO2 :Understand the types of data models.													Understand(K2)		
CO3 :Get knowledge about data input and topology													Understand(K2)		
CO4 :Gain knowledge on data quality and standards													Understand(K2)		
CO5 :Understand data management functions and data output													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	3	3
CO2	3	-	-	-	3	-	-	-	-	-	-	-	3	3	3
CO3	3		3	3		-	-	-	-	-	-	-	3	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEO006	AGRICULTURE ENTREPRENEURSHIP DEVELOPMENT	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
•					
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 programmers (EDP)-Generation incubation and commercialization of ideas and innovations- Motivation and entrepreneurship development- Globalization and the emerging business entrepreneurial environment.		
UNIT II	AGRIPRNEURSHIP 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.		
UNITV	ENTREPRENEURIAL PROMOTION MEASURES AND GOVERNMENT	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													Apply(K3)		
CO2: Evaluate basic concepts, principles and functions of financial management													Apply(K3)		
CO3: Improve the skills on basic banking and insurance schemes available to customers													Understand(K2)		
CO4: Analyze various financial data for efficient farm management													Understand(K2)		
CO5: Identify the financial institutions													Understand(K2)		
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	2	1	1	1	1	1	1	1	1	1	1
CO2	2	1	1	1	1	2	1	2	1	1	1	2	2	1	2
CO3	1	1	1	2	1	1	2	1	1	1	2	1	1	2	1
CO4	1	1	2	1	1	2	1	1	2	1	1	1	1	1	1
CO5	1	1	1	1	1	1	1	1	1	2	1	1	1	1	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEO010	BIODIVERSITY CONSERVATION	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
•					
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 their 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		
Text Books:		
1. A textbook of Botany: Angiosperms- Taxonomy, Anatomy, Economic Botany & Embryology.		
2. S. Chand, Limited, Pandey, B. P. January 2001		
3. Principles of Systematic Zoology, Mcgraw-Hill College, Ashlock, P.D., Latest Edition.		
4. Microbiology, MacGraw Hill Companies Inc, Prescott, L.M., Harley, J.P., and Klein D.A. (2022).		
References:		
1. Ecological Census Technique: A Handbook, Cambridge University Press, Sutherland, W.		
2. Encyclopedia of Biodiversity, Academic Press, Simonson Asher Levin.		
Course Outcomes:		Blooms Taxonomy
CO1: An insight into the structure and function of diversity for ecosystem stability		Analyze(K4)
CO2: Understand the concept of animal diversity and taxonomy		Understand(K2)

CO3: Understand socio-economic issues pertaining to biodiversity													Understand(K2)		
CO4: Understanding of biodiversity in community resource management.													Understand(K2)		
CO5: Student can apply fundamental knowledge of biodiversity conservation to solve problems associated with infrastructure development.													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	-	2	-	-	2	2	-
CO2	-	2	-	2	2	2	-	-	-	-	-	-	3	2	
CO3	-	-	-	2		2	-	-	-	-	-	-	3	2	3
CO4	3	2	-		2	-	-	2	2	2	2		3	2	3
CO5	-	2	3	2	-	-	1	-	-	-	-	1	-	2	-
1 - Low, 2 - Medium, 3 - High , '- No correlation															

23CEO011	BASICS OF INTEGRATED WATER RESOURCES MANAGEMENT	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
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		
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. <i>et al.</i> “ 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. i. 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%20iwr m/Tutorial i. _text.pdf		
4. Pramod R. Bhawe, 2011, Water Resources Systems, Narosa Publishers.		
5. The 17 Goals, United Nations, https://sdgs.un.org/goals .		
Course Outcomes:	Blooms Taxonomy	
CO1: Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.	Apply(K3)	
CO2: Discuss on the different water uses; how it is impacted and ways to tackle these impacts.	Apply(K4)	
CO3: Explain the economic aspects of water and choose the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.	Analyze(K3)	
CO4: Illustrate the recent trends in water management.	Analyze(K3)	
CO5: Understand the implementation hitches and the institutional frameworks.	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	1	2	1	3	3	2	1	1	1	3	2	2	3
CO2	2	3	2	3	1	3	3	2	1	1	2	3	2	3	3
CO3	1	2	1	1	-	2	1	2	-	1	3	2	1	1	2
CO4	2	2	2	3	2	3	3	2	1	1	1	3	2	3	3
CO5	1	1	1	2	-	3	3	3	1	2	2	3	1	2	3
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23MEO021	INTRODUCTION TO INDUSTRIAL AUTOMATION SYSTEMS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
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		
LIST OF SKILLS		
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 Industrial Data Networks.		
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).	Analyze(K4)	
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	Analyze(K4)	

Block.(L3)															
CO5 Able to develop a PLC logic for a specific application on real world problem. (L5)													Analyze(K4)		
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	-	1	1	-	1
CO2	3	1	1	-	1	-	-	1	-	1	-	-	1	-	1
CO3	3	-	1	-	1	-	-	1	-	1	-	-	1	-	1
CO4	3	3	3	3	1	-	-	1	-	1	-	-	1	-	1
CO5	3	3	3	3	1	1	-	1	-	1	-	-	1	-	1
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23EE0010	ENERGY TECHNOLOGY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
•					
Course Objectives:					
- Understand the fundamentals of energy including its classification, units, global and national resource consumption, and the necessity of exploring renewable energy alternatives (Unit I). - Acquaint with conventional energy technologies, specifically the working principles, efficiency, merits, and demerits of Thermal, Hydel, and Nuclear power plants (Unit II). - Familiarize with the various non-conventional energy conversion systems, including solar, wind, ocean (wave, OTEC, tidal), and geothermal energy technologies, and their applications (Unit III). - Develop knowledge of bio-energy conversion methods, including thermo-chemical and biochemical routes (combustion, gasification, biogas), and advanced systems like fuel cells and energy storage technologies (Unit IV). - Apply principles of energy conservation and efficiency by learning about energy audit procedures and energy saving measures in industrial equipment like heat exchangers, distillation columns, ovens, furnaces, and boilers (Unit V).					
UNIT I	INTRODUCTION				8

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	8
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	10
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	10
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		
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.		
5.		
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 Enery - Thermal Collection and Storage, Tata McGraw hill, New Delhi, 1981.		
4.		

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.													Analyze(K4)		
CO2: Students will excel as professionals in the various fields of energy engineering													Understand(k2)		
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.													Analyze(K4)		
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													Analyze(K4)		
CO - PO & PSO 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
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23BTO004	FUNDAMENTALS OF FOOD ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
•					
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 foammat 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, ultra fine grinders, fluid jet pulverizer, 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		
Text Books:		
1. R.L. Earle. 2004. Unit Operations in Food Processing. The New Zealand Institute of Food Science & Technology, Nz. 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.															
5. J. F. Richardson, J. H. Harker and J. R. Backhurst. 2002. Coulson & Richardson's Chemical Engineering, Vol. 2, Particle Technology and Separation Processes, 5th Ed.															
References:															
1. McCabe, Warren L., Smith, Julian, and Harriott, Peter. (2004). Unit Operations of Chemical Engineering, 7th Ed. McGraw-Hill, Inc., NY, USA.															
2. Geankoplis, Christie John. (2003). Transport Processes and Separation Process Principles (Includes Unit Operations), 4th Ed. Prentice-Hall, NY, USA.															
3. Geankoplis, Christie John. (2003). Transport Processes and Separation Process Principles (Includes Unit Operations), 4th Ed. Prentice-Hall, NY, USA.															
Course Outcomes:													Blooms Taxonomy		
CO1 :understand the importance of food polymers													Understand(K2)		
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, electrical properties to develop new technologies for processing and preservation.													Understand(K2)		
CO4: Analyze drying theory, size reduction principles (Rittinger's, Kick's, Bond's laws), and mixing indices to select and design appropriate processing equipment.													Analyze (K4)		
CO5: Evaluate the principles and equipment used for mechanical separations (centrifugation, filtration) and membrane separation processes (UF, RO) for food processing and quality enhancement													Evaluate (K5)		
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	3	1	1
CO2	3	1	1	1	-	1	2	-	-	-	-	2	3	1	1
CO3	3	2	2	2	1	1	2	-	-	-	-	2	3	2	2
CO4	3	3	3	3	2	1	2	-	-	1	1	2	3	3	3
CO5	3	3	3	3	2	1	2	-	-	1	1	3	3	3	3
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					
•					
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	Introduction to Food Safety and Security				9
Introduction to food safety and security: Hygienic design of food plants and equipments, Food Contaminants (Microbial, Chemical, Physical), Food Adulteration (Common adulterants), Food Additives (functional role, safety issues), Food Packaging & labeling. 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	Food Quality and Quality Control				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	Critical Quality Control Points and Food Safety Systems				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	Indian and Global Food Safety Regulations				9
Indian and global regulations: FAO in India, Technical Cooperation programmes, Bio-security in Food and Agriculture, World Health Organization (WHO), World Animal Health Organization (OIE), International Plant Protection Convention (IPPC)					
Unit V	Codex Alimentarius Commission and Global Food Standards				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															
Text Books:															
1. Deshpande, S. S. <i>Handbook of food toxicology</i> , 2002.															
2. Robert, Cynthia A. <i>The food safety information handbook</i> , 2009.															
3. Tannenbaum SR. <i>Nutritional and safety aspects of food processing</i> , 1979.															
4. Hobbs BC. <i>Microbiological safety of Food</i> , 1973.															
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: Thorough Knowledge of food hazards, physical, chemical and biological in the industry and food service establishments													Understand(K2)		
CO2: Awareness on regulatory and statutory bodies in India and the world													Understand(K2)		
CO3: Apply the principles of HACCP (Hazard Analysis Critical Control Point) and identify critical quality control points (CCPs) in various stages of food production.													Apply (K3)		
CO4: Evaluate the process of Risk Assessment (microbial, dose-response modeling) and implement a food safety surveillance and risk communication system.													Evaluate (K5)		
CO5: Awareness on regulatory and statutory bodies in India and the world (FAO, WHO, OIE, IPPC, and Codex Alimentarius Commission) and their roles in setting global standards.													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	-	2	2	1	-	1	-	2	3	1	1

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

23BTO006	NUTRACEUTICALS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
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, zoochemicals and microbes in food, plants, animals and microbes.					
Unit II	PHYTOCHEMICALS AS NUTRACEUTICALS				9
Phytoestrogens in plants; isoflavones; flavonols, polyphenols, tannins, saponins, lignans, lycopene, chitin, caratenoids. Manufacturing practice of selected nutraceuticals such as lycopene, isoflavonoids, 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 in vitro 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		
Text Books:		
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 the Nutraceuticals and functional foods, their classification and benefits.	Understand(K2)	
CO2: acquire knowledge of phytochemicals, zoochemicals and microbes in food, plants, animals and microbes	Understand(K2)	

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 & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	1	3	-	-
CO2	3	-	-	-	-		-	-	-	-	-	1	3	-	-
CO3	3	-	-	-	-	2	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-		-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	2	-	-	-	-	-	1	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					
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-13:978-81-908001-4-3.		
Course Outcomes:	Blooms Taxonomy	
CO 1: Basics of grey fabric	Understand(K2)	
CO2: Basics of pre treatment	Understand(K2)	
CO3: Concept of Dyeing	Understand(K2)	
CO4: Concept of Printing	Understand(K2)	
CO5: Machinery in processing industry	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	-
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															

23CHO011	FIBRE SCIENCE	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
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	REGENERATED FIBRES				9
Production Sequence of Regenerated Cellulosic fibres: Viscose Rayon, Acetate rayon – High wet modulus fibres: Modal and Lyocel ,Tencel					
Unit III	SYNTHETIC 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	SPECIALITY 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 SPECIALITY 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 PERIODS		
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, 2 nd 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)	
CO2: Understand the properties of various fibres	Understand(K2)	
CO3: Explain the production sequence of major Synthetic Fibers (Polyester, Nylon, Acrylic, Polypropylene) and mineral fibers, including the role of spin finishes and texturization.	Understand (K2)	
CO4: Analyze the specific properties required for and the end-uses of Speciality Fibres designed for high tenacity, high modulus, high temperature, flame resistance, and chemical resistance.	Analyze (K4)	
CO5: Evaluate the properties, end-uses, and manufacturing principles of Functional Speciality Fibres like biodegradable fibers (PLA), super absorbent fibers, elastomeric fibers, and electrospun nanofibres.	Evaluate (K5)	

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	3	1	1
CO2	3	2	1	2	1	-	1	-	-	1	-	2	3	1	2
CO3	3	2	2	2	1	1	1	-	-	1	-	2	3	2	2
CO4	3	3	3	3	2	1	2	-	1	1	1	3	3	3	3
CO5	3	3	3	3	3	2	2	1	1	1	1	3	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					
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, specification 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, special 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 INSPECTION AND DIMENSIONAL CHANGES				9

Raw material, in process and final inspection; 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 349abelling of apparels															
Total periods: 45 PERIODS															
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. Peggal 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)		
CO2: Types of seams, stitches and functions of needles													Understand(K2)		
CO3: Components and trims used in garment													Understand(K2)		
CO4: Garment inspection and dimensional changes													Understand(K2)		
CO5: Garment pressing, packing and care abelling													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															

23CEO009	INDUSTRIAL SAFETY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
•					
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. Deshmukh, L. M. <i>Industrial Safety Management: Hazard Identification and Risk Control</i>		
2. Asfahl, C. Ray, and Rieske, David W. <i>Industrial Safety and Health Management</i> (6th Ed. or later)		
3. Poonia, M.P., and Sharma, S.C. <i>Industrial Safety and Maintenance Management</i>		
4. Maiti, J., and Ray, Pradip Kumar. <i>Industrial Safety Management: 21st Century Perspectives of Asia</i>		
References:		
1. Goetsch, David L. <i>Occupational Safety and Health for Technologists, Engineers, and Managers</i> , 9th Edition		
2. Hammer, Willie, and Price, Dennis. <i>Occupational Safety Management and Engineering</i> , 5th Edition or later		
3. National Fire Protection Association (NFPA). <i>Fire Protection Handbook</i>		
4. International Labour Organization (ILO). <i>Encyclopaedia of Occupational Health and Safety</i>		
Course Outcomes:	Blooms Taxonomy	
CO 1: Describe, with example, the common work-related diseases and accidents in occupational setting	Understand(K2)	
CO2: Name essential members of the Occupational Health team	Understand(K2)	
CO3: 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)	
CO4: Identify potential hazards and apply risk management principles to ensure safe industrial operations.	Apply(K4)	
CO5: Apply environmental health and safety principles to manage workplace risks	Apply(K4)	

and promote sustainable, compliant operations.															
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	2	3	1	1	-	2	3	2	3
CO2	1	1	-	-	-	3	1	2	2	2	1	1	2	1	2
CO3	1	1	-	-	-	3	2	2	2	2	1	1	2	1	2
CO4	2	3	2	3	2	3	2	3	2	2	2	3	3	3	3
CO5	2	3	2	3	2	3	3	3	2	2	3	3	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						
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 PERIODS		
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)		
CO2: Study the different flow measuring instruments, the principles of various size reductions, conveying equipment's, sedimentation and mixing tanks.													Understand(K2)		
CO3: Comprehend the laws governing the heat and mass transfer operations to solve the problems.													Understand(K2)		
CO4: Design the heat transfer equipment suitable for specific requirement.													Understand(K2)		
CO5: understand and apply mass transfer principles to analyze and design industrial separation processes.													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	-	2	3	1	2
CO2	3	2	2	2	1	1	-	-	1	1	-	2	3	2	3
CO3	3	3	2	3	1	1	1	-	1	1	-	2	3	3	2
CO4	3	3	3	3	2	1	1	-	1	1	1	3	3	3	3
CO5	3	3	3	3	1	1	1	-	1	1	1	3	3	3	3
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23MEO018	PLASTIC MATERIALS FOR ENGINEERS	Category: OEC			
		L	T	P	C
		3	0	0	3
•					
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 • To understand the preparation methods of thermosetting materials					

Select suitable specialty plastics for different end applications		
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 Periods		
Text Books:		
1.Gilbert, Marianne (Ed.). <i>Brydson's Plastics Materials</i> , 8th Edn., 2017.		

2. Olabisi, Olagoke, and Adewale, Kolapo (Eds.). <i>Handbook of Thermoplastics 2nd Edn.</i> , 2016.															
3. Chanda, Manas, and Roy, Salil K. <i>Plastics Technology Handbook</i> , 4th Edn., 2006.															
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													Analyze(K4)		
CO2: Summarize the raw materials, sources, production, properties and applications of various engineering thermoplastics													Understand(K2)		
CO3: To understand the application of polyamides, polyesters and other engineering thermoplastics, thermosetting resins													Understand(K2)		
CO4: Know the manufacture, properties and uses of thermosetting resins based on polyester, epoxy, silicone and PU													Understand(K2)		
CO5: To understand the engineering applications of various polymers in miscellaneous areas and applications of different biopolymers.													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	2	-	-	1	-	2	3	2	1
CO2	3	2	1	1	-	1	1	-	-	1	-	2	3	2	1
CO3	3	2	2	2	1	1	1	-	1	1	-	2	3	3	2
CO4	3	2	2	2	1	1	1	-	1	1	-	2	3	3	2
CO5	3	3	3	3	2	2	3	1	1	1	1	3	3	3	3

23MEO019	PROPERTIES AND TESTING OF PLASTICS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
•					
Course Objectives:					
- To understand the relevance of standards and specifications as well as the specimen 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. - To gain knowledge on the electrical and optical properties of polymers and their testing methods. - To study about the environmental effects and prevent polymer degradation.					
Unit I	INTRODUCTION TO CHARACTERIZATION AND TESTING OF POLYMERS				9
Introduction- Standard organizations: BIS, ASTM, ISO, BS, DIN etc. Standards and specifications. 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, specific 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 coefficient, 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. Mark, James E. <i>Physical Properties of Polymers</i> , 4th Edition, 2007. (Covers a wide range of physical, thermal, and mechanical properties and their measurement)		
2. Hiemenz, Paul C., and Lodge, Timothy P. <i>Polymer Chemistry</i> , 3rd Edition, 2007. (Strong on the fundamentals of polymer structure and composition, which influence all tested properties)		
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, 2 nd 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, 3 rd Edn., John Wiley & Sons 2007.		
6.S. K. Nayak, S. N. Yadav, S. Mohanty, Fundamentals of Plastic Testing, Springer, 2010.		
Course Outcomes:	Blooms Taxonomy	
CO1: Understand the relevance of standards and specifications.	Understand(K2)	
CO2: Summarize the various test methods for evaluating the mechanical properties of the polymers.	Analyze(K4)	
CO3: To know the thermal, electrical & optical properties of polymers.	Understand(K2)	

CO4: Identify various techniques used for characterizing polymers.													Analyze(K4)		
CO5: Distinguish the processability tests used for thermoplastics, thermosets and elastomers													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	1	1	1	2	-	2	2	2	3
CO2	3	3	2	3	3	1	1	1	1	1	1	3	3	3	3
CO3	3	2	2	2	2	1	1	1	1	1	-	2	3	3	2
CO4	3	3	2	3	3	1	1	1	1	1	1	3	3	3	3
CO5	2	2	1	2	2	1	1	1	1	1	1	2	2	2	3

23ECO008	VLSI DESIGN	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
•					
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. • Understand Interconnects and Memory Architecture. • Understand the design of arithmetic building blocks					
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		
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 Mixed-Signal 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		Apply(K3)
CO3: Design Sequential Logic Circuits and Clocking systems		Apply(K3)
CO4: Understand Memory architecture and interconnects		Understand(K2)
CO5: Design of arithmetic building blocks.		Apply(K3)

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

23ECO009	WEARABLE DEVICES	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives:					
- To understand the communication and security aspects in the wearable devices - To know the applications of wearable devices in the field of medicine					
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															
Text Books:															
1.Annalisa Bonfiglo 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 JamilY.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.													Analyze(K4)		
CO3:Use the concepts of BAN in health care.													Apply(K3)		
CO4:Illustrate the concept of smart textile													Apply(K3)		
CO5:Compare the various wearable devices in healthcare system.													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	-	-	-	-	1	-	1
CO2	3	2	1	1	2	-	-	1	-	-	-	-	1	-	1
CO3	3	2	1	1	2	-	-	1	-	-	-	-	1	-	1
CO4	3	2	1	1	2	-	-	1	-	-	-	-	1	-	1

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

23BMO004	MEDICAL INFORMATICS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives:					
- To study the applications of information technology in health care management. - This course provides knowledge on resources, devices, and methods required to optimize the acquisition, storage, retrieval, and use of information in health and biomedicine.					
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 inclinal 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															
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.Kathryn J. Hannah, Marion J Ball, “Health Informatics”, 3 rd Edition, Springer, 2006.															
Course Outcomes:													Blooms Taxonomy		
CO1: 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.													Analyze(K4)		
CO3: Articulate the functioning of information storage and retrieval in computerized patient record system.													Analyze(K4)		
CO4: Apply the suitable decision support system for automated clinical diagnosis.													Apply(K3)		
CO5: Discuss the application of virtual reality and telehealth technology in medical industry.													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	-	-	-	-	1	1	1
CO2	3	2	1	1	2	-	-	1	-	-	-	-	1	1	1
CO3	3	2	1	1	2	-	-	1	-	-	-	-	1	1	1
CO4	3	2	1	1	2	-	-	1	-	-	-	-	1	1	1
CO5	3	2	1	1	2	-	-	1	-	-	-	-	1	1	1

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 • To describe about capital budgeting and cost of capital • To discuss on how to construct a robust capital structure and dividend policy • To develop an understanding of tools on Working Capital Management.					
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,															
3. Srivatsava, Mishra, Financial Management, Oxford University Press, 2011															
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 Financial Assets, the Indian securities market, the market participants and trading of securities, security market indices, sources of financial information, Concept of return and risk, Impact of Taxes and Inflation on return.					
Unit II	FIXED INCOME SECURITIES				9
Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, default risk and credit rating.					
Unit III	APPROACHES TO EQUITY ANALYSIS				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 and activism					
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															

23CMG004	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, Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations, Wildfire Publishing, 2016															
4. Jacob William, FinTech: The Beginner's Guide to Financial Technology, Createspace Independent Publishing Platform, 2016															
5. IIBF, Digital Banking, Taxmann Publication, 2016															
6. Jacob William, Financial Technology, Create space Independent Pub, 2016															
7. Luke Sutton, Financial Technology: Bitcoin & Blockchain, 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 • To learn the Fintech developments around the world • To know about the future of Fintech					
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 ethics													Evaluate (K5)		
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	PSO1	PSO2	PSO3
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. • To apply the principles and theories of entrepreneurship and management in Technology oriented businesses. • To empower the learners to run a Technology driven business efficiently and effectively • To familiarize learners with emerging trends and modern practices in entrepreneurship locally and globally.					
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 – Business Environmental Factors – Political-Economic-Sociological-Technological-Environmental-Legal aspects – Human Resources 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 - Characteristics of a technopreneur - Impacts of Technopreneurship on Society – Economy- Job Opportunities 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 entrepreneurship - NGO Entrepreneurship – Recent Entrepreneurial Developments - 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.															
3. Lang, J. 2002, The High Tech Entrepreneur's Handbook, Ft.com.															
4. David Sheff 2002, China Dawn: The Story of a Technology and Business Revolution,															
5. HarperBusiness,https://fanny.staff.uns.ac.id/files/2013/12/Technopreneur-BASED-EDUCATION-REVOLUTION.pdf															
6. JumpStart: A Technoprenuership Fable, Dennis Posadas, (Singapore: Pearson Prentice Hall, 2009															
7. Basics of Technoprenuership: Module 1.1-1.2, Frederico Gonzales, President-PESO Inc; M. Barcelon, UP															
8. Journal articles pertaining to Entrepreneurship															
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 opportunites 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. • To apply the principles and theories of Team Building in managing Technology oriented businesses. • To empower the learners to build robust teams for running and leading a business efficiently and effectively					

- To provide knowledge of leadership styles, effectiveness, and global leadership trends.

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), Understand (K2)			
CO2: Understand developing effective teams for business management.												Understand (K2), Apply (K3)			
CO3: Understand the fundamentals of leadership for running a business.												Understand (K2)			
CO4: Learn about the importance of leadership for business development.												Apply (K3), Analyze (K4)			
CO5: Acquaint with emerging trends in leadership effectiveness for entrepreneurs.												Analyze (K4), Evaluate (K5)			
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 • To know the applications of innovation in entrepreneurship. • To develop innovative business models for business. • To develop innovative and sustainable business models for successful enterprises.					
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 Innovation 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.					
5. Innovation Management, C.S.G. Krishnamacharyulu, R. Lalitha, Himalaya Publishing House, 2010.					
6. Dale Timpe, Creativity, Jaico Publishing House, 2003.					

7. Brian Clegg, Paul Birch, Creativity, Kogan Page, 2009.															
8. Strategic Innovation: Building and Sustaining Innovative Organizations- Course Era, Raj Echambadi.															
Course Outcomes:													Blooms Taxonomy		
CO1: Learn the basics of creativity for developing Entrepreneurship													Remember (K1), Understand (K2)		
CO2: Understand the importance of creative intelligence for business growth													Understand (K2), Apply (K3)		
CO3: Understand the advances through Innovation in Industries													Understand (K2), Analyze (K4)		
CO4: Learn about applications of innovation in building successful ventures													Apply (K3), Analyze (K4)		
CO5: Acquaint with developing innovative business models to run the business effecientlty and effectively													Analyze (K4), 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						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. • To give them an understanding of fundamental premise underlying market driven strategies and the basic philosophies and tools of marketing management for business owners. • To provide an understanding of marketing mix decisions, environmental analysis, and customer-focused strategies. • To enable learners to apply marketing concepts to develop solutions for contemporary marketing challenges.					
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													Remember (K1), Understand (K2)		
CO2: Understand the marketing environment													Understand (K2), Analyze (K4)		
CO3: Acquaint about product and pricing strategies													Understand (K2), Apply (K3)		
CO4: Knowledge of promotion and distribution in marketing management.													Apply (K3), Analyze (K4)		
CO5: Comprehend the contemporary marketing scenairos and offer solutions to marketing issues.													Analyze (K4), 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. • To impart understanding of training methods, employee development and compensation systems. • To enable students to understand HR controlling techniques such as performance appraisal, discipline and grievance handling.					
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					Remember (K1), Understand (K2)
CO2: To learn about the HR Planning Methods and practices.					Understand (K2), Apply (K3)
CO3: To acquaint about the Recruitment and Selection Techniques followed in Industries.					Understand (K2), Apply (K3)
CO4: To known about the methods of Training and Employee Development.					Apply (K3), Analyze (K4)
CO5: To comprehend the techniques of controlling human resources in organisations.					Analyze (K4),

													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. • To Explore the interdisciplinary relationships between Public Administration, Political Science, History, and Sociology. • To Develop understanding of leadership, communication and decision-making processes within administrative systems.					
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.															
3. R.B. Jain: Public Administration in India,21st Century Challenges for Good Governance, New Delhi: Deep and Deep, 2002.															
4. Rumki Basu: Public Administration:Concept and Theories, New Delhi:Sterling, 2013.															
5. R. Tyagi, Public Administration, Atma Ram & Sons, New Delhi, 1983.															
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.					

- To explain the functioning of State Government institutions – Governor, State Legislature, High Courts. - To develop awareness on secularism, social justice, and minority rights in the Indian constitutional framework.															
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.					

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Administrative thinkers: Kautilya, Woodrow Willson, C.I. Barnard . Peter Drucker															
Total periods: 45															
Text Books:															
1.Shum Sun Nisa Alvi – Eminent Administrative Thinkers															
2.Keith Davis – Organization Theory															
References:															
1. Crozior 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. - To analyze stages in the policy-making process: formulation, implementation, and evaluation.					

- To study the institutional framework of policy-making and the role of bureaucracy, interest groups, and political parties.

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.															
4. Pradeep Saxena : Public Policy Administration and Development															
5. Sapru R.K. : Public Policy: Formulation, Implementation and Evaluation, Sterling Publishers, 2016															
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. • To apply different sampling techniques and estimation methods to calculate population parameters. • To perform parametric and non-parametric hypothesis testing to validate business assumptions. • To analyze the relationships between multiple business variables using correlation and regression techniques.					
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. • To implement classification and clustering algorithms to segment data for business analysis. • To understand the integration and application of machine learning and AI in data mining.		
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. • To understand common workforce issues and resolving them using people analytics. • To measure the return on investment (ROI) for various training and development initiatives.					
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																
4. Avinash Kaushik, Web Analytics - An Hour a Day, Wiley Publishing, 2007																
5. Ric T. Peterson, Web Analytics Demystified, Celilo Group Media and CafePress 2004																
6. Takeshi Moriguchi, Web Analytics Consultant Official Textbook, 7th Edition, 2016																
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. • Fundamental knowledge of calculus and algebra to solve operational equations. • Understanding of logistics, warehousing, and distribution concepts in a business context. • Basic probability skills to assess risks within supply chain networks					
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.					

- To apply inventory management strategies and risk pooling techniques to optimize stock levels. - To optimize transportation network models using spanning tree and shortest path algorithms. - To apply multi-criteria decision-making models like AHP and TOPSIS to operational problems.																
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. • To familiarize sustainable construction techniques and material selection. • To assess environmental, economic and social impacts of infrastructure projects. • To introduce modern tools and technologies for sustainable infrastructure management.					
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.
9. Ralph Horne, Tim Grant, KarliVerghese, Life Cycle Assessment: Principles, Practice and Prospects, Csiro Publishing,2009
10. European Commission - Joint Research Centre - Institute for Environment and Sustainability: International Reference Life Cycle Data System (ILCD) Handbook - General guide for Life Cycle Assessment - Detailed guidance. Luxembourg. European Union;2010
11. Hudson, Haas, Uddin, Infrastructure management: integrating design, construction, maintenance, rehabilitation, and renovation, McGraw Hill, (1997).
12. GregerLundesjö, Supply Chain Management and Logistics in Construction: Delivering Tomorrow's Built Environment, Kogan Page Publishers, 2015.

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. • To introduce sustainable strategies for energy use and waste management in agriculture. • To enable evaluation of agroecosystem sustainability using appropriate indicators. • To promote sustainable agricultural practices for long-term environmental balance and food security.					
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 • To introduce the students about metals as biomaterials and their usage as implants • To make the students understand the significance of bionanomaterials and its applications.					
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 Compsite(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		
Meatllcnanobiomaterials–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. Leopoido 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 • To enable students to appreciate novel materials and their usage in photovoltaic application • To introduce students to the basic principles of various types Supercapacitors and the materials used.					
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, Sodioted hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, LiCoO2, LiFePO4, LiMn2O4) – 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)Se2 solar cells – Cadium 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 - benzine – 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															
6. Electrode Materials for Supercapacitors: A Review of Recent Advances, Parnia Forouzandeh, Vignesh Kumaravel and Suresh C. Pillai, catalysts 2020.															
7. Recent advances, practical challenges, and perspectives of intermediate temperature solid oxide fuel cell cathodes Amanda Ndubuisi, Sara Abouali, Kalpana Singh and VenkataramanThangadurai, J. Mater. Chem. A, 2022.															
8. Review of next generation photovoltaic solar cell technology and comparative materialistic development Neeraj Kant, Pushpendra Singh, Materials Today: Proceedings, 2022.															
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. - To promote the application of green synthesis and green reagents. - To analyze the role of green nanotechnology in environmental protection.															
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, bench marking, 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															

