

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
Electronics and Communication 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 produce academically excellent and socially responsible engineers in Electronics and Communication Engineering.

Mission

•	To provide good fundamental knowledge in sub-domains of Electronics and Communication Engineering.
•	To offer an efficient teaching learning process with a focus on problem solving skills, analytical skills and technical skills.
•	To inculcate competency, innovative spirit, communication and managerial skills to create socially responsible Engineers.
•	To encourage the students to pursue higher studies and research activities.

III. Program Educational Objectives(PEOs)

PEO1:	To provide solutions to the real-world complex problems in the Society.
PEO2:	To adapt to the emerging technologies with active participation in professional activities to build career skills for prosperous carrier in Organization or Higher studies and Research.
PEO3:	To exhibit and demonstrate leadership skills with ethical values in their profession.

IV. Program Outcomes(POs)

Graduates of the ELCTRONICS AND COMMUNCATION 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 ELCTRONICS AND COMMUNCATION ENGINEERING will be able to

PSO1:	Apply knowledge related to core and specialized fields like Electronic Circuits, Embedded and Communication Systems to solve complex Engineering/Societal problems.
PSO2:	Able to expose students programming skills using latest tools to arrive cost effective and appropriate solutions.
PSO3:	Apply the contextual knowledge with professional ethics to manage different projects in multi-disciplinary environment.

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	3	3	3	3	3	3	2	3	3	3	3	3
PEO2	3	3	3	3	3	2	1	1	1	1	1	3	3	1	1
PEO3	3	3	3	2	2	2	1	1	1	3	3	3	3	2	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	1.6	2.2	1.8	2.2	1.5	3	3	3	1.6	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	3	1.6	1.2	1.8	1	-	-	-	-	-	1	-	-	-
	Introduction to Programming	3	3	3	3	3	-	-	-	-	-	-	3	2	3	-
	தமிழர் மரபு Heritage of Tamils	-	-	-	-	-	3	2	2	1.2	2.2	-	2	-	-	-
	Programming in C Laboratory	3	2	2	2	2	-	-	1	-	1	-	3	-	3	2
	Physics Laboratory	3	2.4	2.6	1	1	-	-	-	-	-	-	-	-	-	-
	English Laboratory \$	-	-	-	-	-	-	-	-	-	3	-	3	-	-	-
2	Professional English - II	1	-	-	-	-	-	1	2	1	3	2	3	-	-	-
	Computational Methods	3	2	2	2	2	1	-	-	-	-	-	1	-	-	-
	Physics for Electronics Engineering	3	2	1.4	1.5	2.5	2	3	-	-	-	-	1	-	-	-
	Basic Electrical and Instrumentation Engineering	2	1	1	-	-	-	-	1	-	-	-	-	2	-	-
	Engineering Graphics	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
	Circuit Analysis	3	2.8	2.4	2.2	-	-	-	1	-	1	-	-	3	-	-
	தமிழரும் தொழில்நுட்பமும் /Tamils and Technology	-	-	-	-	-	2.8	2.7	1	1.2	2	-	2.2	-	-	-
	Engineering Practices Laboratory	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
	Circuits Analysis Laboratory	3	2.8	2.4	2.2	-	-	-	1	-	1	-	3	3	-	-
	Communication Laboratory / Foreign Language\$	1	-	-	-	-	-	2	2	2	3	2	3	-	-	-
3	Transforms and Partial Differential Equation	3	3	3	3	-	1	-	-	-	-	-	1	-	-	-
	Signals and Systems	3	3	3	3	3	2	-	-	-	-	-	3	3	-	-
	Electronic Devices and Circuits	3	2.6	2.6	2.6	1.8	1.6	-	-	-	-	-	1	2	1	1
	Digital Systems Design	3	2	2	2	-	2	-	-	-	-	3	3	3	2	-
	Control Systems	2.8	2.6	3	2.6	2	2.4	-	-	-	-	2	2.6	2.8	2.6	3
	Data Structures	3	3	3	2	2	-	-	-	-	-	-	2	2	3	1
	Electronic Devices Circuits Laboratory	3	3	3	3	3	-	-	1	2	2	1	2	3	-	-
	Data Structures Laboratory	3	2.7	2.7	2.3	-	2	-	-	-	-	2.4	2	2.6	3	1.8
	Professional Development\$	-	-	-	-	-	-	-	-	-	3	2	3	-	1	1
4	Engineering Electromagnetics	3	2	2	2	2	2	2	-	-	1	-	2	3	-	-
	Networks and Security	3	3	3	3	3	2	-	2	-	2	-	2	3	-	2
	Linear Integrated Circuits	3	3	3	3	-	-	-	-	-	-	-	2	3	2	-
	Digital Signal Processing	3	2.8	2.4	2.4	2.4	1.8	-	-	-	-	1	1	3	2	2

Sem	Course Name	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	Communication Systems	3	3	3	3	2.4	1	1	-	-	-	1	1	3	-	-
	Environmental Sciences and Sustainability	3	1	1	-	1	1	2	-	2	-	1	1	-	-	-
	Communication Systems Laboratory	3	3	3	3	3	-	-	1	2	2	1	2	3	2	-
	Linear Integrated Circuits Laboratory	3	3	3	3	3	-	-	1	2	2	1	2	3	2	-
5	Wireless Communication	2.6	2.8	2.4	2.4	2.4	1.6	-	-	-	-	-	1	3	-	2
	Principles of VLSI Design	3	2	2	2	2	2	-	-	-	-	-	2	3	2	1
	Microprocessors and Microcontrollers	2.6	2.4	2.2	1.4	1	1	2	-	-	-	-	1.8	2.6	1.8	-
	Professional Elective I	3	3	3	2	2	2	-	-	-	-	-	2.2	2	-	2
	Professional Elective II	3	2.6	2.6	2.6	1.8	2.6	-	-	-	-	-	1	3	-	-
	Professional Elective III	3	3	2.4	2.4	2.4	1.2	-	-	-	-	-	1.2	2	-	2
	Wireless Communication Laboratory	3	3	3	3	3	-	-	-	2	2	-	2	3	3	2
	VLSI Laboratory	3	3	3	3	3	-	-	-	2	2	-	2	3	3	2
6	Embedded Systems and IOT Design	3	3	2	2	2	-	-	-	-	-	-	2	3	3	2
	Artificial Intelligence and Machine Learning	2	2	2	2.5	2	3	2	-	-	-	-	3	3	3	3
	Open Elective– I*	2.6	2	-	-	-	3	3	3	-	-	-	2	-	-	3
	Professional Elective IV	3	3	2.6	2.2	1.8	1.8	-	-	-	-	-	2.2	2.4	2	2.6
	Professional Elective V	3	3	3	2	2.2	-	2	-	-	-	-	1.2	3	2	2
	Professional Elective VI	3	2.8	2.6	2.6	2	-	-	-	-	-	-	-	2.2	-	2.2
	Embedded Systems and IOT Design Laboratory	3	3	3	3	3	-	-	-	2	2	-	3	3	3	2
	Mini Project	3	3	3	3	3	-	-	-	2	2	-	3	3	3	2
7	Human Values and Ethics	-	-	-	-	-	3	-	3	-	-	-	3	-	-	-
	Professional Elective VII	3	2	1	1	2	-	-	-	-	-	-	-	1	-	1
	Open Elective – II**	3	2.8	2.2	2.4	2.6	1.6	1	1.7	2	2	2.4	2	1	-	2.2
	Project Work – Phase I	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
8	Open Elective – III**	3	2	1	3	-	2	-	-	-	-	-	2	3	2	3
	Open Elective – IV**	3	2	1	1	2	-	-	-	-	-	-	-	1	-	1
	Project Work – Phase 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. ELECTRONICS AND COMMUNICATION ENGINEERING
Regulations 2023
For the students admitted from 2023 onwards
CHOICE BASED CREDIT SYSTEM
CURRICULUM FOR I – VIII SEMESTERS
SEMESTER I

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1.	23IP101	Induction Programme	-	-	-	-	-	-	0
THEORY									
2.	23HST101	Professional English - I	HSMC	40/60	3	0	0	3	3
3.	23MAT101	Matrices and Calculus	BSC	40/60	3	1	0	4	4
4.	23PHT101	Engineering Physics	BSC	40/60	3	0	0	3	3
5.	23CYT101	Engineering Chemistry	BSC	40/60	3	0	0	3	3
6.	23GET101	Introduction to Programming	ESC	40/60	3	0	0	3	3
7.	23GET102	தமிழர் மரபு / Heritage of Tamils	HSMC	40/60	1	0	0	1	1
PRACTICALS									
8.	23GEP101	Programming in C Laboratory	ESC	60/40	0	0	4	4	2
9.	23BSP101	Physics and Chemistry Laboratory	BSC	60/40	0	0	4	4	2
10.	23GEP102	English Laboratory \$	EEC	100/-	0	0	2	2	1
TOTAL				-	16	1	10	27	22
\$ Skill Based Course									

SEMESTER II

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
THEORY									
1	23HST201	Professional English - II	HSMC	40/60	2	0	0	2	2
2	23MAT201	Computational Methods	BSC	40/60	3	1	0	4	4
3	23PHT204	Physics for Electronics Engineering	BSC	40/60	3	0	0	3	3
4	23BET204	Basic Electrical and Instrumentation Engineering	ESC	40/60	3	0	0	3	3
5	23GET201	Engineering Graphics	ESC	40/60	2	0	4	6	4
6	23ECT201	Circuit Analysis	PCC	40/60	3	1	0	4	4

7	23GET202	தமிழரும் தொழில்நுட்பமும் /Tamil and Technology	HSMC	40/60	1	0	0	1	1
PRACTICALS									
8	23GEP201	Engineering Practices Laboratory	ESC	60/40	0	0	4	4	2
9	23ECP201	Circuits Analysis Laboratory	PCC	60/40	0	0	4	4	2
10	23GEP202	Communication Laboratory /Foreign Language ^s	EEC	60/40	0	0	4	4	2
TOTAL				-	17	1	16	35	27
\$ Skill Based Course									

SEMESTER III

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
THEORY									
1	23MAT301	Transforms and Partial Differential Equation	BSC	40/60	3	1	0	4	4
2	23ECT301	Signals and Systems	PCC	40/60	3	1	0	4	4
3	23ECT302	Electronic Devices and Circuits	PCC	40/60	3	0	0	3	3
4	23ECT304	Digital Systems Design	PCC	50/50	3	0	2	5	4
5	23ECT303	Control Systems	PCC	40/60	3	0	0	3	3
6	23CST308	Data Structures	ESC	40/60	3	0	0	3	3
PRACTICALS									
7	23ECP301	Electronic Devices and Circuits Laboratory	PCC	60/40	0	0	3	3	1.5
8	23CSP304	Data Structures Laboratory	ESC	60/40	0	0	3	3	1.5
9	23GEP301	Professional Development ^{\$}	EEC	100/-	0	0	2	2	1
TOTAL				-	18	2	10	30	25
\$ Skill Based Course									

SEMESTER IV

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
THEORY									
1	23ECT401	Engineering Electromagnetics	PCC	40/60	3	0	0	3	3
2	23ECT402	Networks and Security	PCC	50/50	3	0	2	5	4
3	23ECT403	Linear Integrated Circuits	PCC	40/60	3	0	0	3	3
4	23ECT404	Digital Signal Processing	PCC	50/50	3	0	2	5	4
5	23ECT405	Communication Systems	PCC	40/60	3	0	0	3	3
6	23GET401	Environmental Sciences and Sustainability	BSC	40/60	2	0	0	2	2
PRACTICALS									
7	23ECP401	Communication Systems Laboratory	PCC	60/40	0	0	3	3	1.5
8	23ECP402	Linear Integrated Circuits Laboratory	PCC	60/40	0	0	3	3	1.5
TOTAL				-	17	0	10	27	22

SEMESTER V

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
THEORY									
1	23ECT501	Wireless Communication	PCC	40/60	3	0	0	3	3
2	23ECT502	Principles of VLSI Design	PCC	40/60	3	0	0	3	3
3	23ECT503	Microprocessors and Microcontrollers	PCC	40/60	3	0	0	3	3
4		Professional Elective I	PEC	40/60	3	0	0	3	3
5		Professional Elective II	PEC	40/60	3	0	0	3	3
6		Professional Elective III	PEC	40/60	3	0	0	3	3
PRACTICALS									
7	23ECP501	Wireless Communication Laboratory	PCC	60/40	0	0	3	3	1.5

8	23ECP502	VLSI Laboratory	PCC	60/40	0	0	3	3	1.5
TOTAL				-	18	0	6	27	21

SEMESTER VI

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
THEORY									
1	23ECT601	Embedded Systems and IOT Design	PCC	40/60	3	0	0	3	3
2	23CST601	Artificial Intelligence and Machine Learning	ESC	40/60	3	0	0	3	3
3		Open Elective– I*	OEC	40/60	3	0	0	3	3
4		Professional Elective IV	PEC	40/60	3	0	0	3	3
5		Professional Elective V	PEC	40/60	3	0	0	3	3
6		Professional Elective VI	PEC	40/60	3	0	0	3	3
PRACTICALS									
7	23ECP601	Embedded Systems and IOT Design Laboratory	PCC	60/40	0	0	4	4	2
8	23ECP602	Mini Project	EEC	60/40	0	0	4	4	2
TOTAL				-	24	0	0	28	20

SEMESTER VII

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
THEORY									
1	23GET701	Human Values and Ethics	HSMC	40/60	2	0	0	2	2
2		Professional Elective VII	PEC	40/60	3	0	0	3	3
3		Open Elective – II**	OEC	40/60	3	0	0	3	3
PRACTICALS									
4	23ECP701	Project Work – Phase I	EEC	60/40	0	0	4	4	2
TOTAL				-	14	0	0	14	16

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	23ECP801	Project Work – Phase II	EEC	60/40	0	0	20	20	10
TOTAL					6	0	20	26	16

ELECTIVE - MANAGEMENT COURSES

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					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	HumanResource 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. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
THEORY									

1	23MCT001	Introduction to Women and Gender Studies	MC	40/60	3	0	0	3	0
2	23MCT002	Elements of Literature	MC	40/60	3	0	0	3	0
3	23MCT003	Film Appreciation	MC	40/60	3	0	0	3	0
4	23MCT004	Disaster Management	MC	40/60	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	40/60	3	0	0	3	0
2	23MCT006	History of Science and Technology in India	MC	40/60	3	0	0	3	0
3	23MCT007	Political and Economic Thought for a Humane Society	MC	40/60	3	0	0	3	0
4	23MCT008	State, Nation Building and Politics in India	MC	40/60	3	0	0	3	0
5	23MCT009	Industrial Safety	MC	40/60	3	0	0	3	0
TOTAL									

PROFESSIONAL ELECTIVE COURSES: VERTICALS**VERTICAL 1: SEMICONDUCTOR CHIP DESIGN AND TESTING**

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1	23ECE001	Wide Bandgap Devices	PEC	40/60	3	0	0	3	3
2	23ECE002	Validation and testing Technology	PEC	40/60	3	0	0	3	3
3	23ECE003	Low Power IC Design	PEC	40/60	3	0	0	3	3

4	23ECE004	VLSI Testing and Design for Testability	PEC	40/60	3	0	0	3	3
5	23ECE005	Mixed Signal IC Design Testing	PEC	40/60	3	0	0	3	3
6	23ECE006	ASIC and FPGA based Design	PEC	40/60	3	0	0	3	3

VERTICAL 2: SIGNAL PROCESSING

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1	23ECE007	Advanced Digital Signal Processing	PEC	40/60	3	0	0	3	3
2	23ECE008	Image processing	PEC	40/60	3	0	0	3	3
3	23ECE009	Speech Processing	PEC	40/60	3	0	0	3	3
4	23ECE010	Software Defined Radio	PEC	40/60	3	0	0	3	3
5	23ECE011	DSP Architecture and Programming	PEC	40/60	3	0	0	3	3
6	23ECE012	Computer Vision	PEC	40/60	3	0	0	3	3

VERTICAL 3: RF TECHNOLOGIES

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1	23ECE013	RF Transceivers	PEC	40/60	3	0	0	3	3
2	23ECE014	Signal Integrity	PEC	40/60	3	0	0	3	3
3	23ECE015	Antenna and Microwave Engineering	PEC	40/60	3	0	0	3	3
4	23ECE016	MICs and RF System Design	PEC	40/60	3	0	0	3	3
5	23ECE017	EMI/EMC Precompliance Testing	PEC	40/60	3	0	0	3	3
6	23ECE018	RFID System Design and Testing	PEC	40/60	3	0	0	3	3

VERTICAL 4: BIO MEDICAL TECHNOLOGIES

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1	23ECE019	Wearable Devices	PEC	40/60	3	0	0	3	3
2	23ECE020	Human Assist Devices	PEC	40/60	3	0	0	3	3
3	23ECE021	Therapeutic Equipment	PEC	40/60	3	0	0	3	3
4	23ECE022	Medical Imaging Systems	PEC	40/60	3	0	0	3	3
5	23ECE023	Brain Computer Interface and Applications	PEC	40/60	3	0	0	3	3
6	23ECE024	Body Area Networks	PEC	40/60	3	0	0	3	3

VERTICAL 5: UNDERWATER TECHNOLOGIES

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1	23ECE025	Underwater Instrumentation System	PEC	40/60	3	0	0	3	3
2	23ECE026	Underwater Imaging Systems and Image Processing	PEC	40/60	3	0	0	3	3
3	23ECE027	Underwater Communication	PEC	40/60	3	0	0	3	3
4	23ECE028	Ocean Observation Systems	PEC	40/60	3	0	0	3	3
5	23ECE029	Underwater Navigation Systems	PEC	40/60	3	0	0	3	3
6	23ECE030	Ocean Acoustics	PEC	40/60	3	0	0	3	3

VERTICAL 6: SENSOR TECHNOLOGIES AND IOT

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1	23ECE031	IoT Processors	PEC	40/60	3	0	0	3	3
2	23ECE032	IoT Based System Design	PEC	40/60	3	0	0	3	3

3	23ECE033	Wireless Sensor Network Design	PEC	40/60	3	0	0	3	3
4	23ECE034	Industrial IoT and Industry 4.0	PEC	40/60	3	0	0	3	3
5	23ECE035	MEMS Design	PEC	40/60	3	0	0	3	3
6	23ECE036	Fundamentals of Nanoelectronics	PEC	40/60	3	0	0	3	3

VERTICAL 7: SPACE TECHNOLOGIES

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1	23ECE037	Radar Technologies	PEC	40/60	3	0	0	3	3
2	23ECE038	Avionics Systems	PEC	40/60	3	0	0	3	3
3	23ECE039	Positioning and Navigation Systems	PEC	40/60	3	0	0	3	3
4	23ECE040	Satellite Communication	PEC	40/60	3	0	0	3	3
5	23ECE041	Remote Sensing	PEC	40/60	3	0	0	3	3
6	23ECE042	Rocketry and Space Mechanics	PEC	40/60	3	0	0	3	3

VERTICAL 8: HIGH SPEED COMMUNICATIONS

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1	23ECE043	Optical Communication & Networks	PEC	40/60	3	0	0	3	3
2	23ECE044	Wireless BroadBand Networks	PEC	40/60	3	0	0	3	3
3	23ECE045	4G/5G Communication Networks	PEC	40/60	3	0	0	3	3
4	23ECE046	Software Defined Networks	PEC	40/60	3	0	0	3	3
5	23ECE047	Massive MIMO Networks	PEC	40/60	3	0	0	3	3
6	23ECE048	Advanced Wireless Communication Techniques	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

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1	23ECO001	Space Science	OEC	40/60	3	0	0	3	3
2	23MEO022	Introduction to Industrial Engineering	OEC	40/60	3	0	0	3	3
3	23CEO013	Climate Change and Its Impact	OEC	40/60	3	0	0	3	3
4	23EEO011	Renewable Energy System	OEC	40/60	3	0	0	3	3
5	23EEO012	Introduction to Industrial Instrumentation and Control	OEC	40/60	3	0	0	3	3
6	23MAO007	Graph Theory	OEC	40/60	3	0	0	3	3
7	23CSO006	Neural Networks and Deep Learning	OEC	40/60	3	0	0	3	3
8	23CSO007	Digital Marketing	OEC	40/60	3	0	0	3	3

OPEN ELECTIVE - II

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1	23MGO008	Resource Management Techniques	OEC	40/60	3	0	0	3	3
2	23MGO009	Fintech Regulations	OEC	40/60	3	0	0	3	3
3	23BTO007	Holistic Nutrition	OEC	40/60	3	0	0	3	3
4	23CSO008	IT in Agriculture System	OEC	40/60	3	0	0	3	3

5	23EEO013	Introduction to Control Engineering	OEC	40/60	3	0	0	3	3
6	23BMO005	Pharmaceutical Nanotechnology	OEC	40/60	3	0	0	3	3
7	23ECO010	Robotics Process Automation	OEC	40/60	3	0	0	3	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	23EEO001	Renewable Energy Technologies	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	23EEO003	Electric Vehicle technology	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	23BM0001	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 Pharma Industry	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	23MEO008	Foundation Skills in integrated product Development	OEC	40/60	3	0	0	3	3

35	23BMO002	Assistive Technology	OEC	40/60	3	0	0	3	3
36	23MAO001	Operations Research	OEC	40/60	3	0	0	3	3
37	23MAO002	Algebra and Number Theory	OEC	40/60	3	0	0	3	3
38	23MAO003	Linear Algebra	OEC	40/60	3	0	0	3	3
39	23CEO007	Lean Concepts, Tools and Practices	OEC	40/60	3	0	0	3	3
40	23BTO008	Basics Of Micro Biotechnology	OEC	40/60	3	0	0	3	3
41	23BTO009	Basics of Biomolecules	OEC	40/60	3	0	0	3	3
42	23BTO010	Fundamentals of Cell and Molecular biology	OEC	40/60	3	0	0	3	3

OPEN ELECTIVE - IV

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1	23HSO002	Project Report Writing	OEC	40/60	3	0	0	3	3
2	23MAO004	Advanced Numerical Methods	OEC	40/60	3	0	0	3	3
3	23MAO005	Random Processes	OEC	40/60	3	0	0	3	3
4	23MAO006	Queuing and Reliability Modelling	OEC	40/60	3	0	0	3	3
5	23MGO004	Production and Operations Management for Entrepreneurs	OEC	40/60	3	0	0	3	3
6	23MGO005	Multivariate Data Analysis	OEC	40/60	3	0	0	3	3
7	23MEO009	Additive Manufacturing	OEC	40/60	3	0	0	3	3
8	23MEO010	New Product Development	OEC	40/60	3	0	0	3	3
9	23MEO011	Industrial Design & Rapid Prototyping Techniques	OEC	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 Managementsystem	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 andControl	OEC	40/60	3	0	0	3	3
17	23MGO007	Operations Management	OEC	40/60	3	0	0	3	3
18	23BMO003	Industrial Hygiene	OEC	40/60	3	0	0	3	3
19	23CHO008	Chemical Process Safety	OEC	40/60	3	0	0	3	3
20	23EEO007	Electrical, Electronic and Magnetic materials	OEC	40/60	3	0	0	3	3
21	23CHO009	Nanomaterials and applications	OEC	40/60	3	0	0	3	3
22	23CEO012	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 Robotics	OEC	40/60	3	0	0	3	3
26	23MEO015	Marine Propulsion	OEC	40/60	3	0	0	3	3
27	23MEO016	Marine Merchant Vehicles	OEC	40/60	3	0	0	3	3
28	23MEO017	Elements of Marine Engineering	OEC	40/60	3	0	0	3	3
29	23ECO007	Drone Technologies	OEC	40/60	3	0	0	3	3
30	23CEO005	Geographical Information System	OEC	40/60	3	0	0	3	3

31	23CEO006	Agriculture Entrepreneurship Development	OEC	40/60	3	0	0	3	3
32	23CEO010	Biodiversity Conservation	OEC	40/60	3	0	0	3	3
33	23EEO009	Introduction to control systems	OEC	40/60	3	0	0	3	3
34	23MEO021	Introduction to Industrial Automation Systems	OEC	40/60	3	0	0	3	3
35	23EEO010	Energy Technology	OEC	40/60	3	0	0	3	3
36	23BTO004	Fundamentals of Food Engineering	OEC	40/60	3	0	0	3	3
37	23BTO005	Food safety and Quality Regulations	OEC	40/60	3	0	0	3	3
38	23BTO006	Nutraceuticals	OEC	40/60	3	0	0	3	3
39	23CHO010	Basics of Dyeing and Printing	OEC	40/60	3	0	0	3	3
40	23OTT355	Fibre Science	OEC	40/60	3	0	0	3	3
41	23CHO012	Garment Manufacturing Technology	OEC	40/60	3	0	0	3	3
42	23CEO009	Industrial safety	OEC	40/60	3	0	0	3	3
43	23CHO013	Unit Operations in PetroChemical Industries	OEC	40/60	3	0	0	3	3
44	23MEO018	Plastic Materials for Engineers	OEC	40/60	3	0	0	3	3
45	23MEO019	Properties and Testing ofPlastics	OEC	40/60	3	0	0	3	3
46	23BMO004	Medical Informatics	OEC	40/60	3	0	0	3	3
47	23CEO008	Basics of Integrated Water Resources Management	OEC	40/60	3	0	0	3	3
48	23BTO008	Biotechnology for waste management	OEC	40/60	3	0	0	3	3
49	23BTO009	Lifestyle Disease	OEC	40/60	3	0	0	3	3
50	23BTO010	Biotechnology in Healthcare	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					2		9
2	BSC	12	7	4	2					25
3	ESC	5	9	4.5			3			21.5
4	PCC		6	15.5	20	12	5			58.5
5	PEC					9	9	3		21
6	OEC						3	3	6	12
7	EEC	1	2	1				2	10	18
8	Non-Credit (Mandatory)					√	√			
Total		22	27	25	22	21	20	10	16	165

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

Vertical I Fintech and Block Chain	Vertical II Entrepreneurship	Vertical III Public Administration	Vertical IV Business Data Analytics	Vertical V Environmental and Sustainability
Financial Management	Foundations of Entrepreneurship	Principles of Public Administration	Statistics for Management	Sustainable infrastructure Development
Fundamentals of Investment	Team Building & Leadership Management for Business	Constitution of India	Datamining for Business Intelligence	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity & Innovation in Entrepreneurship	Public Personnel Administration	Human Resource Analytics	Sustainable Biomaterials
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	40/60	3	0	0	3	3
2	23CMG002	Fundamentals of Investment	PEC	40/60	3	0	0	3	3
3	23CMG003	Banking, Financial Services and Insurance	PEC	40/60	3	0	0	3	3
4	23CMG004	Introduction to Block chain and its applications	PEC	40/60	3	0	0	3	3
5	23CMG005	Fintech Personal Finance and Payments	PEC	40/60	3	0	0	3	3
6	23CMG006	Introduction to Fintech	PEC	40/60	3	0	0	3	3

Vertical II: ENTREPRENEURSHIP

S. No	Course Code	Course Title	Category	Internal / External	Periods per Week			Total Contacts Period	Credits
					L	T	P		
1	23CMG007	Foundations of Entrepreneurship	PEC	40/60	3	0	0	3	3
2	23CMG008	Team Building & Leadership Management for Business	PEC	40/60	3	0	0	3	3

3	23CMG009	Creativity & Innovation in Entrepreneurship	PEC	40/60	3	0	0	3	3
4	23CMG010	Principles of Marketing Management For Business	PEC	40/60	3	0	0	3	3
5	23CMG011	Human Resource Management for Entrepreneurs	PEC	40/60	3	0	0	3	3
6	23CMG012	Financing New Business Ventures	PEC	40/60	3	0	0	3	3

Vertical III: PUBLIC ADMINISTRATION

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

Vertical IV: BUSINESS DATA ANALYTICS

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

		Analytics							
5	23CMG023	Operation and Supply Chain Analytics	PEC	40/60	3	0	0	3	3
6	23CMG024	Financial Analytics	PEC	40/60	3	0	0	3	3

Vertical V: ENVIRONMENTAL AND SUSTAINABILITY

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

SEMESTER I

23HST101	PROFESSIONAL ENGLISH-I (Common to All BE/B.Tech students except CSBS)	Category: HSMC			
		L	T	P	C
		3	0	0	3
Prerequisites NIL					

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

2. English for Science & Technology Cambridge University Press, 2021.															
3. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.															
.															
References:															
1. Technical Communication – Principles and Practices By Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.															
2. A Course Book on Technical English By Lakshmi Narayanan, Scitech Publications (India) Pvt. Ltd.															
3. English For Technical Communication (With CD) By Aysha Viswamohan, Mcgraw Hill Education, ISBN : 0070264244															
4. Effective Communication Skill, Kulbhusan Kumar, R S Salaria, Khanna Publishing House															
5. Learning to Communicate – Dr. V. Chellammal, Allied Publishing House, New Delhi,2003.															
Course Outcomes:													Blooms Taxonomy		
CO1: Use appropriate words in a professional context.													Remember (K1)		
CO2: Gain understanding of basic grammatical structures and use them in right context.													Understand(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.													Apply(K3)		
CO5: Read and comprehend different types of reading materials.													Apply(K3)		
CO-PO,PSO Mappings															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	3	3	3	1	3	-	3	-	-	-
CO2	1	1	1	1	1	3	3	3	1	3	-	3	-	-	-
CO3	2	3	2	3	2	3	3	3	2	3	3	3	-	-	-
CO4	2	3	2	3	2	3	3	3	2	3	3	3	-	-	-
CO5	2	3	3	3	-	3	3	3	2	3	-	3	-	-	-

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

23MAT101	MATRICES AND CALCULUS (Common to BME,BT,CIVIL,CHEMICAL,ECE,EEE,MECH)	Category: BSC			
		L	T	P	C
		3	1	0	4
Prerequisites					
Basic Mathematical Knowledge					

Course Objectives:		
- To develop the use of matrix algebra techniques that is needed by engineers for practical applications. - To familiarize the students with differential calculus. - To familiarize the student with functions of several variables. This is needed in many branches of engineering. - To make the students understand various techniques of integration. - To understand various techniques of multiple integrals.		
Unit I	MATRICES	9+3
Characteristic equation - Eigenvalues and Eigenvectors of a real matrix - Properties of Eigenvalues and Eigenvectors – Cayley – Hamilton Theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms- Applications of Eigen value and Eigen vector in Engineering (for classroom discussion, assignments and term paper work).		
Unit II	DIFFERENTIAL CALCULUS	9+3
Derivatives – Differentiation rules (Sum, Product, Quotient, Chain rules) – Implicit differentiation – Logarithmic differentiation – Maxima and Minima of functions of one variables- Role of derivatives in Engineering Problems (for classroom discussion, assignments and term paper work).		
Unit III	FUNCTIONS OF SEVERAL VARIABLES	9+3
Partial differentiation – Total derivative - Jacobians – Partial differentiation of implicit functions – Taylor’s series for functions of two variables –Maxima and minima of functions of two variables and Lagrange’s method of undetermined multipliers-Engineering Problems using Partial derivatives (for classroom discussion, assignments and term paper work).		
Unit IV	INTEGRAL CALCULUS	9+3
The Definite and Indefinite integral – Integration techniques - Substitution methods-Integration by parts –Reduction formula ($\sin^n x, \cos^n x$) - Integration of rational functions (Partial fraction method) -Improper Integrals. Role of Integrations in Engineering Problems (for classroom discussion, assignments and term paper work.).		
Unit V	MULTIPLE INTEGRALS	9+3
Double integrals– Double integrals in polar coordinates – Change of order of integration– Area enclosed by plane curves- Triple integrals – Volume of solids – Change of variable in double and triple integrals. Double integral models in Engineering (for classroom discussion, assignments and term paper work).		
Total periods: 60 PERIODS		
Text Books:		
1. Kreyszig E, “Advanced Engineering Mathematics” John Wiley and 10 th Edition, New Delhi, 2016.		
2. Grewal B. S, “Higher Engineering Mathematics, New Delhi, 44 th Edition, 2018.		

3. James Stewart, “Calculus: Early Transcendentals“, Cengage Learning 8 th Edition, New Delhi, 2015.															
References:															
1. Jain R. K and Iyengar S.R.K, “Advanced Engineering Mathematics”, Narasa Publications, New Delhi, 5 th Edition, 2016.															
2. Narayanan S, and Manicavachagam Pillai T. K, “Calculus: Volume I and II”, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.															
3. Ramana B. V, “Higher Engineering Mathematics”, McGraw Hill Education Pvt. Ltd., New Delhi, 2016.															
4. Daniel T. Fink Beiger, “Introduction to matrices and Linear transformations”, Dover publications, 3 rd Edition, January 2011.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Use the matrix algebra methods for solving practical problems.													Apply(K3)		
CO2: Apply differential calculus tools in solving various application problems.													Apply(K3)		
CO3: Able to use differential calculus ideas on several variable functions.													Understand(K2)		
CO4: Apply different methods of integration in solving practical problems.													Apply(K3)		
CO5: Apply various techniques in multiple integrals.													Apply(K3)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	-	-	-	1	-	-	-
CO2	3	2	1	1	-	-	-	-	-	-	-	1	-	-	-
CO3	3	2	1	1	-	-	-	-	-	-	-	1	-	-	-
CO4	3	2	1	1	-	-	-	-	-	-	-	1	-	-	-
CO5	3	2	1	1	-	-	-	-	-	-	-	1	-	-	-
AVG	3	2	1	1	-	-	-	-	-	-	-	1	-	-	-

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

23PHT101	ENGINEERING PHYSICS (Common to AIDS, BME, Biotech, CSE(AIIML), 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	-	-	-	-	-	-	-	-	-
AVG.	3	3	1.6	1.2	1.8	1	-	-	-	-	-	1	-	-	-

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

23CYT101	ENGINEERING CHEMISTRY (Common to BME,BT,CIVIL,CHEMICAL,ECE,EEE,MECH)	Category: BSC			
		L	T	P	C
		3	0	0	3
Prerequisites 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		K1
CO2: Understand adsorption, its types and phases, phase rule		K2
CO3: To use alloys and polymers in day to day life		K3
CO4: To Understand the advantages of batteries, super capacitors and solar cell fabrication		K2

CO5: To Analyse chemical composition of coal and understand petroleum process and uses of shock waves in real life.													K4		
CO - PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	1	1	-	-	-	1	1			
CO2	3	1	-	-	-	1	1	-	-	-	-	1			
CO3	3	1	-	-	1	1	1	-	-	-	1	1			
CO4	3	1	-	-	1	1	1	-	-	-	1	1			
CO5	3	1	-	-	1	1	1	-	-	-	1	1			
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23GET101	INTRODUCTION TO PROGRAMMING	Category: ESC			
		L	T	P	C
		3	0	0	3
Prerequisites None					
Course Objectives: - To understand the constructs of C Language. - To develop C Programs using basic programming constructs - To develop C programs using arrays and strings - To develop applications in C using pointers and structures - To do input/output and file handling in C					
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 (pseudocode, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion), simple problems(find odd or even, sum of n numbers, find factorial of a given number, etc.)					
UNIT II	BASICS OF C PROGRAMMING				9
Introduction to programming paradigms – Applications of C Language - Structure of C program – C programming: Data Types - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions - Input/Output statements, Assignment statements –Decision making statements - Switch statement - Looping statements – Preprocessor directives -Compilation process					
UNIT III	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 binary search.					
UNIT IV	FUNCTIONS AND POINTERS				9
Modular programming - Function prototype, function definition, function call, Built-in functions (string functions, math functions) – 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 V	STRUCTURES, UNION AND FILE PROCESSING				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 - 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, “Programming in C”, Oxford University Press, Second Edition, 2016.															
2. Kernighan, B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2015.															
References:															
1. Paul Deitel and Harvey Deitel, “C How to Program with an Introduction to C++”, Eighth edition, Pearson Education, 2018.															
2. YashwantKanetkar, Let us C, 17th Edition, BPB Publications, 2020.															
Course Outcomes:													Blooms Taxonomy		
CO1: Demonstrate knowledge on C Programming constructs													Apply		
CO2: Develop simple applications in C using basic constructs													Apply		
CO3: Design and implement applications using arrays and strings													Apply		
CO4: Develop applications in C using structures and pointers.													Apply		
CO5: Design applications using sequential and random-access file processing.													Apply		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	-	-	-	-	-	3	2	3	-
CO2	3	3	3	3	3	-	-	-	-	-	-	3	2	3	-
CO3	3	3	3	3	3	-	-	-	-	-	-	3	2	3	-
CO4	3	3	3	3	3	-	-	-	-	-	-	3	2	3	-
CO5	3	3	3	3	3	-	-	-	-	-	-	3	2	3	-
1 - Low, 2 - Medium, 3 - High, ‘-’ No correlation															

23GET102	HERITAGE OF TAMILS	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.					
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, Leather puppetry, 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 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. தமிழக வரலாறு – மக்களும் பண்பாடும் – கக.கக. பிள்ளை (தவளியீடு: தமிழ்நாடு பொடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).															
2. கணினித் தமிழ் – முன்னவர் இல. சுந்தரம். (விகடன் பிரசுரம்).															
3. கீழடி – எவளக நதிக்களையில் சங்ககொல நகர நொகரிகம் (தொல்லியல் துறை தவளியீடு)															
4. பொருளந – ஆற்றங்களந நொகரிகம். (தொல்லியல் துறை தவளியீடு)															
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	
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	
CO3:	Identify and describe the significance of Folk and Martial Arts and traditional sports as expressions of Tamil culture and physical prowess													Remember	
CO4:	Analyze the Thina (Geo-Socio-Cultural) concept in Tamil literature and understand the principles of Aram (Virtue) and ancient Tamil trade/maritime history.													Analyze	
CO5:	Discuss the political, social, and medicinal contributions of Tamils to Indian culture and the National Movement.													Understand	
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	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 திருவள்ளுவர் 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. தமிழக வரலாறு – மக்களும் பண்பாடும் – கக.கக. பிள்ளை (தவளியீடு: தமிழ்நாடு பொடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – எவளக நதிக்களரையில் சங்ககால நகர நொகரிகம் (ததொல்லியல் துளற தவளியீடு)
4. பொருளந – ஆற்றங்களர நொகரிகம். (ததொல்லியல் துளற தவளியீடு)

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
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
CO3: Identify and describe the significance of Folk and Martial Arts and traditional sports as expressions of Tamil culture and physical prowess	Remember
CO4: Analyze the Thinaï (Geo-Socio-Cultural) concept in Tamil literature and understand the principles of Aram (Virtue) and ancient Tamil trade/maritime history.	Analyze
CO5: Discuss the political, social, and medicinal contributions of Tamils to Indian culture and the National Movement.	Understand

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															

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 in C using strings, pointers, functions. - To develop applications in C using structures.					
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: 1D and 2D, multi-dimensional arrays, traversal				
5	Strings: operations				
6	Functions: call, return, passing parameters by (value, reference), passing arrays to function.				
7	Recursion Pointers: Pointers to functions, Arrays, Strings, Pointers to Pointers, Array of Pointers				
8	Structures: Nested Structures, Pointers to Structures, Arrays of Structures and Unions.				
9	Files: reading and writing, File pointers, file operations, random access, processor directives.				
Total periods:60					
Text Books:					
1. ReemaThareja, “Programming in C”, Oxford University Press, Second Edition, 2016.					
2. Kernighan, B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2015					
References:					
1 Paul Deitel and Harvey Deitel, “C How to Program with an Introduction to C++”, Eighth edition, Pearson Education, 2018.					
2 YashwantKanetkar, Let us C, 17th Edition, BPB Publications, 2020.					
3 Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996.					
4 PradipDey, ManasGhosh, “Computer Fundamentals and Programming in C”, Second Edition, Oxford University Press, 2013.					
5 Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, 1st Edition, Pearson Education, 2013.					
Course Outcomes:					Blooms Taxonomy
CO1: Demonstrate knowledge on C programming constructs.					Apply
CO2: Develop programs in C using basic constructs.					Apply
CO3: Develop programs in C using arrays.					Apply

CO4: Develop applications in C using strings, pointers, functions.													Apply		
CO5: Develop applications in C using structures.													Apply		
CO – PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	-	-	1	-	1	-	3	-	3	2
CO2	3	2	2	2	2	-	-	1	-	1	-	3	-	3	2
CO3	3	2	2	2	2	-	-	1	-	1	-	3	-	3	2
CO4	3	2	2	2	2	-	-	1	-	1	-	3	-	3	2
CO5	3	2	2	2	2	-	-	1	-	1	-	3	-	3	2
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/ References:						
1. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, “Vogel's Textbook of Quantitative Chemical Analysis”, Pearson Education, 2009.						
Course Outcomes:						Blooms Taxonomy
• CO1: Understand the functioning of various physics laboratory equipment.						Understanding
• CO2: Use graphical models to analyze laboratory data.						Understanding
• CO3: Use mathematical models as a medium for quantitative reasoning and describing physical reality.						Remembering

CO4: Access, process and analyze scientific information.													Analyzing		
CO5: Solve problems individually and collaboratively.													Applying		
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: BSC			
			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: To analyse the quantity of hardness and Chloride in water sample													K4		
CO2: To analyze the quantity of alkalinity and DO in water sample													K4		
CO3: Using conductivity meter the strength and amount of acids are analyzed.													K4		
CO4: To Analyze quantitatively BaCl ₂ present in the given solution by conductivity meter.													K4		
CO5: To determine the amount of Fe content potentiometrically.													K4		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS O1	PSO2	PSO3
CO1	3	1	-	-	-	1	1	-	2	-	1	1			
CO2	3	1	-	-	-	1	1	-	2	-	1	1			
CO3	3	-	-	-	-	1	1	-	2	-	-	1			
CO4	3	-	-	-	-	1	1	-	2	-	-	1			
CO5	3	-	-	-	-	1	1	-	2	-	-	1			
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23GEP102	ENGLISH LABORATORY	Category: EEC			
		L	T	P	C
		0	0	2	1
Prerequisites • Nil					
Course Objectives: • To improve the learners skill to read and comprehend the technical texts. • To strengthen the ability of the learners’ official written communication skill on technical context. • To help learners to enhance the public speaking skills to make technical presentations, participate in group discussions. • To develop their analytical thinking skills, problem solving skills and interpersonal skills of the learners. • To develop the ability to write job applications and interviews for internship and effective reports.					
LIST OF EXPERIMENTS					
1	Listening – Evaluative Listening: Advertisements, Product Descriptions, -Audio / video; Active and passive Listening. Speaking – Asking and giving directions, Persuasive Speech Techniques. Writing – Professional emails writing - Compare and Contrast Essay; Itinerary Grammar –Tenses in Functional usage, Prepositional phrases Language Development – Contextual meaning of words, Purpose and statement.				
2	Listening - Listening to longer technical talks and completing– gap filling exercises. Listening to the comprehension talks. – Listening to information from podcasts. Speaking – Describing and discussing the reasons of accidents or disasters based on news reports. Describing about process/ product (Technical and General). Reading - Reading longer technical texts-news reports, journals and understanding the technical				

	terms. Writing - Writing responses to complaints. Letter writing- Accepting, Declining the invitation and seeking clarification. Grammar - Active Passive Voice transformations, Infinitive and Gerunds. Language Development – Word Formation, Adverbs.
3	Listening – Listening to / Watching movie scenes/ documentaries depicting a technical problem and suggesting solutions. Speaking – Group Discussion (based on case studies), Discussion on a technical topic of common interest by group participants. Reading - Practice in lexical chunking and speed reading, Reading the Case Studies, excerpts from literary texts, news reports etc., Writing – Jumbled sentences, Problem solution essay / Argumentative Essay. Grammar – Direct and Indirect questions; If conditional sentences. Language Development – Embedded sentences, Sentence Completion.
4	Listening – Listening Comprehension based on IELTS Practice test. Speaking – Public Speaking (Debate, Extempore and just a minute), Presenting an oral report, Mini presentations on select topics. Reading –Newspaper articles; Technical reports and Advertisements. Writing – Minutes of the Meeting, Recommendations, Transcoding, Report writing- Feasibility and Survey report. Grammar – Verbal Analogies, Modals. Language Development – Conjunctions- use of prepositions.
5	Listening – Listening and its process –Practices and strategies of better Listening. Listening to TED Talks, Presentations, Formal job interviews, (analysis of the interview performance); Speaking – Participating in a Role play, (interview/telephone interview), Types of role play, Mock interviews, Formal conversations. Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing – Job application – Cover letter & Resume; Grammar – Numerical adjectives, Misspelt words. Language Development – Idioms, Error Spotting.
Total periods:30	
Text Books:	
1. English for Engineers & Technologists (2022 edition) Orient Blackswan Private Ltd. Hyderabad	
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, New Delhi.	
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. Krishna Mohan, Meera Banerji, “Developing Communication Skills”, Trinity Press, 2017.	
Course Outcomes:	Blooms Taxonomy
CO1: To apply the reading strategies to comprehend the technical terms and helps to compare and contrast products and ideas in technical texts.	Apply
CO2: To listen and comprehend the cause and effects in events, industrial processes through technical texts.	Apply
CO3: To analyze problems in order to arrive at feasible solutions and communicate them orally and in the written format.	Analyze
CO4: To speak appropriately and effectively in varied context in formal and informal context.	Apply

CO5: To present their opinions in a planned and logical manner, and draft effective resumes in context of job search. It helps to report events and the processes of technical and industrial nature.													Apply		
CO – PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	3	-	3	-	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	3	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	3	-	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	3	-	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	3	-	-	-
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

SEMESTER II

3HST 201	PROFESSIONAL ENGLISH – II (Common to All BE/B.Tech(Except CSBS))		Category: HSMC			
			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 Jovani, Department of English, Anna University.															
References:															
1. Raman. Meenakshi, Sharma. Sangeeta (2019).Professional English.Oxford university press. New Delhi.															
2. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, NewDelhi															
3. Learning to Communicate – Dr. V. Chellammal. Allied Publishers, New Delhi, 2003															
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.															
5. Developing Communication Skills by Krishna Mohan, MeeraBannerji- Macmillan India Ltd. 1990, Delhi.															
Course Outcomes:													Blooms Taxonomy		
CO1: To compare and contrast products and ideas in technical texts.													RE		
CO2: To identify and report cause and effects in events, industrial processes through technical texts													UN		
CO3: Toanalyse problems in order to arrive at feasible solutions and communicate them in the written format.													AP		
CO4: To present their ideas and opinions in a planned and logical manner													AP		
CO5: To draft effective resumes in the context of job search.													AP		
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	-	-	-
CO2	1	0	0	0	0	0	1	2	1	3	2	3	-	-	-
CO3	1	0	0	0	0	0	1	2	1	3	2	3	-	-	-
CO4	1	0	0	0	0	0	1	2	1	3	2	3	-	-	-
CO5	1	0	0	0	0	0	1	2	1	3	2	3	-	-	-
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23MAT201	COMPUTATIONAL METHODS (Common to all Branches B.E / B.TECH except B.E EEE)	Category: BSC			
		L	T	P	C
		3	1	0	4
Prerequisites • Basic Mathematical Knowledge • Matrices and Calculus					
Course Objectives: • To introduce the basic concepts of solving algebraic and transcendental equations. • To introduce the various numerical techniques for interpolation, differentiation and integration, this plays an important role in engineering and technology disciplines. • To acquaint the knowledge of various techniques and methods of solving ordinary differential equations. • To understand the knowledge of various techniques and methods of solving various types of partial differential equations. • To acquaint the knowledge of numerical methods by MATLAB.					
UNIT I	NUMERICAL SOLUTION OF EQUATIONS AND MATRIX PROBLEMS				9+3
Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi’s method for symmetric matrices.					
UNIT II	INTERPOLATION, APPROXIMATION AND INTEGRATION				9+3
Interpolation with unequal intervals - Lagrange’s interpolation – Newton’s divided difference interpolation –Newton’s forward and backward difference formulae - Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson’s 1/3 rule – Romberg’s Method.					
UNIT III	NUMERICAL APPROACH FOR IVP IN ORDINARY DIFFERENTIAL EQUATIONS				9+3
Single step methods - Taylor’s series method - Euler’s method - Modified Euler’s method – Fourth order Runge - Kutta method for solving first order equations - Multi step methods - Milne’s and Adams - Bash forth predictor corrector methods for solving first order equations.					
UNIT IV	NUMERICAL APPROACH FOR BVP IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS				9+3
Finite difference methods for solving second order two - point linear boundary value problems – Finite difference techniques for the solution of two dimensional Laplace’s and Poisson’s equations on rectangular domain – One dimensional heat equation (Crank Nicholson, Bender Schemidt’s methods) and One dimensional wave equation.					
UNIT V	MAT LAB INTRODUCTION				9+3

Introduction – Basic features – MATLAB Session – Getting started – Mathematical functions – Basic plotting – Matrix generation-Solutions of algebraic and transcendental equations using MATLAB-Gauss elimination and Gauss Jordan method for system of linear equations by MATLAB.															
Total periods:60 PERIODS															
Text Books:															
1. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.															
2. Grewal, B.S., “Numerical Methods in Engineering & Science (with Programs in C,C++ & MATLAB)” Khanna Publishers, 10th Edition, New Delhi, 2015.															
3. William J. Palm III., “Introduction to MATLAB® for Engineers” , Published by McGraw-Hill,2005.															
References:															
1. Burden, R.L and Faires, J.D, "Numerical Analysis”, 9th Edition, Cengage Learning, 2016.															
2. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis” Pearson Education, Asia, New Delhi, 7th Edition, 2007.															
3. William Bober., “Numerical and analytical methods with MATLAB® for Engineers and Scientists” , Published by CRC press, November 2013.															
Course Outcomes:													Blooms Taxonomy		
CO1: Understand the basic concepts and techniques of solving algebraic and transcendental equations.													Understanding		
CO2: Appreciate the numerical techniques of interpolation, differentiation and integration for engineering problems.													Applying		
CO3: Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.													Understanding		
CO4: Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.													Applying		
CO5: Understand the basic concepts of MATLAB for Computational Methods.													Understanding		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1	-	-	-	-	-	1	-	-	-
CO2	3	2	2	2	2	1	-	-	-	-	-	1	-	-	-
CO3	3	2	2	2	2	1	-	-	-	-	-	1	-	-	-
CO4	3	2	2	2	2	1	-	-	-	-	-	1	-	-	-
CO5	3	2	2	2	2	1	-	-	-	-	-	1	-	-	-
AVG	3	2	2	2	2	1	-	-	-	-	-	1	-	-	-

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

23PHT204	PHYSICS FOR ELECTRONICS ENGINEERING (For Electronics and Communication Engineering)	Category: BSC			
		L	T	P	C
		3	0	0	3
Prerequisites Basic Science Knowledge					
Course Objectives: - To make the students understand basic crystal structures and growth technique - To understand the electrical properties of materials and magnetic 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 and applications. - To inculcate an idea of significance of nanostructures, quantum confinement and ensuring nanodevice applications.					
UNIT I	CRYSTALLOGRAPHY				9
Crystal structures: Crystal lattice – basis - unit cell and lattice parameters – crystal systems and Bravais lattices – Structure and packing fractions of SC, BCC, FCC, HCP, diamond cubic, – crystal planes, directions and Miller indices – distance between successive planes – linear and planar densities – crystalline and noncrystalline materials – Polymorphism - growth of single crystals: solution and melt growth techniques. - imperfections in crystals					
UNIT II	ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS				
Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Quantum free electron theory : Tunneling – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential – Energy bands in solids – tight binding approximation - Electron effective mass – concept of hole. Magnetic materials: Dia, para and ferromagnetic effects – paramagnetism in the conduction electrons in metals – exchange interaction and ferromagnetism – quantum interference devices – GMR devices.					
UNIT III	SEMICONDUCTOR PHYSICS				9
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 – Carrier transport in Semiconductors: Drift, mobility and diffusion – Hall effect and devices – Ohmic contacts – Schottky diode.					
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 – Photo current in a P–N diode–Optoelectronic devices: Light detectors and solar cells –Light emitting diode – Laser diode – Optical processes in organic semiconductor devices – Excitonic state – Electro-optics and nonlinear optics: Modulators and switching devices – Plasmonics.					
UNIT V	NANO 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 – Single electron Transistor. 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 and quantum dot lasers.					
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.															
REFERENCE BOOKS:															
1. Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019.															
2. Jasprit Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw–Hill Education (Indian Edition), 2019.															
3. Umesh K Mishra & Jasprit Singh, “Semiconductor Device Physics and Design”, Springer, 2008.															
4. Wahab, M.A. “Solid State Physics: Structure and Properties of Materials”. Narosa PublishingHouse, 2009.															
5. Mark Fox, Optical Properties of Solids, Oxford Univ. Press, 2001.															
6. N. Gershenfeld. The Physics of Information Technology. Cambridge University Press, 2011.															
Course Outcomes:													Blooms Taxonomy		
• Understand the basic crystal structure and growth techniques.													Understanding		
• Understand the concept of electrical and magnetic properties of metals.													Remembering		
• Analyze the properties of semiconducting materials and apply the basic principles ofsemiconductor physics in the engineering field.													Analyzing		
• Understand the knowledge of optical properties of different materials and working principles ofvarious optical devices.													Understanding		
• Apply the principles of nanotechnology in the field of new emerging areas of engineering field.													Applying		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	2	-	2	-	-	-	-	-	-	-	-	-
CO3	3	2	2	-	2	-	-	-	-	-	-	-	-	-	-
CO4	3	-	1	-	3	2	3	-	-	-	-	1	-	-	-
CO5	3	-	2	1	-	2	-	-	-	-	-	1	-	-	-
AVG	3	2	1.4	1.5	2.5	2	3	-	-	-	-	1	-	-	-

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

23BET204	BASIC ELECTRICAL AND INSTRUMENTATION ENGINEERING	Category: ESC			
		L	T	P	C
		3	0	0	3
Prerequisites					
• Nil					

Course Objectives: - To impart knowledge in types, construction and working of transformers - To impart knowledge in types, construction and working of DC machines - To impart knowledge in types, construction and working of AC rotating machines - To introduce the functional elements and working of measuring instruments. - To introduce the basics of power system and protection schemes															
Unit I		TRANSFORMER											9		
Introduction - Ideal and Practical Transformer – Phasor diagram— Per Unit System – Equivalent circuit- Testing- Efficiency and Voltage Regulation– Three Phase Transformers –Applications- Auto Transformers, Advantages- Harmonics.															
Unit II		DC MACHINES											9		
Introduction – Constructional Features– Motor and Generator mode - EMF and Torque equation – Circuit Model – Methods of Excitation- Characteristics – Starting and Speed Control – Universal Motor- Stepper Motors – Brushless DC Motors- Applications															
Unit III		AC ROTATING MACHINES											9		
Principle of operation of three-phase induction motors – Construction –Types – Equivalent circuit, Speed Control - Single phase Induction motors -Construction– Types–starting methods. Alternator: Working principle–Equation of induced EMF – Voltage regulation, Synchronous motors- working principle-starting methods – Torque equation.															
Unit IV		MEASUREMENTS AND INSTRUMENTATION											9		
Functional elements of an instrument , Standards and calibration, Operating Principle , types - Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Instrument Transformers-CT and PT,DSO- Block diagram- Data acquisition.															
Unit V		BASICS OF POWER SYSTEMS											9		
Power system structure -Generation , Transmission and distribution , Various voltage levels, Earthing – methods of earthing, protective devices- switch fuse unit- Miniature circuit breaker- moulded case circuit breaker- earth leakage circuit breaker, safety precautions and First Aid															
Total periods: 45															
Text Books:															
1. Kothari DP and I.J Nagrah, “Basic Electrical and Electronics Engineering”, Second Edition, McGraw Hill Education, 2020															
2. S. K, Bhattacharya, “Basic Electrical and Electronics Engineering”, Second Edition, Pearson Education, 2017.															
3. A.K. Sawhney, Puneet Sawhney ‘A Course in Electrical & Electronic Measurements & Instrumentation’, Dhanpat Rai and Co, New Delhi, 2015.															
4. C.L.Wadhwa, “Generation, Distribution and Utilisation of Electrical Energy”, New Age International pvt.ltd.,2003															
References:															
1. Kothari DP and I.J Nagrah, “Basic Electrical Engineering”, Fourth Edition, McGraw Hill Education, 2019															
2. Mahmood Nahvi and Joseph A. Edminister, “Electric Circuits”, Schaum’ Outline Series, McGraw Hill, 2002.															
3. H.S. Kalsi, ‘Electronic Instrumentation’, Tata McGraw-Hill, New Delhi, 2010															
Course Outcomes:													Blooms Taxonomy		
CO1:	Explain the working principle of electrical machines												Understand		
CO2:	Analyze the output characterizes of electrical machines												Analyze		
CO3:	Choose the appropriate electrical machines for various applications												Apply		
CO4:	Explain the types and operating principles of measuring instruments												Understand		
CO5:	Explain the basic power system structure and protection schemes												Understand		
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	1	-	-	-	-	1	-	-	-	-	2	-	-
CO4	2	1	1	-	-	-	-	1	-	-	-	-	2	-	-
CO5	2	1	1	-	-	-	-	1	-	-	-	-	2	-	-
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23GET201	ENGINEERING GRAPHICS		Category: ESC			
			L	T	P	C
			2	0	4	4
Prerequisites Nil						
Course Objectives: - Drawing engineering curves. - Drawing freehand sketch of simple objects. - Drawing orthographic projection of solids and section of solids. - Drawing development of solids - Drawing isometric and perspective projections of simple solids.						
Unit I		PLANE CURVES AND FREEHAND SKETCHING				6+12
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+12
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+12
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+12
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the 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+12
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: 90						
Text Books:						
1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 53rd Edition, 2019.						
2. Natrajan 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. Parthasarathy N. S. and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.															
5. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson Education India, 2nd Edition, 2009															
Course Outcomes:													Blooms Taxonomy		
CO1:	Use BIS conventions and specifications for engineering drawing.												Apply		
CO2:	Construct the conic curves, involutes and cycloid.												Apply		
CO3:	Solve practical problems involving projection of lines.												Apply		
CO4:	Draw the orthographic, isometric and perspective projections of simple solids.												Apply		
CO5:	Draw the development of simple solids												Apply		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
CO2	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
CO3	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
CO4	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
CO5	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
1 - Low, 2 - Medium, 3 - High, ‘-’ No correlation															

23ECT201	CIRCUIT ANALYSIS	Category: PCC			
		L	T	P	C
		3	1	0	4
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	DC CIRCUIT ANALYSIS				12
Basic Components of electric Circuits, Charge, current, Voltage and Power, Voltage and Current Sources, Ohms Law, Kirchoff's Current Law, Kirchoff's voltage law, The single Node – Pair Circuit, series and Parallel Connected Independent Sources, Resistors in Series and Parallel, voltage and current division, Nodal analysis, Mesh analysis					
Unit II	NETWORK THEOREM AND DUALITY				12
Useful Circuit Analysis techniques - Linearity and superposition, Thevenin and Norton Equivalent Circuits, Maximum Power Transfer, Delta-Wye Conversion. Duals, Dual circuits. Analysis using dependent current sources and voltage sources.					
Unit III	SINUSOIDAL STEADY STATE ANALYSIS				12
Sinusoidal Steady – State analysis, Characteristics of Sinusoids, The Complex Forcing Function, The Phasor, Phasor relationship for R, L, and C, impedance and Admittance, Nodal and Mesh Analysis, Phasor Diagrams, AC Circuit Power Analysis, Instantaneous Power, Average Power, apparent Power and Power Factor, Complex Power.					

Unit IV	TRANSIENTS AND RESONANCE IN RLC CIRCUITS	12
Basic RL and RC Circuits, The Source- Free RL Circuit, The Source-Free RC Circuit, The Unit- Step Function, Driven RL Circuits, Driven RC Circuits, RLC Circuits, Frequency Response, Parallel Resonance, Series Resonance, Quality Factor.		
Unit V	COUPLED CIRCUITS AND TOPOLOGY	12
Magnetically Coupled Circuits, mutual Inductance, the Linear Transformer, the Ideal Transformer, An introduction to Network Topology, Trees and General Nodal analysis, Links and Loop analysis.		
Total periods: 60		
Text Books:		
1. Hayt Jack Kemmerly, Steven Durbin, "Engineering Circuit Analysis", Mc Graw Hill education, 9th Edition, 2018.		
2. Charles K. Alexander & Mathew N.O.Sadiku, "Fundamentals of Electric Circuits", Mc Graw- Hill, 2nd Edition, 2003.		
3. Joseph Edminister and Mahmood Nahvi, —Electric Circuits, Schaum's Outline Series, Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition Reprint 2016.		
References:		
1. Robert.L. Boylestead, "Introductory Circuit Analysis", Pearson Education India, 12th Edition, 2014. David Bell, "Fundamentals of Electric Circuits", Oxford University press, 7th Edition, 2009.		
2. John O Mallay, Schaum's Outlines "Basic Circuit Analysis", The Mc Graw Hill companies, 2nd Edition, 2011		
3. Allan H.Robbins, Wilhelm C.Miller, —Circuit Analysis Theory and Practicel, Cengage Learning, Fifth Edition, 1st Indian Reprint 2013		
Course Outcomes:		Blooms Taxonomy
CO1:	Apply the basic concepts of circuit analysis such as Kirchoff's laws, mesh current and node voltage method for analysis of DC and AC circuits.	Apply
CO2:	Apply suitable network theorems and analyze AC and DC circuits	Apply
CO3:	Analyze steady state response of any R, L and C circuits	Analyze
CO4:	Analyze the transient response for any RC, RL and RLC circuits and frequency response of parallel and series resonance circuits.	Analyze
CO5:	Analyze the coupled circuits and network topologies	Analyze
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 - -	3 - -
CO2	3 3 2 2 - - - 1 - 1 - -	3 - -
CO3	3 3 3 3 - - - 1 - 1 - -	3 - -
CO4	3 3 3 3 - - - 1 - 1 - -	3 - -
CO5	3 3 3 2 - - - 1 - 1 - -	3 - -
1 - Low, 2 - Medium, 3 - High, '-' No correlation		

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:		
5. தமிழக வரலாறு – மக்களும் பண்பொடும் – கக.கக. பிள்ளை (தவளியீடு: தமிழ்நாடு பொடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).		
6. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).		
7. கீழடி – எவளக நதிக்களரயில் சங்ககொல நகர நொகரிகம் (ததொல்லியல் துளற தவளியீடு)		
8. பொருளந – ஆற்றங்களர நொகரிகம். (ததொல்லியல் துளற தவளியீடு)		
References:		
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).		
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).		
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)		
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamilnadu)		
10. 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
CO2:	Correlate the structural and aesthetic features of present-day engineering and architecture with ancient Tamil design and construction technology.	Understand
CO3:	Recognize the ingenuity behind ancient Tamil manufacturing technology, particularly in metallurgy, coinage, and shipbuilding.	Understand

CO4:	Analyze the engineering principles applied in ancient irrigation and agricultural technology (e.g., dams, tanks, Kumizhi Thoompu).	Apply
CO5:	Develop awareness of the evolution of Scientific Tamil and utilize modern tools and platforms for Tamil Computing and Digitalization	Apply
CO-PO Mapping		
Particular	PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12	PSO1 PSO2 PSO3
CO1	- - - - - 3 2 - 1 2 - 2	- - -
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 குழுமித் 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:		
9. தமிழக வரலாறு - மக்களும் பண்பொடும் - கக.கக. பிள்ளை (தவளியீடு: தமிழ்நாடு பொடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).		
10. கணினித் தமிழ் - முளனவர் இல. சுந்தரம். (விகடன் பிரசுரம்).		
11. கீழடி - எவளக நதிக்களரயில் சங்ககொல நகர நொகரிகம் (ததொல்லியல் துளற தவளியீடு)		
12. பொருளந - ஆற்றங்களர நொகரிகம். (ததொல்லியல் துளற தவளியீடு)		
References:		
11. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).		
12. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).		
13. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)		
14. 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)		
15. 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
CO2:	Correlate the structural and aesthetic features of present-day engineering and architecture with ancient Tamil design and construction technology.	Understand
CO3:	Recognize the ingenuity behind ancient Tamil manufacturing technology, particularly in metallurgy, coinage, and shipbuilding.	Understand
CO4:	Analyze the engineering principles applied in ancient irrigation and agricultural technology (e.g., dams, tanks, Kumizhi Thoompu).	Apply
CO5:	Develop awareness of the evolution of Scientific Tamil and utilize modern tools and platforms for Tamil Computing and Digitalization	Apply
CO-PO Mapping		

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

23GEP201	ENGINEERING PRACTICES LABORATORY	Category: ESC			
		L	T	P	C
		0	0	4	2
Prerequisites Nil					
Course Objectives: - Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work. - Wiring various electrical joints in common household electrical wire work. - Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work. - Soldering and testing simple electronic circuits; - Assembling and testing simple electronic components on PCB.					
GROUP – A (CIVIL & ELECTRICAL)					
PART I CIVIL ENGINEERING PRACTICES					
PLUMBING WORK: a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household. b) Preparing plumbing line sketches. c) Laying pipe connection to the suction side of a pump d) Laying pipe connection to the delivery side of a pump. e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances. WOOD WORK: a) Sawing, b) Planing and c) Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint. Wood Work Study: a) Studying joints in door panels and wooden furniture b) Studying common industrial trusses using models.					
PART II ELECTRICAL ENGINEERING PRACTICES					
a) Introduction to switches, fuses, indicators and lamps - Basic switch board wiring					

- with lamp, fan and three pin socket
- b) Staircase wiring
- c) Fluorescent Lamp wiring with introduction to CFL and LED types.
- d) Energy meter wiring and related calculations/ calibration
- e) Study of Iron Box wiring and assembly
- f) Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac)
- g) Study of emergency lamp wiring/Water heater

GROUP – B (MECHANICAL AND ELECTRONICS)**PART III MECHANICAL ENGINEERING PRACTICES****WELDING WORK:**

- a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
- b) Practicing gas welding.

BASIC MACHINING WORK:

- a) (simple)Turning.
- b) (simple)Drilling.
- c) (simple)Tapping.

ASSEMBLY WORK:

- a) Assembling a centrifugal pump.
- b) Assembling a household mixer.
- c) Assembling an airconditioner.

SHEET METAL WORK:

- a) Making of a square tray

FOUNDRY WORK:

- a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES**SOLDERING WORK:**

- a) Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:

- a) Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:

- a) Study an elements of smart phone..
- b) Assembly and dismantle of LED TV.
- c) Assembly and dismantle of computer/ laptop

Total periods:60**Text Books:**

1. Hajra Choudhury, S.K. and Roy, P.K. (2010) Elements of Workshop Technology, Vol. I & II. 14th edn. New Delhi: Media Promoters & Publishers.

References:

1. Raghuwanshi, B.S. (2018) Workshop Technology Vol I and II. 6th edn. New Delhi: Dhanpat Rai Publications.															
2. Raghuwanshi, A. (2015) Basic Workshop Practice Manual. New Delhi: Laxmi Publications.															
Course Outcomes:												Blooms Taxonomy			
CO1: Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.												Apply			
CO2: Wire various electrical joints in common household electrical wire work.												Apply			
CO3: Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.												Apply			
CO4: Solder and test simple electronic circuits;												Apply			
CO5: Assemble and test simple electronic components on PCB.												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	1	1	-	-	-	-	2	2	1	1
CO2	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
CO3	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
CO4	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
CO5	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23ECP201	CIRCUIT ANALYSIS LABORATORY	Category: PCC			
		L	T	P	C
		0	0	4	2
Prerequisites Nil					
Course Objectives: - To gain hands- on experience in Thevenin & Norton theorem, KVL & KCL, and Superposition Theorems. - To understand the working of RL,RC and RLC circuits					
LIST OF EXPERIMENTS					
1	Verifications of KVL & KCL.				
2	Verifications of Thevenin & Norton theorem.				
3	Verification of Superposition Theorem.				
4	Verification of maximum power transfer Theorem				
5	Determination of Resonance Frequency of Series & Parallel RLC Circuits.				
6	Transient analysis of RL and RC circuits.				
Total periods:60					
Text Books:					
3.	Hayt JackKemmerly, Steven Durbin, "Engineering Circuit Analysis", McGraw Hill education, 9th Edition, 2018.				
4.	2. Charles K. Alexander & Mathew N.O.Sadiku, "Fundamentals of Electric Circuits", McGraw- Hill, 2nd Edition, 2003.				
5.	3. Joseph Edminister and Mahmood Nahvi, “Electric Circuits, Schaum’s Outline Series”, Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition Reprint 2016.				

References:															
6	David Bell, "Fundamentals of Electric Circuits", Oxford University press, 7th Edition, 2009														
7	John O Mallay, Schaum's Outlines "Basic Circuit Analysis", The Mc Graw Hill companies, 2nd Edition, 2011.														
8	A.Bruce Carlson, "Circuits: Engineering Concepts and Analysis of Linear Electric Circuits, Cengage Learning, India Edition 2nd Indian Reprint 2009.														
9	Allan H.Robbins, Wilhelm C.Miller, "Circuit Analysis Theory and Practice", Cengage Learning, Fifth Edition, 1st Indian Reprint 2013														
Course Outcomes:													Blooms Taxonomy		
CO1: Verify Kirchoff's Voltage Law													Apply		
CO2: Verify Kirchoff's Current Law													Apply		
CO3: Verify various circuit theorems													Apply		
CO4: Verify the resonance and serial and parallel circuits													Apply		
CO5: Verify the transients in RL and RC circuits													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	1	-	-	-	1	-	1	-	3	3	-	-
CO2	3	3	2	2	-	-	-	1	-	1	-	3	3	-	-
CO3	3	3	3	3	-	-	-	1	-	1	-	3	3	-	-
CO4	3	3	3	3	-	-	-	1	-	1	-	3	3	-	-
CO5	3	3	3	2	-	-	-	1	-	1	-	3	3	-	-
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23GEP202	COMMUNICATION LABORATORY (Common to All Branches)	Category: ESC			
		L	T	P	C
		0	0	4	2
Prerequisites					
•					
Course Objectives:					
- To identify varied group discussion skills and apply them to take part in effective discussions in a professional context. - To analyze concepts and problems and make effective presentations explaining them clearly and precisely. - To be able to communicate effectively through formal and informal writing. - To be able to use appropriate language structures to write emails, reports and essays - To give instructions and recommendations that are clear and relevant to the context					
LIST OF EXPERIMENTS					
1	Speaking-Role Play Exercises Based on Workplace Contexts				
2	Talking about competition- discussing progress toward goals-talking about experiences-				
3	Talking about events in life- discussing past events-Writing: writing emails (formal& semi-formal).				

4	Speaking: discussing news stories-talking about frequency-talking about travel problems- discussing travel procedures- talking about travel problems
5	Making arrangements-describing arrangements-discussing plans and decisions-
6	Discussing purposes and reasons- understanding common technology terms-Writing: - writing different types of emails.
7	Speaking: discussing predictions-describing the climate-discussing forecasts and scenarios- talking about purchasing-discussing advantages and disadvantages
8	Making comparisons- discussing likes and dislikes- discussing feelings about experiences-
9	Discussing imaginary scenarios Writing: short essays and reports-formal/semi-formal letters.
10	Speaking: discussing the natural environment-describing systems-describing position and movement-
11	Explaining rules-(example-discussing rental arrangements)- understanding technical instructions-
12	Writing: Writing instructions-writing a short article.
13	Speaking: describing things relatively-describing clothing
14	Discussing safety issues (making recommendations) talking about electrical devices
15	Describing controlling actions- Writing: job application (Cover letter + Curriculum vitae)-writing recommendations.

Total periods: 60

Text Books:

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

References:

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

Course Outcomes:

CO1: Speak effectively in group discussions held in a formal/semi formal contexts.

Blooms Taxonomy

RE

CO2: Discuss, analyse and present concepts and problems from various perspectives to arrive at suitable solutions													AP		
CO3: Write emails, letters and effective job applications													UN		
CO4: Write critical reports to convey data and information with clarity and precision													AP		
CO5: Give appropriate instructions and recommendations for safe execution of tasks													AP		
CO – PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	0	0	0	0	0	2	2	2	3	2	3	-	-	-
CO2	1	0	0	0	0	0	2	2	2	3	2	3	-	-	-
CO3	1	0	0	0	0	0	2	2	2	3	2	3	-	-	-
CO4	1	0	0	0	0	0	2	2	2	3	2	3	-	-	-
CO5	1	0	0	0	0	0	2	2	2	3	2	3	-	-	-
1 - Low, 2 - Medium, 3 -High, ‘-‘ No correlation															

SEMESTER III

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

Classification of PDE – Method of separation of variables - Fourier series solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (Cartesian coordinates only).															
Unit IV		FOURIER TRANSFORMS											9+3		
Statement of Fourier integral theorem– Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval’s identity.															
Unit V		Z - TRANSFORMS AND DIFFERENCE EQUATIONS											9+3		
Z-transforms - Elementary properties – Convergence of Z-transforms - – Initial and final value theorems - Inverse Z-transform using partial fraction and convolution theorem - Formation of difference equations – Solution of difference equations using Z - transforms.															
Total periods:60 PERIODS															
Text Books:															
1. Grewal B.S., “Higher Engineering Mathematics" 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		
CO 1: Understand how to solve the given standard partial differential equations.													Understanding		
CO2: Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.													Applying		
CO3: Apply the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.													Applying		
CO4: Conclude the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.													Analyzing		
CO5: Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.													Understanding		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	1	-	-	-	-	-	1	-	-	-
CO2	3	3	3	3	-	1	-	-	-	-	-	1	-	-	-
CO3	3	3	3	3	-	1	-	-	-	-	-	1	-	-	-
CO4	3	3	3	3	-	1	-	-	-	-	-	1	-	-	-
CO5	3	3	3	3	-	1	-	-	-	-	-	1	-	-	-

AVG	3	3	3	3	-	1	-	-	-	-	-	1	-	-	-

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

23ECT301	SIGNALS AND SYSTEMS												Category: PCC			
													L	T	P	C
													3	1	0	4
Prerequisites Nil																
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 in the Fourier and Z transform domain - To analyze discrete LTI system in the Fourier and Z transform domain																
Unit I		CLASSIFICATION OF SIGNALS AND SYSTEMS												12		
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												12		
Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and Properties																
Unit III		LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS												12		
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												12		
Baseband signal Sampling–Fourier Transform of discrete time signals (DTFT)– Properties of DTFT-Z Transform & Properties																
Unit V		LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS												12		
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: 60																
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”, 2nd 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:													Blooms Taxonomy			
CO1: Determine if a given system is linear/causal/stable													Apply			
CO2: Determine the frequency components present in a deterministic signal													Apply			
CO3: Characterize continuous LTI systems in the time domain and frequency domain													Apply			
CO4: Characterize discrete LTI systems in the time domain and frequency domain													Apply			
CO5: Compute the output of an LTI system in the time and frequency domains													Apply			
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	

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

23ECT302	ELECTRONIC DEVICES AND CIRCUITS		Category: PCC			
			L	T	P	C
			3	0	0	3
Prerequisites Nil						
Course Objectives: - To explain the structure and working operation of basic electronic devices. - To design and analyze amplifiers. - To analyze frequency response of BJT and MOSFET amplifiers - To design and analyze feedback amplifiers and oscillator principles. - To design and analyze power amplifiers and supply circuits						
Unit I		SEMICONDUCTOR DEVICES				9
PN junction diode, Zener diode, BJT, MOSFET, UJT –structure, operation and V-I characteristics, diffusion and transition capacitance - 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 –MOSFET small signal model– Analysis of CS, CG 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 – MOSFET input stages – tuned amplifiers – Gain and frequency response – Neutralization methods.						
Unit IV		FEEDBACK AMPLIFIERS AND OSCILLATORS				9
Advantages of negative feedback – 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-Power MOSFET-Temperature Effect- Class AB Power amplifier using MOSFET –DC/DC convertors – Buck, Boost, Buck-Boost analysis and design.						
Total periods: 45						
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, 7th Edition, 2014.						
References:						
1. Donald.A. Neamen, "Electronic Circuit Analysis and Design", Tata McGraw Hill, 3rd 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:					Blooms Taxonomy	
CO1: Explain the structure and working operation of basic electronic devices.					Understand	

CO2: Design and analyze amplifiers.													Analyze		
CO3: Analyze frequency response of BJT and MOSFET amplifiers													Analyze		
CO4: Design and analyze feedback amplifiers and oscillator principles.													Analyze		
CO5: Design and analyze power amplifiers and supply circuits													Analyze		
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	-	-	-	-	-	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															

23ECT303	CONYTROL SYSTEMS		Category: PCC			
			L	T	P	C
			3	0	0	3
Prerequisites						
Nil						
Course Objectives:						
- To introduce the components and their representation of control systems - To learn various methods for analyzing the time response, frequency response and stability of the systems. - To learn the various approach for the state variable analysis						
Unit I	SYSTEMS COMPONENTS AND THEIR REPRESENTATION					9
Control System: Terminology and Basic Structure-Feed forward and Feedback control theory- Electrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs models-DC and AC servo Systems-Synchronous -Multivariable control system						
Unit II	TIME RESPONSE ANALYSIS					9
Transient response-steady state response-Measures of performance of the standard first order and second order system-effect on an additional zero and an additional pole-steady error constant and system- type number-PID control-Analytical design for PD, PI,PID control systems						
Unit III	FREQUENCY RESPONSE AND SYSTEM ANALYSIS					9
Latches, Flip flops – SR, JK, T, D, Master/Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits – Design - Moore/Mealy models, state minimization, state assignment, lock - out condition circuit implementation - Counters, Ripple Counters, Ring Counters, Shift registers, Universal Shift Register. Model Development: Designing of rolling display/real time clock						
Unit IV	CONCEPTS OF STABILITY ANALYSIS					9
Concept of stability-Bounded - Input Bounded - Output stability-Routh stability criterion-Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion.						
Unit V	CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS					9
State variable representation-Conversion of state variable models to transfer functions-Conversion of transfer functions to state variable models-Solution of state equations-Concepts of Controllability and Observability-Stability of linear systems-Equivalence between transfer function and state variable representations-State variable analysis of digital control system-Digital control design using state feedback.						
Total periods: 45						
Text Books:						
5. M.Gopal,“Control System – Principles and Design”, Tata McGraw Hill, 4 th Edition, 2012						
References:						
4. J.Nagrath and M.Gopal, “Control System Engineering”, New Age International Publishers, 5 th Edition, 2007.						
5. K.Ogata, “Modern Control Engineering”, PHI, 5 th Edition, 2012.						

6. S.K.Bhattacharya, “Control System Engineering”, Pearson, 3 rd Edition, 2013.															
7. Benjamin.C.Kuo, “Automatic Control Systems”, Prentice Hall of India, 7 th Edition,1995															
Course Outcomes:													Blooms Taxonomy		
CO1:	Compute the transfer function of different physical systems.												Apply		
CO2:	Analyze the time domain specification and calculate the steady state error.												Analyze		
CO3:	Illustrate the frequency response characteristics of open loop and closed loop systemresponse.												Analyze		
CO4:	Analyze the stability using Routh and root locus techniques.												Analyze		
CO5:	Illustrate the state space model of a physical system and discuss the concepts of sampleddata control system.												Analyze		
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	-	-	-	-	2	3	3	3	3
CO2	3	3	3	3	2	3	-	-	-	-	2	2	3	3	3
CO3	3	2	3	3	2	2	-	-	-	-	2	3	3	2	3
CO4	3	3	3	2	2	2	-	-	-	-	2	2	3	3	3
CO5	2	2	3	3	2	3	-	-	-	-	2	3	2	2	3
1 - Low, 2 - Medium, 3 - High, ‘-‘ No correlation															

23ECT304	DIGITAL SYSTEMS DESIGN		Category: PCC			
			L	T	P	C
			3	0	2	4
Prerequisites Nil						
Course Objectives: - To present the fundamentals of digital circuits and simplification methods - To practice the design of various combinational digital circuits using logic gates - To bring out the analysis and design procedures for synchronous and asynchronous Sequential circuits - To learn integrated circuit families. - To introduce semiconductor memories and related technology						
Unit I		BASIC CONCEPTS				9
Review of number systems-representation-conversions, Review of Boolean algebra- theorems, sum of product and product of sum simplification, canonical forms min term and max term, Simplification of Boolean expressions- Karnaugh map, completely and incompletely specified functions, Implementation of Boolean expressions using universal gates, Tabulation methods.						
Unit II		COMBINATIONAL LOGIC CIRCUITS				9
Problem formulation and design of combinational circuits - Code-Converters, Half and Full Adders, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Mux/Demux, Case study: Digital trans-receiver / 8 bit Arithmetic and logic unit, Parity Generator/Checker, Seven Segment display decoder						
Unit III		SYNCHRONOUS SEQUENTIAL CIRCUITS				9
Latches, Flip flops – SR, JK, T, D, Master/Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits – Design - Moore/Mealy models, state minimization, state assignment,lock - out condition circuit implementation - Counters, Ripple Counters, Ring Counters, Shift registers, Universal Shift Register. Model Development: Designing of rolling display/real time clock						
Unit IV		ASYNCHRONOUS SEQUENTIAL CIRCUITS				9
Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Fundamental and Pulse mode sequential circuits, Design of Hazard free circuits.						
Unit V		LOGIC FAMILIES AND PROGRAMMABLE LOGIC DEVICES				9

Logic families- Propagation Delay, Fan - In and Fan - Out - Noise Margin - RTL, TTL, ECL, CMOS - Comparison of Logic families - Implementation of combinational logic/sequential logic design using standard ICs, PROM, PLA and PAL, basic memory, static ROM, PROM, EPROM, EEPROM EAPROM.																
LIST OF EXPERIMENTS																
1	Design of adders and subtractors & code converters.															
2	Design of Multiplexers & Demultiplexers.															
3	Design of Encoders and Decoders.															
4	Design of Magnitude Comparators															
5	Design and implementation of counters using flip-flops															
6	Design and implementation of shift registers.															
Lecture : 45 Practical :30 Total periods:75																
Text Books:																
6. M. Morris Mano and Michael D. Ciletti, ‘Digital Design’, Pearson, 5th Edition, 2013.(Unit - I - V)																
References:																
8. Charles H. Roth, Jr, ‘Fundamentals of Logic Design’, Jaico Books, 4th Edition, 2002.																
9. William I. Fletcher, "An Engineering Approach to Digital Design", Prentice- Hall of India,1980.																
10. Floyd T.L., "Digital Fundamentals", Charles E. Merrill publishing company,1982.																
11. John. F. Wakerly, "Digital Design Principles and Practices", Pearson Education, 4 thEdition,2007.																
Course Outcomes:														Blooms Taxonomy		
CO1:	Use Boolean algebra and simplification procedures relevant to digital logic.													Apply		
CO2:	Design various combinational digital circuits using logic gates.													Apply		
CO3:	Analyze and design synchronous sequential circuits.													Analyze		
CO4:	Analyze and design asynchronous sequential circuits.													Analyze		
CO5:	Build logic gates and use programmable devices													Apply		
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	3	3	2	-	
CO2	3	2	2	2	-	2	-	-	-	-	3	3	3	2	-	
CO3	3	2	2	2	-	2	-	-	-	-	3	3	3	2	-	
CO4	3	2	2	2	-	2	-	-	-	-	3	3	3	2	-	
CO5	3	2	2	2	-	2	-	-	-	-	3	3	3	2	-	
1 - Low, 2 - Medium, 3 - High, ‘-’ No correlation																

23CST308	DATA STRUCTURES	Category: ESC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
Course Objectives: • Employ linear and non-linear data structures for a given scenario. • Choose appropriate graph representation methods to solve problems • Apply topological sort, graph traversals and minimum spanning tree algorithms for solving real-time problems • Employ appropriate sorting techniques based on their time complexities • Select appropriate design methodology to develop an algorithm for a given problem.					

Unit I	INTRODUCTION TO DATA STRUCTURES												9		
Introduction: Mathematical review - Recursion - Classes and Details - Templates - Using matrices. Algorithm Analysis: Mathematical Background and Model - What to Analyze - running time calculations.															
Unit II	LISTS, STACKS AND QUEUES												9		
Lists, Stacks and Queues: ADT, List ADT- Vectors and List - Implementation of Vectors and List. Stack ADT - Queue ADT															
Unit III	TREES												9		
Trees: Preliminaries - Binary Trees - Binary Search trees - AVL trees - tree traversal - B-trees Hashing: Hash function - separate chaining - Hash table without linked lists - rehashing - hash table in STL - extendible hashing. Priority queues: Model - simple implementations of Binary heap - applications of priority queue															
Unit IV	SORTING												9		
Sorting: Preliminaries - insertion sort - Lower Bound for Simple Algorithms - Shell Sort - Heap Sort - Merge Sort - Quick Sort - Indirect Sorting - Bucket Sort - External Sorting. Graphs: Definition - Topological Sort - Shortest Path Algorithms - Network Flow Problems - Minimum Spanning Tree - Applications of DFS															
Unit V	ALGORITHM DESIGN												9		
Algorithm Design: Greedy Algorithms - Divide and Conquer - Dynamic Programming - Back Tracking. String Matching: Notation and Terminology -The naïve string matching - Rabin Karp algorithm - Knuth-Morris-Pratt algorithm. algorithm.															
Total periods: 45															
Text Books:															
1. Mark Allen Weiss. Data Structures and Algorithm Analysis in C++, Pearson Education, Fourth Edition, 2014.															
2. T.H. Cormen, C.E. Leiserson, R.L. Rivest, and C. Stein. Introduction to Algorithms, Prentice Hall of India, Third Edition, 2009.															
References:															
1. Jon Kleinberg and ÉvaTardos. Algorithm Design, Pearson Education, First Edition, 2013.															
2. Anany Levitin. Introduction to the Design and Analysis of Algorithm, Pearson Education, Third Edition, 2012.															
3. Ellis Horowitz, SartajSahni and Susan Anderson Freed. Fundamentals of Data Structures in C, University Press, Second Edition, 2008.															
4. Richard F. Gilberg and Behrouz A. Forouzan. Data Structures: A Pseudo code Approach with C, Thomson Learning, Second Edition, 2007.															
Course Outcomes:													Blooms Taxonomy		
CO1:	Employ linear and non-linear data structures for a given scenario.												Apply		
CO2:	Choose appropriate graph representation methods to solve problems												Analyze		
CO3:	Apply topological sort, graph traversals and minimum spanning tree algorithms for solving real-time problems												Analyze		
CO4:	Employ appropriate sorting techniques based on their time complexities												Analyze		
CO5:	Select appropriate design methodology to develop an algorithm for a given problem.												Analyze		
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	2	3	1
CO2	3	3	3	2	2	-	-	-	-	-	-	2	2	3	1
CO3	3	3	3	2	2	-	-	-	-	-	-	2	2	3	1
CO4	3	3	3	2	2	-	-	-	-	-	-	2	2	3	1
CO5	3	3	3	2	2	-	-	-	-	-	-	2	2	3	1
1 - Low, 2 - Medium, 3 - High, ‘-’ No correlation															

23ECP301	ELECTRONIC DEVICES AND CIRCUITS LABORATORY											Category: PCC			
												L	T	P	C
												0	0	3	1.5
Prerequisites Nil															
Course Objectives: - To study the characteristics of PN Junction Diode and Zener diode. - To design and test BJT amplifiers. - To design and test MOSFET amplifiers. - To design and test differential amplifiers. - To design and test power amplifiers.															
LIST OF EXPERIMENTS															
1	Characteristics of PN Junction Diode and Zener diode.														
2	Full Wave Rectifier with Filters.														
3	Design of Zener diode Regulator.														
4	Common Emitter input-output Characteristics.														
5	MOSFET Drain current and Transfer Characteristics.														
6	Frequency response of CE and CS amplifiers.														
7	Frequency response of CB and CC amplifiers.														
8	Frequency response of Cascode Amplifier														
9	CMRR measurement of Differential Amplifier														
10	Class A Transformer Coupled Power Amplifier.														
Total periods:45															
Text Books:															
1. Boylestad, R.L. and Nashelsky, L. (2016) <i>Electronic Devices and Circuit Theory</i> . 11th edn. Harlow: Pearson Education.															
2. Malvino, A.P. and Bates, D.J. (2020) <i>Electronic Principles</i> . 8th edn. New York: McGraw-Hill Education.															
3. Sedra, A.S. and Smith, K.C. (2017) <i>Microelectronic Circuits</i> . 7th edn. New York: Oxford University Press.															
References:															
1 Millman, J. and Halkias, C.C. (2007) <i>Integrated Electronics: Analog and Digital Circuits and Systems</i> . Revised edn. New Delhi: Tata McGraw Hill.															
2 Neamen, D.A. (2010) <i>Electronic Circuits: Analysis and Design</i> . 4th edn. New York: McGraw-Hill Education.															
3 Razavi, B. (2017) <i>Fundamentals of Microelectronics</i> . 3rd edn. Hoboken: John Wiley & Sons.															
Course Outcomes:													Blooms Taxonomy		
CO1: Study the characteristics of PN Junction Diode and Zener diode.													Analyze		
CO2: Design and test BJT amplifiers.													Evaluate		
CO3: Design and test MOSFET amplifiers.													Evaluate		
CO4: Design and test differential amplifiers.													Evaluate		
CO5: Design and test power amplifiers.													Evaluate		
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	-	-	1	2	2	1	2	3	-	-
CO2	3	3	3	3	3	-	-	1	2	2	1	2	3	-	-
CO3	3	3	3	3	3	-	-	1	2	2	1	2	3	-	-
CO4	3	3	3	3	3	-	-	1	2	2	1	2	3	-	-
CO5	3	3	3	3	3	-	-	1	2	2	1	2	3	-	-
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CSP304	DATA STRUCTURES LABORATORY	Category: ESC			
		L	T	P	C
		0	0	3	1.5
Prerequisites Nil					
Course Objectives: - To develop applications in C - To implement linear and non-linear data structures - To understand the different operations of search trees - To apply appropriate hash functions that result in a collision free scenario for data storage and Retrieval - To get familiarized to sorting and searching algorithms					
LIST OF EXPERIMENTS					
1	Practice of C programming using statements, expressions, decision making and iterative statements				
2	Practice of C programming using Functions and Arrays				
3	Implement C programs using Pointers and Structures				
4	Implement C programs using Files				
5	Development of real time C applications				
6	Array implementation of List ADT				
7	Array implementation of Stack and Queue ADTs				
8	Linked list implementation of List, Stack and Queue ADTs				
9	Applications of List, Stack and Queue ADTs				
10	10.Implementation of Binary Trees and operations of Binary Trees				
11	Implementation of Binary Search Trees				
12	Implementation of searching techniques				
13	Implementation of Sorting algorithms : Insertion Sort, Quick Sort, Merge Sort				
14	Implementation of Hashing – any two collision techniques				
Total periods:45					
Text Books:					
2. Bakariya, B. (no date) Data Structures and Algorithms Implementation Through C. Available at: [Insert Publisher/Source if known].					
3. Gilberg, R.F. and Forouzan, B.A. (2005) Data Structure- A Pseudocode Approach with C. 2nd edn. Boston: Thomson Course Technology.					
4. Rao, R.N. (2018) The Ultimate C with Data Structures. 2nd edn. New Delhi: Cengage Learning India.					
5. hareja, R. (2014) Data Structures Using C. 2nd edn. New Delhi: Oxford University Press.					
References:					
1. Horowitz, E., Sahni, S. and Anderson-Freed, S. (2007) Fundamentals of Data Structures in C. 2nd edn. Rockville, MD: Computer Science Press.					
1. Sedgewick, R. (1998) Algorithms in C, Parts 1-5. 3rd edn. Boston: Addison-Wesley Professional.					
2. Tenenbaum, A.M., Langsam, Y. and Augenstein, M.J. (1990) Data Structures Using C. Upper Saddle River, NJ: Prentice Hall.					
Course Outcomes:					Blooms Taxonomy
CO1: Use different constructs of C and develop applications					Apply
CO2: Write functions to implement linear and non-linear data structure operations					Apply
CO3: Suggest and use the appropriate linear / non-linear data structure operations for a given problem					Evaluate
CO4: Apply appropriate hash functions that result in a collision free scenario for data storage and Retrieval					Apply

CO5: Implement Sorting and searching algorithms for a given application													Apply		
CO – PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	2	-	-	-	-	3	3	3	3	2
CO2	-	-	-	-	-	-	-	-	-	-	2	1	2	3	2
CO3	-	3	3	2	-	2	-	-	-	-	2	2	3	3	2
CO4	-	-	-	-	-	-	-	-	-	-	3	2	2	3	1
CO5	-	3	3	3	-	-	-	-	-	-	2	2	3	3	2
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23GEP301	PROFESSIONAL DEVELOPMENT		Category: EEC			
			L	T	P	C
			0	0	2	1
Prerequisites Nil						
Course Objectives: - 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						
MS WORD						
1	Create and format document					
2	Working with tables					
3	Working with Bullets and Lists					
4	Working with styles, shapes, smart art, charts					
5	Inserting objects, charts and importing objects from other office toolsCreating and Using document templates					
6	Inserting equations, symbols and special characters Working with Table of contents and References, citations Insert and review comments					
7	Create bookmarks, hyperlinks, endnotes footnoteViewing document in different modes					
8	Working with document protection and securityInspect document for accessibility.					
MS EXCEL						
9	Create worksheets, insert and format data					
10	Work with different types of data: text, currency, date, numeric etc.Split, validate, consolidate, Convert data					
11	Sort and filter data					
12	Perform calculations and use functions: (Statistical, Logical, Mathematical, date, Time etc.,)Work with Lookup and reference formulae					
13	Create and Work with different types of charts Use pivot tables to summarize and analyze data					
14	Perform data analysis using own formulae and functions					
15	Combine data from multiple worksheets using own formulae and built-in functions to generateresults					

16	Export data and sheets to other file formatsWorking with macros														
17	Protecting data and Securing the workbook														
MS POWERPOINT															
18	Select slide templates, layout and themes														
19	Formatting slide content and using bullets and numberingInsert and format images, smart art, tables, charts														
20	Using Slide master, notes and handout masterWorking with animation and transitions Organize and Group slides														
21	Import or create and use media objects: audio, video, animation														
22	Perform slideshow recording and Record narration and create presentable videos														
Total periods:30															
Text Books:															
1. Microsoft Office 365 & Office 2021: In Practice (Series by Nordell, Ruffolo, and Copley).															
References:															
1. Microsoft Office 365 & Excel, Word, & PowerPoint Bible (By Faithe Wempen, et al.)															
Course Outcomes:													Blooms Taxonomy		
CO1:Use MS Word to create quality documents, by structuring and organizing content for their dayto day technical and academic requirements													Apply		
CO2:Use MS EXCEL to perform data operations and analytics, record, retrieve data as perrequirements and visualize data for ease of understanding													Apply		
CO3:Use MS PowerPoint to create high quality academic presentations by including commontables, charts, graphs, interlinking other elements, and using media objects.													Apply		
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	2	3	-	1	1
CO3	-	-	-	-	-	-	-	-	-	3	2	3	-	1	1
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

SEMESTER IV

23ECT401	ENGINEERING ELECTROMAGNETICS	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
Course Objectives: • To apply electrostatic laws to determine electric fields, potential, and energy density • To apply magnetostatic laws to determine magnetic field intensity, magnetic potential, and energy density • To apply Maxwell's Equations in both static and time-varying field forms. • To describe the characteristics of plane wave propagation in various media, • To solve problems involving Transmission Line Equations and impedance matching.					
Unit I	ELECTROSTATICS				9
Introduction to coordinate systems, divergence and curl of the vector, divergence theorem and Stoke’s theorem - Coulomb's law – Electric field intensity - Electrostatic flux - Gauss's law and its applications - Electrostatic potential - Energy density in electrostatic fields - Convection and Conduction currents - Electrostatic boundary conditions.					
Unit II	MAGNETOSTATICS				9

Biot- Savart's law – Determination of magnetic field intensity due to various current elements - Ampere's circuit law and its applications - Magnetic flux – Magnetic potential - Energy density in magnetostatic fields - Magnetostatic boundary conditions.															
Unit III		MAXWELL’S EQUATION												9	
Time varying fields: Faraday’s Laws of Electromagnetic Induction – Transformer and Motional EMF – Displacement current - Maxwell's equations in static fields and time varying fields - Equation of Continuity – Inconsistency of Ampere’s Law –Time Harmonic Fields – Maxwell’s Equations in phasor form															
Unit IV		ELECTROMAGNETIC WAVE PROPAGATION												9	
General Wave Equations – Wave Propagation in Lossy Dielectrics and in Lossless Dielectrics – Free Space Wave Propagation – Plane Wave in Good Conductors – Power and Poynting vector - Reflection of Plane Wave at Normal and Oblique Incidence.															
Unit V		TRANSMISSION LINES AND WAVEGUIDES												9	
Transmission Line Parameters – Transmission Line Equations –, Standing Wave Ratio – Shorted, Open and Matched Lines – Smith Chart – Impedance matching. Rectangular Waveguides – TM, TE modes– Wave Propagation in the waveguide.															
Total periods: 45															
Text Books:															
1. Matthew N.O.Sadiku, Principles of Electromagnetics, 6th Edition, Oxford University Press, New York, 2017.															
2. William H. Hayt. Jr and John A. Buck, Engineering Electromagnetics, 6th Edition, McGraw Hill, 2006															
3. David K.Cheng, <i>Field and wave Electromagnetics</i> , 2 nd Edition, Pearson Education Asia, 2004															
References:															
1. Edward C. Jordan and Keith G. Balmain, <i>Electromagnetic Waves and Radiating Systems</i> , Prentice Hall of India, New Delhi, 2006.															
2. Bhag Singh Guru and Huseyin R.Hiziroglu, <i>Electromagnetic Field Theory Fundamentals</i> , Vikas Publishing House, New Delhi, 2005.															
Course Outcomes:													Blooms Taxonomy		
CO1:	Apply electrostatic laws to determine electric fields, potential, and energy density in various media, including the application of boundary conditions.												Apply		
CO2:	Apply magnetostatic laws to determine magnetic field intensity, magnetic potential, and energy density, and utilize magnetostatic boundary conditions.												Apply		
CO3:	Formulate, interpret, and apply Maxwell's Equations in both static and time-varying field forms.												Apply		
CO4:	Analyze and describe the characteristics of plane wave propagation in various media,.												Analyze		
CO5:	Analyze and solve problems involving Transmission Line Equations and impedance matching using the Smith Chart.												Analyze		
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	2	2	-	-	1	-	2	3	-	-
CO2	3	2	2	2	2	2	2	-	-	1	-	2	3	-	-
CO3	3	2	2	2	2	2	2	-	-	1	-	2	3	-	-
CO4	3	2	2	2	2	2	2	-	-	1	-	2	3	-	-
CO5	3	2	2	2	2	2	2	-	-	1	-	2	3	-	-
1 - Low, 2 - Medium, 3 - High, ‘-’ No correlation															

23ECT402	NETWORKS AND SECURITY										Category: PCC			
											L	T	P	C

			3	0	2	4
Prerequisites • Nil						
Course Objectives: • To learn the Network Models and datalink layer functions. • To understand routing in the Network Layer. • To explore methods of communication and congestion control by the Transport Layer. • To study Network Security Mechanisms. • To learn various hardware security attacks and their countermeasures						
Unit I	NETWORK MODELS AND DATALINK LAYER					9
Overview of Networks and its Attributes – Network Models – OSI, TCP/IP, Addressing – Introduction to Datalink Layer – Error Detection and Correction – Ethernet (802.3)- Wireless LAN – IEEE 802.11, Bluetooth – Flow and Error Control Protocols – HDLC – PPP.						
Unit II	NETWORK LAYER PROTOCOLS					9
Network Layer – IPv4 Addressing – Network Layer Protocols (IP, ICMP and Mobile IP) Unicast and Multicast Routing – Intradomain and Interdomain Routing Protocols – IPv6 Addresses – IPv6 – Datagram Format - Transition from IPv4 to IPv6.						
Unit III	TRANSPORT AND APPLICATION LAYERS					9
Transport Layer Protocols – UDP and TCP Connection and State Transition Diagram - Congestion Control and Avoidance (DEC bit, RED)- QoS - Application Layer Paradigms – Client – Server Programming – Domain Name System – World Wide Web, HTTP, Electronic Mail.						
Unit IV	NETWORK SECURITY					9
OSI Security Architecture – Attacks – Security Services and Mechanisms – Encryption –Advanced Encryption Standard – Public Key Cryptosystems – RSA Algorithm – Hash Functions – Secure Hash Algorithm – Digital Signature Algorithm.						
Unit V	HARDWARE SECURITY					9
Introduction to hardware security, Hardware Trojans, Side – Channel Attacks – Physical Attacks and Countermeasures – Design for Security. Introduction to Blockchain Technology.						
LIST OF EXPERIMENTS						
1	Implement the Data Link Layer framing methods, i) Bit stuffing, (ii) Character stuffing					
2	Implementation of Error Detection / Correction Techniques i)					
3	Implementation of Stop and Wait, and Sliding Window Protocols					
4	Implementation of Go back-N and Selective Repeat Protocols.					
5	Implementation of Distance Vector Routing algorithm (Routing Information Protocol) (Bellman-Ford).					
6	Implementation of Link State Routing algorithm (Open Shortest Path First) with 5 nodes (Dijkstra's).					
7	Data encryption and decryption using Data Encryption Standard algorithm.					
8	Data encryption and decryption using RSA (Rivest, Shamir and Adleman) algorithm.					
9	Implement Client Server model using FTP protocol					
Experiments using Tool Command Language						
	1. Implement and realize the Network Topology - Star, Bus and Ring using NS2.					
	2. Implement and perform the operation of CSMA/CD and CSMA/CA using NS2.					
		Lecture : 45	Practical :30	Total periods:75		
Text Books:						
1. Behrouz.A.Forouzan, Data Communication and Networking, Fifth Edition, TMH, 2013. (Unit– I,II,III)						
2. William Stallings, Cryptography and Network Security, Fifth Edition, Pearson Education, 2011(Unit- IV)						
3. Bhunia Swarup, Hardware Security –A Hands On Approach,Morgan Kaufmann, First edition, 2018.(Unit – V).						

References:																
12. James.F.Kurose and Keith.W.Ross, Computer Networking – A Top – Down Approach, Sixth Edition, Pearson, 2017.																
13. Doughlas .E.Comer, Computer Networks and Internets with Internet Applications, Fourth Edition, Pearson Education, 2008																
Course Outcomes:													Blooms Taxonomy			
CO1:	Explain the Network Models, layers and functions.												Understand			
CO2:	Categorize and classify the routing protocols.												Analyze			
CO3:	List the functions of the transport and application layer.												Understand			
CO4:	Evaluate and choose the network security mechanisms.												Evaluate			
CO5:	Discuss the hardware security attacks and countermeasures												Analyze			
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	-	2	-	2	-	2	3	-	2	
CO2	3	3	3	3	3	2	-	2	-	2	-	2	3	-	2	
CO3	3	3	3	3	3	2	-	2	-	2	-	2	3	-	2	
CO4	3	3	3	3	3	2	-	2	-	2	-	2	3	-	2	
CO5	3	3	3	3	3	2	-	2	-	2	-	2	3	-	2	
1 - Low, 2 - Medium, 3 - High, ‘-’ No correlation																

23ECT403	LINEAR INTEGRATED CIRCUITS	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Nil					
Course Objectives:					
- To introduce the basic building blocks of linear integrated circuits - To learn the linear and non-linear applications of operational amplifiers - To introduce the theory and applications of analog multipliers and PLL - To learn the theory of ADC and DAC - To introduce the concepts of waveform generation and introduce some special function ICs					
Unit I	BASICS OF OPERATIONAL AMPLIFIERS				9
Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations – MOSFET Operational Amplifiers – LF155 and TL082.					
Unit II	APPLICATIONS OF OPERATIONAL AMPLIFIERS				9
Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.					
Unit III	ANALOG MULTIPLIER AND PLL				9
Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing and clock synchronization					
Unit IV	ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS				9
Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R - 2R Ladder types - switches for D/A converters, high speed sample-and-hold					

circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters, Sigma – Delta converters.															
Unit V		WAVEFORM GENERATORS AND SPECIAL FUNCTION ICS												9	
Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Low Drop – Out(LDO) Regulators - Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters, Audio Power amplifier, Video Amplifier, Isolation Amplifier, Opto- couplers and fibre optic IC															
Total periods: 45															
Text Books:															
1. D.Roy Choudhry, Shail Jain, “Linear Integrated Circuits”, New Age International Pvt. Ltd., 2018, Fifth Edition. (Unit I – V)															
2. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, 4th Edition, Tata Mc Graw-Hill, 2016 (Unit I – V)															
References:															
4. Ramakant A. Gayakwad, “OP-AMP and Linear ICs”, 4th Edition, Prentice Hall / Pearson Education, 2015															
5. Robert F.Coughlin, Frederick F.Driscoll, “Operational Amplifiers and Linear Integrated Circuits”, Sixth Edition, PHI, 2001.															
6. S.Salivahanan & V.S. Kanchana Bhaskaran, “Linear Integrated Circuits”, TMH,2nd Edition, 4th Reprint, 2016.															
Course Outcomes:														Blooms Taxonomy	
CO1: Understand the basics of operational amplifiers														Understand	
CO2: Design linear and nonlinear applications of OP – AMPS														Apply	
CO3: Design applications using analog multiplier and PLL														Apply	
CO4: Design ADC and DAC using OP – AMPS														Apply	
CO5: Analyze waveforms generators using OP – AMP circuits and special function ICs														Analyze	
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	3	2	-
CO2	3	3	3	3	-	-	-	-	-	-	-	2	3	2	-
CO3	3	3	3	3	-	-	-	-	-	-	-	2	3	2	-
CO4	3	3	3	3	-	-	-	-	-	-	-	2	3	2	-
CO5	3	3	3	3	-	-	-	-	-	-	-	2	3	2	-
1 - Low, 2 - Medium, 3 - High, ‘-’ No correlation															

23ECT404	DIGITAL SIGNAL PROCESSING	Category: PCC			
		L	T	P	C
		3	0	2	4
Prerequisites • Nil					
Course Objectives: • To learn discrete fourier transform, properties of DFT and its application to linear filtering • To understand the characteristics of digital filters, design digital IIR and FIR filters and apply these filters to filter undesirable signals in various frequency bands • To understand the effects of finite precision representation on digital filters • To understand the fundamental concepts of multi rate signal processing and its applications					

To introduce the concepts of adaptive filters and its application to communication engineering		
Unit I	DISCRETE FOURIER TRANSFORM	9
Sampling Theorem, concept of frequency in discrete-time signals, summary of analysis & synthesis equations for FT & DTFT, frequency domain sampling, Discrete Fourier transform (DFT) - deriving DFT from DTFT, properties of DFT - periodicity, symmetry, circular convolution. Linear filtering using DFT. Filtering long data sequences - overlap save and overlap add method. Fast computation of DFT - Radix-2 Decimation-in-time (DIT) Fast Fourier transform (FFT), Decimation-in-frequency (DIF) Fast Fourier transform (FFT). Linear filtering using FFT.		
Unit II	INFINITE IMPULSE RESPONSE FILTERS	9
Characteristics of practical frequency selective filters. characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation. Frequency transformation in the analog domain. Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.		
Unit III	FINITE IMPULSE RESPONSE FILTERS	9
Design of FIR filters - symmetric and Anti-symmetric FIR filters - design of linear phase FIR filters using Fourier series method - FIR filter design using windows (Rectangular, Hamming and Hanning window), Frequency sampling method. FIR filter structures - linear phase structure, direct form realizations.		
Unit IV	FINITE WORD LENGTH EFFECTS	9
Fixed point and floating-point number representation - ADC - quantization - truncation and rounding - quantization noise - input / output quantization - coefficient quantization error - product quantization error - overflow error - limit cycle oscillations due to product quantization and summation - scaling to prevent overflow.		
Unit V	DSP APPLICATIONS	9
Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor – Adaptive Filters: Introduction, Applications of adaptive filtering to equalization-DSP Architecture- Fixed and Floating point architecture principles		
LIST OF EXPERIMENTS		
1	Generation of elementary Discrete-Time sequences	
2	Linear and Circular convolutions	
3	Auto correlation and Cross Correlation	
4	Frequency Analysis using DFT	
5	Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operation	
6	Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations	
7	Study of architecture of Digital Signal Processor	
8	Perform MAC operation using various addressing modes	
9	Generation of various signals and random noise	
10	Design and demonstration of FIR Filter for Low pass, High pass, Band pass and Band stop filtering	
11	Design and demonstration of Butter worth and Chebyshev IIR Filters for Low pass, High pass, Band pass and Band stop filtering	
12	Implement an Up-sampling and Down-sampling operation in DSP Processor	
Lecture : 45 Practical :30 Total periods:75		
Text Books:		
7. John G. Proakis and Dimitris G.Manolakis, Digital Signal Processing – Principles, Algorithms and Applications, Fourth Edition, Pearson Education / Prentice Hall, 2007.		
8. A. V. Oppenheim, R.W. Schafer and J.R. Buck, —Discrete-Time Signal Processing”, 8th Indian Reprint, Pearson, 2004.		
References:		

1. Emmanuel C. Ifeachor& Barrie. W. Jervis, “Digital Signal Processing”, Second Edition, Pearson Education / Prentice Hall, 2002.															
2. Sanjit K. Mitra, “Digital Signal Processing – A Computer Based Approach”, Tata Mc Graw Hill, 2007.															
3. Andreas Antoniou, “Digital Signal Processing”, Tata Mc Graw Hill, 2006.															
Course Outcomes:													Blooms Taxonomy		
CO1:	Apply DFT for the analysis of digital signals and systems												Apply		
CO2:	Design IIR and FIR filters												Apply		
CO3:	Characterize the effects of finite precision representation on digital filters												Apply		
CO4:	Design multirate filters												Apply		
CO5:	Apply adaptive filters appropriately in communication systems												Apply		
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	-	-	-	-	1	1	3	2	2
CO2	3	3	3	3	2	2	-	-	-	-	1	1	3	2	2
CO3	3	3	2	2	2	2	-	-	-	-	1	1	3	2	2
CO4	3	3	2	2	3	1	-	-	-	-	1	1	3	2	2
CO5	3	2	2	2	3	2	-	-	-	-	1	1	3	2	2
1 - Low, 2 - Medium, 3 - High, ‘-’ No correlation															

23ECT405	COMMUNICATION SYSTEMS	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
Course Objectives: • To introduce Analog Modulation Schemes • To impart knowledge in random process • To study various Digital techniques • To introduce the importance of sampling & quantization • To impart knowledge in demodulation techniques.					
Unit I	AMPLITUDE MODULATION				9
Review of signals and systems, Time and Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals. SSB Generation – Filter and Phase Shift Methods, VSB Generation – Filter Method, Hilbert Transform, Pre-envelope & complex envelope AM techniques, Superheterodyne Receiver.					
Unit II	RANDOM PROCESS & SAMPLING				9
Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and De- emphasis, Threshold effect in angle modulation. Low pass sampling – Aliasing- Signal Reconstruction-Quantization - Uniform & non-uniform quantization - quantization noise - Nyquist criterion- Logarithmic Companding –PAM, PPM, PWM, PCM – TDM.					
Unit III	DIGITAL TECHNIQUES				9
Pulse modulation Differential pulse code modulation. Delta modulation, Noise considerations in PCM,, Digital Multiplexers, Channel coding theorem - Linear Block codes - Hamming codes - Cyclic codes - Convolutional codes - Viterbi Decoder.					
Unit IV	DIGITAL MODULATION SCHEME				9
Geometric Representation of signals - Generation, detection, IQ representation, PSD & BER of Coherent BPSK, BFSK, & QPSK - QAM - Carrier Synchronization - Structure of Non-coherent Receivers Synchronization and Carrier Recovery for Digital modulation, Spectrum Analysis – Occupied bandwidth – Adjacent channel power, EVM, Principle of DPSK					

Unit V	DEMODULATION TECHNIQUES												9		
Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Baseband Pulse Transmission- Inter symbol Interference, Optimum demodulation of digital signals over band-limited channels.															
Total periods: 45															
Text Books:															
3. Simon Haykins,” Communication Systems”, Wiley, 5th Edition, 2009.(Unit I - V)															
4. B.P. Lathi, “Modern Digital and Analog Communication Systems”, 4th Edition, Oxford University Press, 2011.															
References:															
5. Wayner Tomasi, Electronic Communication System, 5th Edition, Pearson Education,2008.															
6. D.Roody, J.Coolen, Electronic Communications, 4th edition PHI 2006															
7. A.Papoulis, “Probability, Random variables and Stochastic Processes”, McGraw Hill, 3rd edition, 1991.															
8. B.Sklar, “Digital Communications Fundamentals and Applications”, 2nd Edition Pearson Education 2007															
9. H P Hsu, Schaum Outline Series - “Analog and Digital Communications” TMH 2006.															
10. Couch.L., "Modern Communication Systems", Pearson, 2001.															
Course Outcomes:													Blooms Taxonomy		
CO1:	Gain knowledge in amplitude modulation techniques												Understand		
CO2:	Understand the concepts of Random Process to the design of communication systems												Understand		
CO3:	Gain knowledge in digital techniques												Understand		
CO4:	Gain knowledge in sampling and quantization												Understand		
CO5:	Understand the importance of demodulation techniques												Understand		
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	1	-	-	-	1	1	3	-	-
CO2	3	3	3	3	2	1	1	-	-	-	1	1	3	-	-
CO3	3	3	3	3	3	1	1	-	-	-	1	1	3	-	-
CO4	3	3	3	3	3	1	1	-	-	-	1	1	3	-	-
CO5	3	3	3	3	2	1	1	-	-	-	1	1	3	-	-
1 - Low, 2 - Medium, 3 - High, ‘-‘ No correlation															

23GET401	ENVIRONMENTAL SCIENCE AND ENGINEERING (Common to all programmes)	Category: BSC			
		L	T	P	C
		2	0	0	2
Prerequisites					
NIL					
Course Objectives:					
❖ To study the nature of environment and biodiversity. ❖ To impart knowledge on the causes, effects and control/preventive 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	9
Definition, scope and importance of environment – need for public awareness. Eco-system and energy flow– ecological succession. Ecosystems: Forest ecosystem and grassland ecosystem. Types of biodiversity: genetic, species and ecosystem diversity. Values of biodiversity, hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife and man- wildlife conflicts. Conservation of biodiversity: In-situ and ex-situ.		
Unit II	ENVIRONMENTAL POLLUTION	6
Causes, effects, prevention and treatment technologies for Air, Water, Soil. Solid waste management and R principle. Solid, hazardous and E-waste management, Industrial safety measures.		
Unit III	RENEWABLE ENERGY RESOURCES	6
Deforestation. New Energy Sources: Need of new energy resources. Different energy resources: Tidal, Solar, Wind, Nuclear and Biomass energy resources. Applications of Hydrogen energy, Ocean energy resources and Tidal energy conversion.		
Unit IV	SOCIAL ISSUES OF ENVIRONMENT	9
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:36		
Text Books:		
1. Benny Joseph, ‘Environmental Science and Engineering’, 3 rd edition, Tata McGraw-Hill, New Delhi, 2017		
2. Gilbert M.Masters, ‘Introduction to Environmental Engineering and Science’, 2 nd edition, Pearson Education, 2004		
3. Anubha Kaushik and C.P. Kaushiks, ‘Perspectives in Environmental Studies, 6 th edition, New Age International Publishers, 2018.		
4. A.K. De, ‘Environmental Chemistry, New Age International Publishers, New Delhi, 2016.		
References:		
1. Cunningham, W.P. Cooper, T.H. Gorhani, ‘Environmental Encyclopedia, Jaico Publishing House,		

Mumbai, 2001.															
2. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure, 'Oxford University Press, 3 rd edition, 2015.															
3. Erach Bharucha, 'Textbook of Environmental Studies for Undergraduate Courses, Orient Black swan Private limited, 2013.															
Course Outcomes:													Blooms Taxonomy		
CO1: Familiar the functions of ecosystems, environment and biodiversity.													K1		
CO2: Know well about the effects of environmental pollutions													K1		
CO3: Inculcate the basic knowledge of renewable energy resources													K1		
CO4: Differentiate various social problems.													K2		
CO5: Describe the importance/impacts of population growth.													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	1	-	-	-
CO2	3	1	1	-	-	1	2	-	2	-	1	1	-	-	-
CO3	3	1	-	-	1	1	2	-	2	-	1	1	-	-	-
CO4	3	1	-	-	1	1	2	-	2	-	1	1	-	-	-
CO5	3	1	-	-	1	1	2	-	-	-	1	1	-	-	-

23ECP401	COMMUNICATION SYSTEMS LABORATORY	Category: PCC			
		L	T	P	C
		0	0	3	1.5
Prerequisites Nil					
Course Objectives: - To study the AM & FM Modulation and Demodulation. - To learn and realize the effects of sampling and TDM. - To understand PCM & Digital Modulation. - To simulate Digital Modulation Schemes. - To Implement Equalization Algorithms and Error Control Coding Schemes.					
LIST OF EXPERIMENTS					
1	AM- Modulator and Demodulator				
2	FM - Modulator and Demodulator				
3	Pre-Emphasis and De-Emphasis.				
4	Signal sampling and TDM.				
5	Pulse Code Modulation and Demodulation.				
6	Pulse Amplitude Modulation and Demodulation.				
7	Pulse Position Modulation and Demodulation and Pulse Width Modulation and Demodulation.				
8	Digital Modulation – ASK, PSK, FSK.				

9	Delta Modulation and Demodulation.														
10	Simulation of ASK, FSK, and BPSK Generation and Detection Schemes.														
11	Simulation of DPSK, QPSK and QAM Generation and Detection Schemes.														
12	Simulation of Linear Block and Cyclic Error Control Coding Schemes														
Total periods:45															
Text Books:															
1. Simon Haykins,” Communication Systems”, Wiley, 5th Edition, 2009.(Unit I - V)															
B.P. Lathi, “Modern Digital and Analog Communication Systems”, 4th Edition, Oxford University Press, 2011.															
1. References:															
2. Wayner Tomasi, Electronic Communication System, 5th Edition, Pearson Education,2008.															
3. D.Roody, J.Coolen, Electronic Communications, 4th edition PHI 2006															
4. A.Papoulis, “Probability, Random variables and Stochastic Processes”, McGraw Hill, 3rd edition, 1991.															
5. B.Sklar, “Digital Communications Fundamentals and Applications”, 2nd Edition Pearson Education 2007															
Course Outcomes:													Blooms Taxonomy		
CO1: Design AM, FM & Digital Modulators for specific applications.													Analyze		
CO2: Compute the sampling frequency for digital modulation.													Analyze		
CO3: Simulate & validate the various functional modules of Communication system.													Analyze		
CO4: Demonstrate their knowledge in base band signalling schemes through implementation of digital modulation schemes.													Analyze		
CO5: Apply various channel coding schemes & demonstrate their capabilities towards the improvement of the noise performance of Communication system.													Analyze		
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	-	-	1	2	2	1	2	3	2	-
CO2	3	3	3	3	3	-	-	1	2	2	1	2	3	2	-
CO3	3	3	3	3	3	-	-	1	2	2	1	2	3	2	-
CO4	3	3	3	3	3	-	-	1	2	2	1	2	3	2	-
CO5	3	3	3	3	3	-	-	1	2	2	1	2	3	2	-
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23ECP402	LINEAR INTEGRATED CIRCUITS LABORATORY	Category: PCC			
		L	T	P	C
		0	0	3	1.5
Prerequisites • Nil					
Course Objectives: • To gain hands on experience in designing electronic circuits • To learn simulation software used in circuit design • To learn the fundamental principles of amplifier circuits • To differentiate feedback amplifiers and oscillators. • To differentiate the operation of various multivibrators					
LIST OF EXPERIMENTS					
DESIGN AND ANALYSIS OF THE FOLLOWING CIRCUITS					
1	Series and Shunt feedback amplifiers-Frequency response, Input and output impedance				
2	RC Phase shift oscillator and Wien Bridge Oscillator				
3	Hartley Oscillator and Colpitts Oscillator				

4	RC Integrator and Differentiator circuits using Op-Amp														
5	Clippers and Clampers														
6	Instrumentation amplifier														
7	Active low-pass, High pass & Band pass filters														
8	PLL Characteristics and its use as frequency multiplier, clock synchronization														
9	R-2R ladder type D-A converter using Op-Amp														
SIMULATION USING SPICE (Using Transistor)															
10	Tuned Collector Oscillator														
11	Twin -T Oscillator / Wein Bridge Oscillator														
12	Double and Stagger tuned Amplifiers														
13	Bistable Multivibrator														
14	Schmitt Trigger circuit with Predictable hysteresis														
15	Analysis of power amplifier														
Total periods:45															
Text Books:															
1. D.Roy Choudhry, Shail Jain, “Linear Integrated Circuits”, New Age International Pvt. Ltd., 2018, Fifth Edition.															
2. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, 4th Edition, Tata Mc Graw-Hill, 2016															
References:															
4 Ramakant A. Gayakwad, “OP-AMP and Linear ICs”, 4th Edition, Prentice Hall / Pearson Education, 2015															
5 Robert F.Coughlin, Frederick F.Driscoll, “Operational Amplifiers and Linear Integrated Circuits”, Sixth Edition, PHI, 2001.															
6 S.Salivahanan & V.S. Kanchana Bhaskaran, “Linear Integrated Circuits”, TMH,2nd Edition, 4th Reprint, 2016.															
Course Outcomes:													Blooms Taxonomy		
CO1:Analyze various types of feedback amplifiers													Analyze		
CO2:Design oscillators, tuned amplifiers, wave-shaping circuits and multivibrators													Analyze		
CO3:Design and simulate feedback amplifiers, oscillators, tuned amplifiers, wave- shaping circuits and multivibrators, filters using SPICE Tool.													Analyze		
CO4:Design amplifiers, oscillators, D-A converters using operational amplifiers.													Analyze		
CO5:Design filters using op-amp and perform an experiment on frequency response.													Analyze		
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	-	-	1	2	2	1	2	3	2	-
CO2	3	3	3	3	3	-	-	1	2	2	1	2	3	2	-
CO3	3	3	3	3	3	-	-	1	2	2	1	2	3	2	-
CO4	3	3	3	3	3	-	-	1	2	2	1	2	3	2	-
CO5	3	3	3	3	3	-	-	1	2	2	1	2	3	2	-
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

SEMESTER V

23ECT501	WIRELESS COMMUNICATION	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites					
• Nil					

Course Objectives:		
- To understand the Concept of Cellular System and design cellular system based on resource availability and traffic - To understand Mobile Radio Propagation and Various Digital Modulation Techniques. - To understand the various Digital Modulation schemes and Diversity - To understand the Concepts of Multiple Access Techniques and perform capacity calculation - To understand various wireless networking standards and architecture		
Unit I	THE CELLULAR CONCEPT-SYSTEM DESIGN FUNDAMENTALS	9
Introduction-Frequency Reuse-Channel Assignment Strategies-Handoff Strategies: Prioritizing Handoffs, Practical Handoff Considerations. Interference and System Capacity: Co-Channel Interference and System Capacity-Channel Planning for Wireless Systems, Adjacent Channel Interference, Power Control for Reducing Interference, Trunking and Grade of Service. Improving Coverage and Capacity in Cellular Systems: Cell Splitting, Sectoring.		
Unit II	MOBILE RADIO PROPAGATION	9
Large Scale Path Loss: Introduction to Radio Wave Propagation - Free Space Propagation Model – Three Basic Propagation Mechanism: Reflection – Brewster Angle- Diffraction- Scattering. Small Scale Fading and Multipath: Small Scale Multipath Propagation, Factors Influencing Small-Scale Fading, Doppler Shift, Coherence Bandwidth, Doppler Spread and Coherence Time. Types of Small- Scale Fading: Fading Effects due to Multipath Time Delay Spread, Fading Effects due to Doppler Spread.		
Unit III	MODULATION TECHNIQUES AND EQUALIZATION AND DIVERSITY	9
Digital Modulation – An Overview: Factors that Influence the choice of Digital Modulation, Linear Modulation Techniques: Minimum Shift Keying (MSK), Gaussian Minimum Shift Keying(GMSK), Quadrature Amplitude Modulation (QAM), OFDM, Spread Spectrum Modulation Techniques: Pseudo- Noise (PN) Sequences, Direct Sequence Spread Spectrum (DS-SS)- Modulation Performance In Fading and Multipath Channels- Equalization, Diversity and Channel Coding: Introduction-Fundamentals of Equalization- Diversity Techniques: Practical Space Diversity Considerations, Polarization Diversity, Frequency Diversity, Time Diversity.		
Unit IV	MULTIPLE ACCESS TECHNIQUES	9
Introduction: Introduction to Multiple Access- Frequency Division Multiple Access (FDMA)- Time Division Multiple Access (TDMA)- Spread Spectrum Multiple Access-Code Division Multiple Access (CDMA)- Space Division Multiple Access (SDMA)- Capacity of Cellular Systems: Capacity of Cellular CDMA, Capacity of CDMA with Multiple Cells.		
Unit V	WIRELESS NETWORKING	9
Introduction: Difference Between Wireless and Fixed Telephone Networks, The Public Switched Telephone Network(PSTN), Development of Wireless Networks: First Generation Wireless Networks, Second Generation Wireless Networks, Third Generation Wireless Networks, Fixed Network Transmission Hierarchy, Traffic Routing in Wireless Networks: Circuit Switching, Packet Switching- Personal Communication Services/ Networks(PCS/PCNs):Packet vs Circuit Switching for PCN, Cellular Packet- Switched Architecture- Packet Reservation Multiple Access(PRMA)- Network Databases: Distributed Database For Mobility Management- Universal Mobile Telecommunication Systems(UMTS).		
Total periods: 45		
Text Books:		
1. Rappaport, T.S., -Wireless communications”, Pearson Education, Second Edition, 2010.		
References:		
1. Wireless Communication –Andrea Goldsmith, Cambridge University Press, 2011		
2. Van Nee, R. and Ramji Prasad, —OFDM for wireless multimedia communications, Artech House, 2000		
3. David Tse and Pramod Viswanath, —Fundamentals of Wireless Communication, Cambridge University Press, 2005.		
4. Upena Dalal —Wireless Communication”, Oxford University Press, 2009.		
5. Andreas.F. Molisch, —Wireless Communications”, John Wiley – India, 2006.		
6. Wireless Communication and Networks –William Stallings, Pearson Education, Second Edition 2002.		
Course Outcomes:		Blooms Taxonomy
CO1:	Understand the Concept of Cellular System and design cellular system based on resource availability and traffic	Apply

CO2:	Understand Mobile Radio Propagation and Various Digital Modulation Techniques.	Apply
CO3:	Understand the various Digital Modulation schemes and Diversity	Apply
CO4:	Understand the Concepts of Multiple Access Techniques and perform capacity calculation	Analyze
CO5:	Understand various wireless networking standards and architecture	Analyze
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 - - - - - 1	3 - 2
CO2	3 3 2 1 3 2 - - - - - 1	3 - 2
CO3	3 3 3 3 2 2 - - - - - 1	3 - 2
CO4	2 3 2 2 2 2 - - - - - 1	3 - 2
CO5	2 3 3 3 2 1 - - - - - 1	3 - 2
1 - Low, 2 - Medium, 3 - High, '-' No correlation		

23ECT502	PRINCIPLES OF VLSI DESIGN	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To understand the principles of VLSI System Design. - To study operation, characteristics, layout & fabrication of MOS Transistor and design of CMOS Inverter. - To design CMOS Combinational & Sequential Logic Circuits and Arithmetic Blocks. - To design CMOS Arithmetic Blocks. - To learn the testability of VLSI circuits					
Unit I	VLSI SYSTEM DESIGN				9
Introduction to VLSI Design: VLSI Design Problem - VLSI Design Cycle - VLSI Design Domains - Types of IC Design – Hierarchical Design Approach - VLSI Design Principles Implementation Methodologies: Full Custom Design - Standard Cell Based Design - Gate Array Based Design - Programmable Logic Devices Based Design – Overview of SPLD/CPLD/FPGA Architectures					
Unit II	MOS TRANSISTOR				9
Metal Oxide Semiconductor (MOS) Transistor: Structure, Operation & Characteristics - Threshold Voltage (VT0 & VT), Drain Current (ID). MOS Capacitances - MOS Scaling - Second Order & Non Ideal Effects - Modeling of MOS Transistor – SPICE Models - Fabrication Cycle, NMOS & PMOS Fabrication Processes. Layout Design Rules, Full-Custom Mask Layout Design, Stick Diagrams.					
Unit III	CMOS INVERTER				9
CMOS Inverter: Construction and Operation - Static & Dynamic Characteristics – Inverter Design with Delay Constraints, Estimation of Interconnect Parasitics & Delay. Power analysis of CMOS Inverter – Low Power Design Principles. Fabrication & Layout of CMOS Inverter: n-well, p-well, twin-tub & triple-well processes. Latch-Up in CMOS Technology. Layout and Stick Diagram of CMOS Inverter.					
Unit IV	CMOS LOGIC CIRCUITS				9
Combinational MOS Logic Circuits: Classical CMOS logic – Pseudo-nMOS logic – Transmission Gates – Design Examples: Basic Gates, Complex Logic Circuits. Sequential MOS Logic Circuits: Behavior of Bistable Elements – SR latch – Clocked Latch and Flip-flop – Timing parameters of Clocked Storage Elements – CMOS D Latch and Edge Triggered Flip-Flop. Dynamic Logic Circuits: Dynamic CMOS Circuit Techniques – High Performance Dynamic CMOS Circuits.					
Unit V	ARITHMETIC BUILDING BLOCKS & TESTING				9

Arithmetic Building Blocks: Adders – Multipliers – Shifters. Design for Testability: Fault Types and Models, Ad Hoc Testable Design Techniques, Scan-Based Techniques, Boundary Scan Testing, Built-In Self-Test (BIST) Techniques, Automatic Test Pattern Generation (ATPG), Fault Simulation, Current Monitoring IDDQ Test.															
Total periods: 45															
Text Books:															
1. Sung Mo Kang, Yusuf Leblebici, Chulwoo Kim, CMOS Digital Integrated Circuits, Mc Graw Hill India, Fourth Edition, 2016. (Unit I to V)															
References:															
2. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, Digital Integrated Circuits: A Design Perspective, Pearson Education India, Second Edition, 2016															
3. David Money Harris, Neil Weste and Ayan Banerjee, CMOS VLSI Design: A circuits and Systems Perspective, Pearson Education India, Fourth Edition, 2016.															
4. Jacob Baker R, CMOS Circuit Design, Layout and Simulation, Wiley Student Edition 2018.															
5. Uyemura J. P, Introduction to VLSI Circuits and Systems, Wiley Student Edition, 2015															
6. Douglas A. Pucknell and Kamran Eshraghian, Basic VLSI Design, Prentice Hall, Third Edition,2016.															
Course Outcomes:														Blooms Taxonomy	
CO1: Summarize various VLSI design principles and methodologies														Understand	
CO2: Describe operation, characteristics, layout and fabrication of MOS Transistor														Understand	
CO3: Describe operation, characteristics, layout and fabrication of CMOS Inverter.														Understand	
CO4: Apply design concepts to realize CMOS Combinational Logic Circuits and Sequential Logic Circuits.														Apply	
CO5: Analyze various architectures of Arithmetic Building Blocks and implement testing techniques to CMOS VLSI Circuits.														Analyze	
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	2	-	-	-	-	-	2	3	2	1
CO2	3	2	2	2	2	2	-	-	-	-	-	2	3	2	1
CO3	3	2	2	2	2	2	-	-	-	-	-	2	3	2	1
CO4	3	2	2	2	2	2	-	-	-	-	-	2	3	2	1
CO5	3	2	2	2	2	2	-	-	-	-	-	2	3	2	1
1 - Low, 2 - Medium, 3 - High, ‘-’ No correlation															

23ECT503	MICROPROCESSORS AND MICROCONTROLLERS	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To design and implement programs on 8086 microprocessor - To design and implement programs on 8051 microcontrollers - To design I/O circuits and Memory Interfacing circuits - To design and implement programs on 16 bit microcontrollers. - To design and develop components of ARM processor					
Unit I	MICROPROCESSORS				9

Architecture of 8085 Microprocessor – 8085 Microprocessor Operations - Architecture of 8086 Microprocessor - 8086 Addressing Modes - Instruction Set of 8086 – RISC – CISC - Pipelining - Assembly Language Programming with 8086 – Stack Pointer – Program Counter - Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Byte and String Manipulation - Interrupt System in 8086 - Programming the Pentium processor															
Unit II		8086 SYSTEM BUS STRUCTURE AND I/O INTERFACING												9	
8086 signals – Basic configurations – System bus timing – System design using 8086– Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations - Memory interfacing and I/O Interfacing and programming - D/A and A/D interfacing – Serial and Parallel Interfacing – Keyboard / Display Interfacing – DMA Interfacing.															
Unit III		8 BIT MICROCONTROLLER AND INTERFACING												9	
Architecture of 8051 – Special Function Registers(SFRs) – Crystal Oscillators - Instruction set - Addressing modes - I/O Pins Ports and Circuits - Stepper Motor – Baud - Serial Port Programming - Interrupts Programming – LCD & Keyboard – ADC/DAC interfacing - Programming 8051 Timers – External Memory Interface.															
Unit IV		16 BIT MICROCONTROLLER												9	
The MSP430 Architecture - CPU Registers – Embedded C, On-Chip Peripherals - MSP430 - Development Tools, IO Ports, ADC - PWM - UART - Timer Interrupts - System design using MSP430 Microcontroller.															
Unit V		32 BIT ARM												9	
ARM architecture - Bus Operations – Stages of Pipelining – Branch predication – floating point unit - Operating Modes – Paging – Multitasking – IO Port – Registers and PIN selection modes – Serial Communication Protocols – ADC – PWM – RTC - Exception and Interrupts.															
Total periods: 45															
Text Books:															
1. Yu-Cheng Liu, Glenn A.Gibson, “Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design”, Second Edition, Prentice Hall of India, 2007.															
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Second Edition, Pearson education, 2011.															
3. Steve Furber, “ARM System –On –Chip architecture”, Addison Wesley, 2000.															
4. John H.Davis, “MSP 430 Micro controller basics”, Elsevier, 2008.															
5. Barry.B.Breg, “The Intel Microprocessors Architecture, Programming and Interfacing “, PHI, 2002.															
References:															
1. Daniel Tabak, “ Advanced Microprocessors” McGraw Hill.Inc., 1995															
2. James L. Antonakos , “The Pentium Microprocessor”, Pearson Education , 1997.															
3. James L.Antonakos, “An Introduction to the Intel family of Microprocessors”, Pearson Education 1999.															
Course Outcomes:													Blooms Taxonomy		
CO1: Design and implement programs on 8086 microprocessor													Apply		
CO2: Design and implement programs on 8051 microcontrollers													Apply		
CO3: Design I/O circuits and Memory Interfacing circuits													Apply		
CO4: Design and implement programs on 16 bit microcontrollers.													Apply		
CO5: Design and develop components of ARM processor													Apply		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	-	-	-	-	-	-	-	1	2	1	-
CO2	2	2	1	1	-	-	-	-	-	-	-	1	2	2	-
CO3	3	2	3	1	-	-	-	-	-	-	-	1	3	2	-
CO4	3	3	3	2	-	1	2	-	-	-	-	3	3	2	-
CO5	3	3	3	2	1	1	2	-	-	-	-	3	3	2	-
1 - Low, 2 - Medium, 3 - High, ‘-‘ No correlation															

23ECP501	WIRELESS COMMUNICATION LABORATORY	Category: PCC			
		L	T	P	C
		0	0	3	1.5
Prerequisites Nil					
Course Objectives: - To understand various modulation used in wireless communication - To understand the effect of noise in wireless communication - To understand various equalization techniques - To understand the characteristics of signals in fading channel - To understand the effects of adjacent and co-channel interference on a transmitted signal					
LIST OF EXPERIMENTS					
Experiments using MATLAB					
1	Modeling of wireless communication systems using MATLAB(Two ray channel and Okumura –Hata model)				
2	Modeling and simulation of Multipath fading channel				
3	Design, analyze and test Wireless standards and evaluate the performance measurements such as BER, PER, BLER, throughput, capacity, ACLR, EVM for 4G and 5G using Matlab				
4	Modulation: Spread Spectrum – DSSS Modulation & Demodulation				
5	Wireless Channel equalization: Zero-Forcing Equalizer (ZFE), MMSE Equalizer (MMSEE), Adaptive Equalizer (ADE), Decision Feedback Equalizer (DFE)				
6	Modeling and simulation of TDMA, FDMA and CDMA for wireless communication				
Experiments using COMMUNICATION TOOLBOX					
7	Modulation & demodulation of a random binary data stream using 16 – QAM.				
8	(a) Simulate basic OFDM with no cyclic prefix. (b) Perform Equalization, Convolution, and Cyclic Prefix Addition on basic OFDM.				
9	Obtain the scatter plots & eye diagrams of a QPSK signal to visualize the signal behaviour in presence of AWGN				
10	(a) Generate a multiband signal using the Communications Toolbox. (b) Random noise generation using Simulink & display histogram plots of Gaussian, Rayleigh, Rician, and Uniform noise.				
11	QPSK Transmitter and Receiver in Simulink.				
12	Multipath Fading Channel in Simulink – For example: Simulate QPSK transmission over a - multipath Rayleigh fading channel and - a multipath Rician fading channel.				
13	Adjacent and Co-Channel Interference using Simulink Use PSK-modulated signals to show the effects of adjacent and co-channel interference on a transmitted signal.				
Total periods:45					
Text Books:					
1. Rappaport,T.S.-“Wireless communications”, Pearson Education, Second Edition, 2010.					
References:					
1. Wireless Communication –Andrea Goldsmith, Cambridge University Press, 2011					
2. Van Nee, R. and Ramji Prasad, —OFDM for wireless multimedia communications, Artech House, 2000					
3. David Tse and Pramod Viswanath, —Fundamentals of Wireless Communication, Cambridge University Press, 2005.					
4. Upena Dalal —Wireless Communication”, Oxford University Press, 2009.					
5. Andreas.F. Molisch, —Wireless Communications”, John Wiley – India, 2006.					
6. Wireless Communication and Networks –William Stallings, Pearson Education, Second Edition 2002.					
Course Outcomes:					Blooms Taxonomy
CO1: Analyze various modulation used in wireless communication					Analyze

CO2: Analyze the effect of noise in wireless communication													Analyze		
CO3: Analyze various equalization techniques													Analyze		
CO4: Analyze the characteristics of signals in fading channel													Analyze		
CO5: Analyze the effects of adjacent and co-channel interference on a transmitted signal.													Analyze		
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	2
CO2	3	3	3	3	3	-	-	-	2	2		2	3	3	2
CO3	3	3	3	3	3	-	-	-	2	2		2	3	3	2
CO4	3	3	3	3	3	-	-	-	2	2		2	3	3	2
CO5	3	3	3	3	3	-	-	-	2	2		2	3	3	2
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23ECP502	VLSI LABORATORY	Category: PCC			
		L	T	P	C
		0	0	3	1.5
Prerequisites Nil					
Course Objectives: - To learn Hardware Descriptive Language (Verilog/VHDL). - To learn the fundamental principles of Digital System Desing using HDL and FPGA. - To learn the fundamental principles of VLSI circuit design in digital domain - To learn the fundamental principles of VLSI circuit design in analog domain - To provide hands on design experience with EDA platforms.					
LIST OF EXPERIMENTS					
Experiments using MATLAB					
1	Design of basic combinational and sequential (Flip-flops) circuits using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA				
2	Design an Adder; Multiplier (Min 8 Bit) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA				
3	Design and implement Universal Shift Register using HDL. Simulate it using Xilinx/Altera Software				
4	Design Memories using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA				
5	Design Finite State Machine (Moore/Mealy) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA				
6	Design 3-bit synchronous up/down counter using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA				
7	Design 4-bit Asynchronous up/down counter using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA				
8	Design and simulate a CMOS Basic Gates & Flip-Flops. Generate Manual/Automatic Layout.				
9	Design				
10	Design and Simulate a CMOS Inverting Amplifier.				
11	Design and Simulate basic Common Source, Common Gate and Common Drain Amplifiers.				
12	Design and simulate simple 5 transistor differential amplifier				
					Total periods:45
Text Books:					

2. Sung Mo Kang, Yusuf Leblebici, Chulwoo Kim, CMOS Digital Integrated Circuits, Mc Graw Hill India, Fourth Edition, 2016.															
References:															
6. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, Digital Integrated Circuits: A Design Perspective, Pearson Education India, Second Edition, 2016															
7. David Money Harris, Neil Weste and Ayan Banerjee, CMOS VLSI Design: A circuits and Systems Perspective, Pearson Education India, Fourth Edition, 2016.															
8. Jacob Baker R, CMOS Circuit Design, Layout and Simulation, Wiley Student Edition 2018.															
9. Uyemura J. P, Introduction to VLSI Circuits and Systems, Wiley Student Edition, 2015															
10. Douglas A. Pucknell and Kamran Eshraghian, Basic VLSI Design, Prentice Hall, Third Edition,2016.															
Course Outcomes:													Blooms Taxonomy		
CO1: Write HDL code for basic as well as advanced digital integrated circuit													Apply		
CO2: Import the logic modules into FPGA Boards													Apply		
CO3: Synthesize Place and Route the digital Ips													Create		
CO4: Design, Simulate and Extract the layouts of Digital & Analog IC Blocks using EDA tools													Evaluate		
CO5: Test and Verification of IC design													Apply		
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	-
CO2	3	3	3	3	3	-	-	-	2	2		2	3	3	-
CO3	3	3	3	3	3	-	-	-	2	2		2	3	3	-
CO4	3	3	3	3	3	-	-	-	2	2		2	3	3	-
CO5	3	3	3	3	3	-	-	-	2	2		2	3	3	-
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

SEMESTER VI

23ECT601	EMBEDDED SYSTEMS AND IOT DESIGN	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
Course Objectives: • Learn the architecture and features of 8051. • Study the design process of embedded systems. • Understand the real – time processing in an embedded system. • Learn the architecture and design flow of IoT. • Build an IoT based system.					
Unit I	8051 AND PIC MICROCONTROLLER				9
Microcontrollers for an Embedded System – 8051 – Instruction Set – Program and Data Memory – Stacks – Interrupts – Timers/Counters – Serial Ports – Programming. PIC Microcontroller: Architecture, Memory organization, Instruction set, I/O ports- Programming					
Unit II	EMBEDDED SYSTEMS				9
Embedded System Design Process – Model Train Controller – ARM Processor – Instruction Set Preliminaries – CPU – Programming Input and Output – Supervisor Mode – Exceptions and Trap – Models for programs – Assembly, Linking and Loading – Compilation Techniques – Program Level Performance Analysis.					
Unit III	PROCESSES AND OPERATING SYSTEMS				9

Structure of a real – time system – Task Assignment and Scheduling – Multiple Tasks and Multiple Processes – Multirate Systems – Pre emptive real – time Operating systems – Priority based scheduling – Interprocess Communication Mechanisms – Distributed Embedded Systems – MPSoCs and Shared Memory Multiprocessors – Design Example – Audio Player, Engine Control Unit and Video Accelerator.															
Unit IV		IOT ARCHITECTURE AND PROTOCOLS												9	
Internet – of – Things – Physical Design, Logical Design – IoT Enabling Technologies – Domain Specific IoTs – IoT and M2M – IoT System Management with NETCONF – YANG – IoT Platform Design – Methodology – IoT Reference Model – Domain Model – Communication Model – IoT Reference Architecture – IoT Protocols - MQTT, XMPP, Modbus, CANBUS and BACNet.															
Unit V		IOT SYSTEM DESIGN												9	
Basic building blocks of an IoT device – Raspberry Pi – Board – Linux on Raspberry Pi – Interfaces – Programming with Python – Case Studies: Home Automation, Smart Cities, Environment and Agriculture.															
Total periods: 45															
Text Books:															
2. Mohammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D.McKinlay, The 8051 Microcontroller and Embedded Systems Using Assembly and C, Second Edition, Pearson Education, 2008.(Unit – I)															
3. Muhammad Ali Mazidi , Danny Causey, and Rolin D. McKinlay , PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18, 2008															
4. 2.Marilyn Wolf, Computers as Components – Principles of Embedded Computing System Design, Third Edition, Morgan Kaufmann, 2012.(Unit – II,III)															
5. Arshdeep Bahga, Vijay Madiseti, Internet – of- Things – A Hands on Approach, Universities Press, 2015.(Unit – IV,V)															
6. Mohammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D.McKinlay, The 8051 Microcontroller and Embedded Systems Using Assembly and C, Second Edition, Pearson Education, 2008.(Unit – I)															
References:															
7. Mayur Ramgir, Internet – of – Things, Architecture, Implementation and Security, First Edition, Pearson Education, 2020.															
8. Lyla B.Das, Embedded Systems: An Integrated Approach, Pearson Education 2013.															
9. Jane.W.S .Liu, Real – Time Systems, Pearson Education, 2003.															
Course Outcomes:														Blooms Taxonomy	
CO1: Explain the architecture and features of 8051.														Understand	
CO2: Develop a model of an embedded system.														Apply	
CO3: List the concepts of real time operating systems.														Understand	
CO4: Learn the architecture and protocols of IoT.														Understand	
CO5: Design an IoT based system for any application.														Apply	
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	3	3	2
CO2	3	3	2	2	2	-	-	-	-	-	-	2	3	3	2
CO3	3	3	2	2	2	-	-	-	-	-	-	2	3	3	2
CO4	3	3	2	2	2	-	-	-	-	-	-	2	3	3	2
CO5	3	3	2	2	2	-	-	-	-	-	-	2	3	3	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CST601	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	Category: ESC			
		L	T	P	C
		3	0	0	3
Prerequisites					

• Nil		
Course Objectives: • Study about uninformed and Heuristic search techniques. • Learn techniques for reasoning under uncertainty • Introduce Machine Learning and supervised learning algorithms • Study about ensembling and unsupervised learning algorithms • Learn the basics of deep learning using neural networks		
Unit I	PROBLEM SOLVING	9
Introduction to AI - AI Applications - Problem solving agents – search algorithms – uninformed search strategies – Heuristic search strategies – Local search and optimization problems – adversarial search – constraint satisfaction problems (CSP)		
Unit II	PROBABILISTIC REASONING	9
Acting under uncertainty – Bayesian inference – naïve bayes models. Probabilistic reasoning – Bayesian networks – exact inference in BN – approximate inference in BN – causal networks.		
Unit III	SUPERVISED LEARNING	9
Introduction to machine learning – Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random forests		
Unit IV	ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING	9
Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization		
Unit V	NEURAL NETWORKS	9
Perceptron - Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation, from shallow networks to deep networks – Unit saturation (aka the vanishing gradient problem) – ReLU, hyperparameter tuning, batch normalization, regularization, dropout.		
Total periods: 45		
Text Books:		
1. Stuart Russell and Peter Norvig, “Artificial Intelligence – A Modern Approach”, Fourth Edition, Pearson Education, 2021.		
2. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Fourth Edition, 2020.		
References:		
7. Dan W. Patterson, “Introduction to AI and ES”, Pearson Education, 2007		
8. Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008		
9. Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006		
10. Deepak		
11. Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.		
12. Tom Mitchell, “Machine Learning”, McGraw Hill, 3rd Edition, 1997.		
13. Charu C. Aggarwal, “Data Classification Algorithms and Applications”, CRC Press, 2014		
14. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, “Foundations of Machine Learning”, MIT Press, 2012.		
15. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016		
Course Outcomes:		Blooms Taxonomy
CO1:	Use appropriate search algorithms for problem solving	Apply
CO2:	Apply reasoning under uncertainty	Apply
CO3:	Build supervised learning models	Apply
CO4:	Build ensembling and unsupervised models	Apply
CO5:	Build deep learning neural network models	Apply

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

23ECP601	EMBEDDED SYSTEMS AND IOT DESIGN LABORATORY	Category: PCC			
		L	T	P	C
		0	0	4	2
Prerequisites					
Nil					
Course Objectives:					
- To understand and perform ALU operation using 8051 - To design 8051 interfacing for various application - To design ARM interfacing for various application - To design IOT application - To perform image processing using RASPBERRY pi					
LIST OF EXPERIMENTS					
Experiments using 8051.					
1	Programming Arithmetic and Logical Operations in 8051.				
2	Generation of Square waveform using 8051.				
3	Programming using On – Chip ports in 8051.				
4	Programming using Serial Ports in 8051.				
5	Design of a Digital Clock using Timers/Counters in 8051.				
Experiments using ARM					
6	Interfacing ADC and DAC				
7	Blinking of LEDs and LCD				
8	Interfacing keyboard and Stepper Motor.				
Miniprojects for IoT					
9	Garbage Segregator and Bin Level Indicator				
10	Colour based Product Sorting				
11	Image Processing based Fire Detection				
12	Smart Lock System				
Total periods:45					
Text Books:					
2. Mohammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D.McKinlay, The 8051 Microcontroller and Embedded Systems Using Assembly and C, Second Edition, Pearson Education, 2008.(Unit – I)					
3. Muhammad Ali Mazidi , Danny Causey, and Rolin D. McKinlay , PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18, 2008					
4. 2.Marilyn Wolf, Computers as Components – Principles of Embedded Computing System Design, Third Edition, Morgan Kaufmann, 2012.(Unit – II,III)					
5. Arshdeep Bahga, Vijay Madiseti, Internet – of- Things – A Hands on Approach, Universities Press, 2015.(Unit – IV,V)					

6. Mohammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D.McKinlay, The 8051 Microcontroller and Embedded Systems Using Assembly and C, Second Edition, Pearson Education, 2008.(Unit – I)																
References:																
7. Mayur Ramgir, Internet – of – Things, Architecture, Implementation and Security, First Edition, Pearson Education, 2020.																
8. Lyla B.Das, Embedded Systems: An Integrated Approach, Pearson Education 2013.																
9. Jane.W.S .Liu, Real – Time Systems, Pearson Education, 2003.																
Course Outcomes:														Blooms Taxonomy		
CO1: Understand and perform ALU operation using 8051														Apply		
CO2: Design 8051 interfacing for various application														Apply		
CO3: Design ARM interfacing for various application														Apply		
CO4: Design IOT and application														Apply		
CO5: Perform image processing using RASPBERRY pi														Apply		
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	3	3	2	
CO2	3	3	3	3	3	-	-	-	2	2		3	3	3	2	
CO3	3	3	3	3	3	-	-	-	2	2		3	3	3	2	
CO4	3	3	3	3	3	-	-	-	2	2		3	3	3	2	
CO5	3	3	3	3	3	-	-	-	2	2		3	3	3	2	
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation																

SEMESTER VII

23GET701	HUMAN VALUES AND ETHICS	Category: HSMC			
		L	T	P	C
		2	0	0	2
Prerequisites Nil					
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.					
Reading Text: Excerpts from John Stuart Mills' On Liberty					
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.					
Reading Text: Excerpt from Secularism in India: Concept and Practice by Ram Puniyani					
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.					

Reading Text: Excerpt from The Scientific Temper by Antony Michaelis R																
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.																
Reading Text: Excerpt from 21 Lessons for the 21st Century by Yuval Noah Harari																
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.																
Reading Text: Excerpt from American Prometheus: The Triumph and Tragedy of Robert Oppenheimer by Kai Bird and Martin J. Sherwin.																
Total periods: 30																
Text Books:																
1. The Nonreligious: Understanding Secular People and Societies, Luke W. Galen Oxford University Press, 2016.																
References:																
1. Secularism: A Dictionary of Atheism, Bullivant, Stephen; Lee, Lois, Oxford University Press, 2016.																
2. The Oxford Handbook of Secularism, John R. Shook, Oxford University Press, 2017.																
3. The Civic Culture: Political Attitudes and Democracy in Five Nations by Gabriel A. Almond and Sidney Verba, Princeton University Press,																
4. Research Methodology for Natural Sciences by Soumitro Banerjee, IISc Press, January 2022																
Course Outcomes:														Blooms Taxonomy		
CO1:		Identify the importance of democratic, secular and scientific values in harmonious functioning of social life												Understand		
CO2:		Practice democratic and scientific values in both their personal and professional life.												Understand		
CO3:		Find rational solutions to social problems												Understand		
CO4:		Behave in an ethical manner in society												Understand		
CO5:		Practice critical thinking and the pursuit of truth.												Understand		
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	-	-	-	-	-	3	-	3	-	-	-	3	-	-	-	
CO2	-	-	-	-	-	3	-	3	-	-	-	3	-	-	-	
CO3	-	-	-	-	-	3	-	3	-	-	-	3	-	-	-	
CO4	-	-	-	-	-	3	-	3	-	-	-	3	-	-	-	
CO5	-	-	-	-	-	3	-	3	-	-	-	3	-	-	-	
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation																

SEMESTER VIII

23GET801	ENVIRONMENT AND SOCIALIMPACT ASSESSMENT	Category: HSMC			
		L	T	P	C
		3	0	0	3
Prerequisites:Nil					

Course Objectives:		
- Carry out scoping and screening of developmental projects for environmental and social assessments - Explain different methodologies for environmental impact prediction and assessment - Plan environmental impact assessments and environmental management plans - Evaluate environmental impact assessment reports		
Unit I	INTRODUCTION	9
Impacts of Development on Environment – Rio Principles of Sustainable Development- Environmental Impact Assessment (EIA) – Objectives – Historical development – EIA Types – EIA in project cycle –EIA Notification and Legal Framework–Stakeholders and their Role in EIA– Selection & Registration Criteria for EIA Consultants		
Unit II	ENVIRONMENTAL ASSESSMENT	9
Screening and Scoping in EIA – Drafting of Terms of Reference,Baseline monitoring, Prediction and Assessment of Impact on land, water, air, noise and energy, flora and fauna - Matrices – Networks – Checklist Methods - Mathematical models for Impact prediction – Analysis of alternatives		
Unit III	ENVIRONMENTAL MANAGEMENT PLAN	9
Plan for mitigation of adverse impact on water, air and land, water, energy, flora and fauna – Environmental Monitoring Plan – EIA Report Preparation – Review of EIA Reports – Public Hearing-Environmental Clearance Post Project Monitoring.		
Unit IV	SOCIO ECONOMIC ASSESSMENT	9
Baseline monitoring of Socio economic environment – Identification of Project Affected Personal – Rehabilitation and Resettlement Plan- Economic valuation of Environmental impacts – Cost benefit Analysis.		
Unit V	CASE STUDIES	9
EIA case studies pertaining to Infrastructure Projects – Real Estate Development - Roads and Bridges – Mass Rapid Transport Systems - Ports and Harbor – Airports - Dams and Irrigation projects - Power plants – CETPs- Waste Processing and Disposal facilities – Mining Projects.		
Total periods: 45		
Text Books:		
1. Canter, R.L, “Environmental impact Assessment “, 2nd Edition, McGraw Hill Inc, New Delhi,1995.		
2. Lohani, B., J.W. Evans, H. Ludwig, R.R. Everitt, Richard A. Carpenter, and S.L. Tu, “Environmental Impact Assessment for Developing Countries in Asia”, Volume 1 – Overview, Asian Development Bank,1997.		
3. Peter Morris, Riki Therivel “Methods of Environmental Impact Assessment”, Routledge Publishers,2009.		
References:		
1. Becker H. A., Frank Vanclay,“The International handbook of social impact assessment” conceptual and methodological advances, Edward Elgar Publishing, 2003.		
2. Barry Sadler and Mary McCabe, “Environmental Impact Assessment Training Resource Manual”, United Nations Environment Programme, 2002.		
3. Judith Petts, “Handbook of Environmental Impact Assessment Vol. I and II”, Blackwell Science New York, 1998.		
4. Ministry of Environment and Forests EIA Notification and Sectoral Guides, Government of India, New Delhi, 2010.		
Course Outcomes:		Blooms Taxonomy
CO1:	Carry out scoping and screening of developmental projects for environmental and social assessments	Apply

CO2:	Explain different methodologies for environmental impact prediction and assessment												Understanding		
CO3:	Plan environmental impact assessments and environmental management plans												Analyse		
CO4:	Evaluate environmental impact assessment reports												Apply		
CO5:	To study the various EIA assessment and its applications												Remember		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	1	1	2	-	1	-	-	-	-	2	2	-	-	-
CO2	-	2	-	1	-	-	-	-	-	-	2	2	-	-	-
CO3	-	1	1	1	-	1	-	-	-	-	2	2	-	-	-
CO4	-	-	1	1	-	1	-	-	-	-	2	2	-	-	-
CO5	-	-	1	1	-	1	-	-	-	-	2	2	-	-	-

ELECTIVE – MANAGEMENT COURSES

23EMT001	PRINCIPLES OF MANAGEMENT	Category: HSMC			
		L	T	P	C
		3	0	0	3
Prerequisites					
•					
Course Objectives:					
• Sketch the Evolution of Management. • Extract the functions and principles of management. • Learn the application of the principles in an organization. • Study the various HR related activities. • 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															
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., 10 th Edition, 2009.															
References:															
1. Robert Kreitner and Mamata Mohapatra, “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:														Blooms Taxonomy	
CO1: Have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling.														Understand	
CO2: Have same basic knowledge on international aspect of management.														Remember	
CO3: Ability to understand management concept of organizing.														Apply	
CO4: Ability to understand management concept of directing.														Analyze	
CO5: Ability to understand management concept of controlling.														Analyze	
CO-PO 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

23EMT002	TOTAL QUALITY MANAGEMENT	Category: HSMC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Course Objectives: - Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM. - Explain the TQM Principles for application. - Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA. - Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR. - 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, 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 - 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																
Text Books:																
1. Dale H.Besterfiled, Carol B.Michna,Glen H. Bester field,Mary B.Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.																
References:																
2 Joel.E. Ross, “Total Quality Management – Text and Cases”,Routledge.,2017.																
3 Kiran.D.R, “Total Quality Management: Key concepts and case studies, Butterworth – Heinemann Ltd, 2016.																
4 Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition, 2003.																
5 Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd., 2006.																
Total periods:45																
Course Outcomes:														Blooms Taxonomy		
CO1:		Ability to apply TQM concepts in a selected enterprise.												Apply		
CO2:		Ability to apply TQM principles in a selected enterprise.												Apply		
CO3:		Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.												Apply		
CO4:		Ability to understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.												Apply		
CO5:		Ability to apply QMS and EMS in any organization.												Apply		
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1		3										3	2		3	
CO2						3						3		2		
CO3					3		3	2	2					2	3	
CO4					3	2	3	2				3	3	2		
CO5			3			3										

23EMT003	ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING										Category: HSMC			
											L	T	P	C

[illegible]

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

23EMT004	HUMAN RESOURCE MANAGEMENT		Category: HSMC			
			L	T	P	C
			3	0	0	3
Prerequisites						
•						
Course Objectives:						
- To provide knowledge about management issues related to staffing. - To provide knowledge about management issues related to training. - To provide knowledge about management issues related to performance - To provide knowledge about management issues related to compensation. - 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, New Delhi.						
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	
CO1:	Students would have gained knowledge on the various aspects of HRM.					Remember
CO2:	Students will gain knowledge needed for success as a human resources professional.					Understand
CO3:	Students will develop the skills needed for a successful HR manager.					Apply

CO4: Students would be prepared to implement the concepts learned in the workplace.													Apply		
CO5: Students would be aware of the emerging concepts in the field of HRM.													Understand		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	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

23EMT005	KNOWLEDGE MANAGEMENT		Category: HSMC			
			L	T	P	C
			3	0	0	3
Prerequisites						
•						
Course Objectives:						
• Learn the Evolution of Knowledge management. • Be familiar with tools. • Be exposed to Applications • 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	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						
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 University Press, 1995.															
Total periods:45															
Course Outcomes:														Blooms Taxonomy	
CO1: Understand the process of acquire knowledge from experts.														Understand	
CO2: Understand the learning organization.														Understand	
CO3: Use the knowledge management tools.														Apply	
CO4: Develop knowledge management Applications.														Create	
CO5: Design and develop enterprise applications.														Create	
CO-PO 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	

23EMT006	INDUSTRIAL MANAGEMENT		Category: HSMC			
			L	T	P	C
			3	0	0	3
Prerequisites						
•						
Course Objectives:						
- 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. - To study the planning; organizing and staffing functions of management in professional organization. - To study the leading; controlling and decision making functions of management in professional organization. Learn the application of the principles in an organization. - To learn the organizational theory in professional organization - 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-Mounton, 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”, 8 th Edition, Tata McGrawhill, New Delhi, 2010															
References:															
1 Joseph J, Massie, “Essentials of Management”, 4 th 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, 11 th Edition, 2012.															
5 S. TrevisCerto, “Modern Management Concepts and Skills”, Pearson Education, 2018.a															
Course Outcomes:													Blooms Taxonomy		
CO1:	Explain basic concepts of management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.												Understand		
CO2:	Discuss the planning; organizing and staffing functions of management in professional organization.												Understand		
CO3:	Apply the leading; controlling and decision making functions of management in professional organization.												Apply		
CO4:	Discuss the organizational theory in professional organization.												Understand		
CO5:	Apply principles of productivity and modern concepts in management in professional organization.												Apply		
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	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

MANDATORY COURSES -I

23MCT001	INTRODUCTION TO WOMEN AND GENDER STUDIES	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites Nil					
Course Objectives: - Define and explain foundational concepts such as sex, gender, sexuality, patriarchy, feminism, intersectionality, and gender norms. - Identify how power and privilege operate across social categories including race, class, sexuality, ability, and nationality.					
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															
Text Books:															
3. Introduction to Women's and Gender Studies: An Interdisciplinary Approach by Melissa J. Gillis and Andrew T. Jacobs (Oxford University Press)															
4. Threshold Concepts in Women’s and Gender Studies: Ways of Seeing, Thinking, and Knowing by Christie Launius and Holly Hassel (Routledge).															
References:															
1. Victoria Robinson & Linda Diane Richardson , Publisher: Bloomsbury Academic.															
2. Kathy Davis, Mary Evans & Judith Lorber <u>Sage Publications+1</u> , Publisher: SAGE.															
3. Sharmila Rege ,. Publisher: Zubaan Books.															
4. V. Geetha															
5. Kumkum Sangari & Sudesh Vaid , Publisher: Kali for Women / Zubaan.															
Course Outcomes:														Blooms Taxonomy	
CO1:	Explain key concepts, definitions, and theories related to gender, sex, sexuality, feminism, and patriarchy.													Understand	
CO2:	Analyze gender inequalities and power structures in social, cultural, economic, and political contexts.													Analyze	
CO3:	Evaluate the impact of gender norms, stereotypes, and institutional practices on individuals and communities.													Evaluate	
CO4:	Apply gender-sensitive perspectives to contemporary issues and real-life case studies.													Apply	
CO5:	Demonstrate effective communication, teamwork, and ethical responsibility in gender-related discussions, presentations, and projects.													Apply	
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	–	–	1	3	3	2	–	2	–	1	3	2	1
CO2	2	3	2	–	1	3	3	2	–	3	–	2	3	3	2
CO3	2	3	2	–	1	3	3	3	1	3	–	2	3	3	2
CO4	1	2	2	1	2	3	3	3	2	3	1	2	2	3	3
CO5	–	1	2	1	3	3	3	3	3	3	2	2	1	2	3

23MCT002	ELEMENTS OF LITERATURE										Category: MC			
											L	T	P	C

													3	0	0	0
Prerequisites Nil																
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.																
Unit I		Relevance of literature												9		
a)		Enhances Reading, thinking, discussing and writing skills.														
b)		Develops finer sensibility for better human relationship.														
c)		Increases understanding of the problem of humanity without bias.														
d)		Providing space to reconcile and get a cathartic effect.														
Unit II		Elements of fiction												9		
a)		Fiction, fact and literary truth.														
b)		Fictional modes and patterns.														
c)		Plot character and perspective.														
Unit III		Elements of poetry												9		
a)		Emotions and imaginations.														
b)		Figurative language.														
c)		(Simile, metaphor, conceit, symbol, pun and irony).														
d)		Personification and animation.														
e)		Rhetoric and trend.														
Unit IV		Elements of drama												9		
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.														
Total periods: 45																
Text Books:																
1. Literature: An Introduction to Fiction, Poetry, Drama, and Writing by X. J. Kennedy and Dana Gioia																
2. Elements of Literature: Essay, Fiction, Poetry, Drama, Film by Robert Scholes, Carl H. Klaus, Nancy R. Comley, and Michael Silverman																
References:																
1. Robert Scholes, Carl H. Klaus, Nancy R. Comley, Publisher: Oxford University Press																
2. X. J. Kennedy & Dana Gioia, Publisher: Pearson																
3. Kelly , publisher: W.W. Norton																
4. M. H. Abrams (later editions with Geoffrey Harpham) , Publisher: Cengage																
5. Peter , publisher: Manchester University Press																
Course Outcomes:														Blooms Taxonomy		
CO1: •Students will be able to understand the relevance of literature in human life and appreciate its aspects in developing finer sensibilities.														APPLY		
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	2	–	–	1	–	1	1	–	2	–	1	3	2	1	
CO2	2	3	2	2	2	–	1	1	–	3	–	2	2	3	2	
CO3	2	3	2	–	2	1	1	1	–	3	–	2	2	3	2	
CO4	1	2	2	1	2	2	2	2	–	3	–	2	2	3	2	
CO5	–	1	2	1	3	3	1	2	3	3	2	2	1	2	3	

23MCT003	FILM APPRECIATION	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites Nil					
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.					
Theme – A:	The Component of Films				9
A-1: The material and equipment A-2: The story, screenplay and script A-3: The actors, crew members, and the director A-4: The process of film making... structure of a film					
Theme – B:	Evolution of Film Language				9
B-1: Film language, form, movement etc. B-2: Early cinema... silent film (Particularly French) B-3: The emergence of feature films: Birth of a Nation B-4: Talkies.					
Theme - C:	Film Theories and Criticism/Appreciation				9
C-1: Realist theory; Auteurs C-2: Psychoanalytic, Ideological, Feminists. C-3: How to read films? C-4: Film Criticism / Appreciation.					
Theme - D:	Development of Films				9
D-1: Representative Soviet films D-2: Representative Japanese films D-3: Representative Italian films D-4: Representative Hollywood film and the studio system.					
Theme - E:	Indian Films				9
E-1: The early era E-2: The important films made by the directors E-3: The regional films E-4: The documentaries in India.					
Total periods: 45					
Text Books:					
1. David Bordwell & Kristin Thompson ,Publisher: McGraw-Hill					
2. Louis Giannetti , Publisher: Pearson					
References:					
1. Geoffrey Nowell-Smith					
2. Susan Hayward, Publisher: Routledge					
3. Leo Braudy & Marshall Cohen					
4. James Monaco					
5. Wheeler Winston Dixon & Gwendolyn Foster					
Course Outcomes:					Blooms Taxonomy

CO1:	Identify and define fundamental cinematic elements and terminology, including technical aspects of cinematography	Understand
CO2:	Analyze how the formal elements of film (cinematography, editing, sound, etc.)	Analyze
CO3:	Evaluate films within their relevant historical, cultural, and socio-political contexts, recognizing.	Analyze
CO4:	Critically assess the narrative structures and stylistic conventions of different film genres and historical movements.	Evaluate
CO5:	Articulate informed, evidence-based critiques and interpretations of films through both verbal discussion and formal written analysis.	Apply
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 – 2 – 1	3 2 1
CO2	2 3 2 2 3 – 1 – – 2 – 2	3 3 2
CO3	2 3 2 2 2 2 2 2 – 3 – 2	2 3 2
CO4	1 3 3 2 2 – 2 2 1 3 – 2	2 3 3
CO5	– 1 2 1 3 3 1 2 3 3 2 2	1 2 3

23MCT004	DISASTER RISK REDUCTION AND MANAGEMENT	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites Nil					
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															
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															
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		
CO1:	To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR).												Apply		
CO2:	To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction												Understand		
CO3:	To develop disaster response skills by adopting relevant tools and technology												Apply		
CO4:	Enhance awareness of institutional processes for Disaster response in the country and												Analyze		
CO5:	Develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity												Evaluate		
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	–	1	–	2	3	2	1
CO2	2	3	2	2	–	–	3	1	–	2	–	3	3	3	2
CO3	2	2	3	2	1	–	3	2	2	2	–	3	3	3	3
CO4	1	2	3	3	1	–	3	2	2	3	–	3	2	3	3
CO5	–	1	2	2	1	3	3	3	3	3	2	2	2	3	3

MANDATORY COURSES -II

23MCT005	WELL-BEING WITH TRADITIONAL PRACTICES-YOGA, AYURVEDA AND SIDDHA	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites					

• Nil		
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 health. 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		
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	ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH AYUSH	9
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 - Pancheekarana 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		
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.		
3.Read more: https://www.legit.ng/1163909-classes-food-examples-functions.html .		
Course Outcomes:		Blooms Taxonomy

CO1:	Learn the importance of different components of health	Understand
CO2:	Gain confidence to lead a healthy life	Apply
CO3:	Learn new techniques to prevent lifestyle health disorders	Apply
CO4:	Understand the importance of diet and workouts in maintaining health	Analyze
CO5:	Learn the importance of different components of health	Evaluate
CO-PO Mapping		
Particular	PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12	PSO1 PSO2 PSO3
CO1	2 1 1 1 1 2 3 3 1 2 1 2	2 1 1
CO2	2 2 1 1 1 3 3 3 1 2 1 2	2 2 1
CO3	1 1 2 1 1 3 3 3 3 2 1 2	3 3 3
CO4	2 1 1 1 2 3 3 3 1 2 1 3	2 3 2
CO5	1 1 2 1 1 3 3 3 3 3 2 3	2 3 3

23MCT006	HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites Nil					
Course Objectives: - Provide an understanding of India’s scientific and technological heritage from ancient to modern times. - Highlight the major contributions of Indian scientists, thinkers, and civilizations in fields such as mathematics, astronomy, medicine, metallurgy, agriculture, and engineering. - Explain how traditional knowledge systems evolved and influenced global scientific developments. - reate awareness about the continuity, originality, and relevance of India’s scientific innovations in contemporary society.					
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, Dharmpal, 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 1 st 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 haping 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															
Text Books:															
1. A Concise History of Science in India”Edited by: D.M. Bose, S.N. Sen, B.V. Subbarayappa Indian National Science Academy (INSA).															
2. “Science and Technology in India Through the Ages” Author: N. S. Seshan National Book Trust (NBT)															
References:															
1. “The Argumentative Indian” Author: Amartya Sen															
2.“Science in India: Past and Present” Edited by R.C. Gupta															
3. Indian Mathematics and Astronomy: Some Landmarks” Author: Kusum Lata															
Course Outcomes:													Blooms Taxonomy		
CO1:	Explain the evolution of science and technology in India from ancient to modern times.												Understand		
CO2:	Describe the major contributions of Indian scholars in mathematics, astronomy, medicine, metallurgy, engineering, and other scientific fields.												Apply		
CO3:	Relate traditional Indian scientific and technological knowledge to contemporary scientific principles and applications.												Apply		
CO4:	Analyze how India’s scientific heritage influenced global scientific progress and technological development.												Analyze		
CO5:	Evaluate the relevance and significance of indigenous technologies and knowledge systems in modern society.												Evaluate		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	2	3	2	1	2	1	2	3	1	1
CO2	2	2	1	1	1	2	3	2	1	2	1	2	3	2	1
CO3	2	2	2	2	2	2	3	2	2	2	1	3	2	3	2
CO4	1	2	2	3	2	2	3	2	1	2	1	3	2	2	3
CO5	1	2	1	2	1	3	3	3	1	3	2	3	1	2	3

	POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY		L	T	P	C
			3	0	0	0
Prerequisites						
• Nil						
Course Objectives:						
• This course will begin with a short overview of human needs and desires and how different political-economic systems try to fullfill them.						
• In the process, we will end with a critique of different systems and their implementations in the past, with possible future directions.						
	Lectures					9
Considerations for humane society, holistic thought, human being’s desires, harmony in self, harmony in relationships, society, and nature, societal systems.						
	Lectures					5
Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism. Liberal democracy.						
	Lectures					4
Fascism and totalitarianism. World war I and II. Cold war.						
	Lectures					5
Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models.						
	Lectures					5
Welfare state. Relation with human desires. Empowered human beings, satisfaction.						
	Lectures					6
Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one’s lives. Relationship with nature.						
	Lectures					5
Essential elements of Indian civilization						
	Lectures					6
Technology as driver of society, Role of education in shaping of society. Future directions						
Total periods: 45						
Text Books:						
1. A Nagaraj, M K Gandhi, JC Kumarappa)						
2. Adam smith, J S Mill						
References:						
1. Marx, Lenin, Mao, M N Roy						
2. M K Gandhi, Schumacher, Kumarappa.						
3. Nandkishore Acharya, David Dixon, Levis Mumford						
Course Outcomes:						Blooms Taxonomy
CO1:	Explain the major political and economic ideas that contribute to the development of a humane and just society.					Understand
CO2:	Describe the contributions of key political and economic thinkers who emphasized human dignity, equality, and social welfare.					Understand / apply

CO3:	Apply ethical and humane principles to analyze contemporary political and economic issues.												Apply		
CO4:	Analyze the relationship between political institutions, economic systems, and human well-being.												Analyze		
CO5:	Evaluate public policies, governance models, and economic approaches from a humane and socially responsible perspective.												Evaluate		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	2	3	3	1	3	1	2	3	1	1
CO2	2	2	1	1	1	3	3	3	1	3	1	2	3	2	1
CO3	2	2	2	2	1	3	3	3	2	3	2	3	2	3	2
CO4	1	2	2	3	1	3	3	3	1	3	1	3	2	3	3
CO5	1	2	1	2	1	3	3	3	1	3	2	3	1	3	3

23MCT008	STATE, NATION BUILDING AND POLITICS IN INDIA	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites Nil					
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.					
	Lectures				
Understanding the need and role of State and politics. Development of Nation-State, sovereignty, sovereignty in a globalized world. 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															
Text Books:															
1. Sunil Khilnani, The Idea of India. Penguin India Ltd., New Delhi.															
2. Madhav Khosla, The Indian Constitution, Oxford University Press. New Delhi, 2012.															
References:															
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.															
Course Outcomes:													Blooms Taxonomy		
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.													UNDERSTAND		
													UNDERSTAND / APPLY		
													APPLY		
													ANALYZE		
													EVALUATE		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	2	3	3	1	3	1	2	3	1	1
CO2	2	2	1	1	1	3	3	3	1	3	1	2	3	2	1
CO3	2	2	2	2	1	3	3	3	2	3	2	3	2	3	2
CO4	1	2	2	3	1	3	3	3	1	3	1	3	2	3	3
CO5	1	2	1	2	1	3	3	3	1	3	2	3	1	3	3

23MCT009	INDUSTRIAL SAFETY	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites Nil					
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:														Blooms Taxonomy		
CO1: Understand the basic concept of safety.														Understand		
CO2: Obtain knowledge of Statutory Regulations and standards.														Understand / apply		
CO3: Know about the safety Activities of the Working Place.														Apply		
CO4: Analyze on the impact of Occupational Exposures and their Remedies														Analyze		
CO5: Obtain knowledge of Risk Assessment Techniques.														Evaluate		
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	–	1	–	2	3	2	1
CO2	2	3	2	2	–	–	3	–	–	2	–	3	3	3	2
CO3	2	2	3	2	1	–	3	2	–	2	–	3	3	3	3
CO4	1	2	3	2	1	–	3	2	2	2	–	3	2	3	3
CO5	1	3	3	3	1	–	3	2	2	3	–	3	2	3	3

Vertical I :Semiconductor Chip Design and Testing

23ECE001	WIDE BAND GAP DEVICES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - Introduce the concept of wide band gap (WBG) devices and its application in real world - Advantages and disadvantages of WBG devices - Provide an introduction to basic operation of WBG power devices - Learn Design principles of modern power devices - Ability to deal high frequency design complexity					
Unit I	WBG DEVICES AND THEIR APPLICATION IN REAL WORLD				9
Review of semiconductor basics, Operation and characteristics of the SiC Schottky Barrier Diode, SiC DMOSFET and GaN HEMT, Review of Wide bandgap semiconductor technology -Advantages and disadvantages					
Unit II	SWITCHING CHARACTERIZATION OF WBG				9
Turn-on and Turn-off characteristics of the device, Hard switching loss analysis, Double pulse test set-up					
Unit III	DRIVERS FOR WIDE BAND GAP DEVICES				9
Gate driver, Impact of gate resistance, Gate drivers for wide bandgap power devices, Transient immunity integrated gate drivers					
Unit IV	HIGH FREQUENCY DESIGN COMPLEXITY AND PCB DESIGNING				9
Effects of parasitic inductance, Effects of parasitic capacitance, EMI filter design for high frequency power converters High frequency PCB design, Conventional power loop design, High frequency power loop optimization, Separation of power from signal PCB					
Unit V	APPLICATIONS OF WIDE BANDGAP DEVICES				9
Consumer electronics applications, Wireless power transfer applications, Electric vehicle applications, Renewable energy sources applications					
Total periods: 45					
Text Books:					
4. A. Lidow, J. Strydom, M. D. Rooij, D. Reusch, GaN Transistors for Efficient Power Conversion, Wiley, 2014, ISBN-13: 978-1118844762.					
5. G. Meneghesso, M. Meneghini, E. Zanoni, “Gallium Nitride-enabled High Frequency and High Efficiency Power Conversion,” Springer International Publishing, 2018, ISBN: 978-3- 319-77993-5.					
References:					
1. F. Wang, Z. Zhang and E. A. Jones, Characterization of Wide Bandgap Power Semiconductor Devices, IET, ISBN-13: 978-1785614910 (2018).					
2. B.J.Baliga, “Gallium Nitride and Silicon Carbide Power Devices,” World Scientific Publishing Company (3 Feb. 2017).					
3. L. Corradini, D. Maksimovic, P. Mattavelli, R. Zane, “Digital Control of HighFrequency Switched-Mode Power Converters”, Wiley, ISBN-13: 978-1118935101 (9th June, 2015).					
Course Outcomes:					Blooms Taxonomy

CO1:	Students master design principles of power devices	Apply
CO2:	Students become familiar with reliability issues and testing methods	Understand
CO3:	An ability to design and conduct experiments, as well as to analyze and interpret data	Analyze
CO4:	Student to get real life experience and to know practical applications of WBG	Apply
CO5:	Indepth knowledge on practical usage of this technology	Apply
CO-PO Mapping		
Particular	PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12	PSO1 PSO2 PSO3
CO1	3 3 2 3 2 - - - - - - -	1 1 3
CO2	3 3 3 2 2 - - - - - - -	1 1 2
CO3	3 3 2 2 2 - - - - - - -	2 2 2
CO4	3 3 3 3 2 - - - - - - -	3 2 2
CO5	3 2 3 3 2 - - - - - - -	2 2 2

23ECE002	VALIDATION AND TESTING TECHNOLOGY	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
Course Objectives: • Getting familiar with various IC technology. • Learn MOS theory and testing • Learn CMOS circuit theory and testing • Getting expertise on CMOS characterization. • Explore circuit and device level testing methods					
Unit I	TECHNOLOGY INTRODUCTION				9
Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS Technologies. VLSI Fabrication, Oxidation, Lithography, Diffusion, Ion Implantation, Metallization, Integrated Resistors and Capacitors.					
Unit II	MOS THEORY ANALYSIS-I				9
Basic Electrical Properties of MOS Circuits: Ids-Vds Relationships, MOS Transistor Threshold Voltage Vth, gm, gds, Figure of Merit ω0, Short Channel and Narrow Channel Width Effects.					
Unit III	MOS THEORY ANALYSIS- II				9
Pass Transistor, Transmission Gate, NMOS Inverter, Various Pull-ups, CMOS Inverter Analysis and Design, Bi-CMOS Inverters, Latch up in CMOS Circuits.					
Unit IV	CMOS CIRCUIT CHARACTERISATION AND PERFORMANCE ESTIMATION				9
Sheet Resistance RS, conductivity and its Concept to MOS, Area Capacitance Units, Calculations - Delays, Driving Large Capacitive Loads, Delay Estimation, Logical Effort and Transistor Sizing, Power Dissipation, Reliability.					
Unit V	BASIC OF SILICON VALIDATION				9
Need for Testing, Testing at Various Levels, Objectives of Testing - VLSI Test process and Test Equipment - Types of Testing: Functionality Tests, Silicon Debug, Manufacturing Tests, Defect during manufacturing - Fault Modelling, Observability and Controllability, Fault Coverage, Fault Sampling - ATE, Test economics.					
Total periods: 45					
Text Books:					
1. Kamran Ehraghian, Dauglas A. Pucknell and Sholeh Eshraghiam, “Essentials of VLSI Circuits and Systems” – PHI, EEE, 2005 Edition.					
2. Neil H. E. Weste and David. Harris Ayan Banerjee,, “CMOS VLSI Design” - Pearson Education, 1999.					

References:															
1. M.L. Bushnell and V.D. Agrawal, “Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits”, Kluwer Academic Publishers, 2004															
2. N.K. Jha and S.G. Gupta, “Testing of Digital Systems”, Cambridge University Press, 2003															
3. Etienne Sicard, Sonia Delmas Bendhia, “Basics of CMOS Cell Design”, TMH, EEE, 2005															
Course Outcomes:													Blooms Taxonomy		
CO1: Complete overview to CMOS fabrication process.													Understand		
CO2: Understand the fundamental concept of MOS FET and testing.													Understand		
CO3: Explain the concept of MOS theory and analysis.													Understand		
CO4: To give the student an understanding of CMOS performance testing and estimation.													Understand		
CO5: Explain the basics of Testing and Fault Modeling													Understand		
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	1	-	-	-	2	2	3	2	3
CO2	2	3	3	3	2	1	1	-	-	-	2	2	3	3	2
CO3	3	2	2	3	2	3	3	-	-	-	3	2	2	2	2
CO4	3	3	2	3	2	3	3	-	-	-	2	2	1	2	1
CO5	3	2	3	3	3	3	2	-	-	-	2	2	1	2	1

23ECE003	LOW POWER IC DESIGN	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To learn the fundamentals of low power low voltage VLSI design. - To understand the impact of power on system performances. - To understand the different design approaches. - To develop the low power low voltage memories					
Unit I	FUNDAMENTALS OF LOW POWER CIRCUITS				9
Need for Low Power Circuit Design, Sources of Power Dissipation – Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.					
Unit II	LOW-POWER DESIGN APPROACHES				9
Low-Power Design through Voltage Scaling: VTCMOS circuits, MTCMOS circuits, Architectural Level Approach – Pipelining and Parallel Processing Approaches. Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, Mask level Measures.					
Unit III	LOW-VOLTAGE LOW-POWER ADDERS				9
Introduction, Standard Adder Cells, CMOS Adder’s Architectures – Ripple Carry Adders, Carry Look-Ahead Adders, Carry Select Adders, Carry Save Adders, Low Voltage Low Power Design Techniques –Trends of Technology and Power Supply Voltage, Low Voltage Low-Power Logic Styles.					
Unit IV	LOW-VOLTAGE LOW-POWER MULTIPLIERS				9
Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh- Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.					
Unit V	LOW-VOLTAGE LOW-POWER MEMORIES				9

Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low Power SRAM Technologies, Basics of DRAM, Self-Refres Circuit, Future Trend and Development of DRAM.															
															Total periods: 45
Text Books:															
1. Sung-Mo Kang, Yusuf Leblebici, “CMOS Digital Integrated Circuits – Analysis and Design”, TMH, 2011.															
2. Kiat-Seng Yeo, Kaushik Roy, “Low-Voltage, Low-Power VLSI Subsystems”, TMH Professional Engineering, 2004.															
References:															
1. Ming-BO Lin, “Introduction to VLSI Systems: A Logic, Circuit and System Perspective”, CRC Press, 2012.															
2. Anantha Chandrakasan, “Low Power CMOS Design”, IEEE Press, /Wiley International, 1998															
3. Kaushik Roy, Sharat C. Prasad, “Low Power CMOS VLSI Circuit Design”, John Wiley, & Sons, 2000.															
4. Gary K. Yeap, “Practical Low Power Digital VLSI Design”, Kluwer Academic Press, 2002															
5. Bellamour, M. I. Elamasri, “Low Power CMOS VLSI Circuit Design”, A Kluwer Academic Press, 1995.															
6. Siva G. Narendran, Anatha Chandrakasan, “Leakage in Nanometer CMOS Technologies”, Springer, 2005															
Course Outcomes:														Blooms Taxonomy	
CO1: Understand the fundamentals of Low power circuit design.														Understand	
CO2: Attain the knowledge of architectural approaches.														Understand	
CO3: Analyze and design Low-Voltage Low-Power combinational circuits.														Analyze	
CO4: Learn the design of Low-Voltage Low-Power Memories														Apply	
CO5: Design and develop Low Power, Low Voltage Circuits														Apply	
CO-PO 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	2
CO2	3	2	1	2	3	-	-	-	-	-		1	2	2	1
CO3	3	3	3	2	2	-	-	-	-	-	-	1	2	2	2
CO4	2	3	3	3	3	-	-	-		-	-	1	2	3	3
CO5	3	3	3	2	2	-	-	-	-	-	-	2	2	2	3

23ECE004	VLSI TESTING AND DESIGN FOR TESTABILITY	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To introduce logic and fault simulation and testability measures. - To study the design for testability. - To know about interfacing and testing of memory - To introduce power management techniques in testing - To study testability in analog circuits					
Unit I	TEST REQUIREMENTS AND METRICS				9

Validation platforms- SOC design methodology, IP components, Integration, Clocking, I/Os and interfaces, Device modes, Logic, memories, analog, I/Os, power management; Test requirements- Test handoffs, Testers Where DUT and DFT fit into design / framework; Test- ATPG, DFT, BIST, COF, TTR; Test cost metrics and test economics; Logic fault models- SAF, TDF, PDF, Iddq, St- BDG, Dy-BDG, SDD; Basics of test generation and fault simulation- Combinational circuits, Sequential; Specific algorithmic approaches, CAD framework, Optimisations.															
Unit II		SCAN DESIGN AND BIST												9	
Scan Design- Scan design requirements, Types of scan and control mechanisms, Test pattern construction for scan, Managing scan in IPs and SOCs, Scan design optimisations, Partitioning, Clocking requirements for scan and delay fault testing, Speed of operation; BIST – Framework, Controller configurations, FSMs, LFSRs, STUMPS architecture, Scan compression and bounds, Test per cycle, Test per scan, Self-testing and self-checking circuits, Online test.															
Unit III		MEMORY TEST AND TEST INTERFACES												9	
Memory Test -Memory fault models, Functional architecture as applicable to test, Test of memories, Test of logic around memories, BIST controller configuration, Test of logic around memories, DFT and architecture enhancements, Algorithmic optimisations; Test Interfaces-Test control requirements, Test interfaces - 1500, JTAG, Hierarchical, serial control, Module / IP test, SOC test, Board test, System test, Boundary scan.															
Unit IV		DESIGN CONSIDERATIONS AND POWER MANAGEMENT DURING TEST												9	
Design Considerations- Design considerations, Physical design congestion, Partitioning, Clocks, Test modes, Pins, Test scheduling, Embedded test, Architecture improvements, Test in the presence of security; Power management during test- Methods for low power test, ATPG methods, DFT methods, Scan methods, Low power compression, Test of power management, Implications of power excursions, Optimisations.															
Unit V		ANALOG TEST												9	
Test requirements. DFT methods. BIST methods. Test versus measurement. Defect tests versus performance tests. Tests for specific modules - PLL, I/Os, ADC, DAC, SerDes, etc. RF test requirements.															
Total periods: 45															
Text Books:															
1. Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits,Vishwani Agrawal and Michael Bushnell, Springer, 2002.															
Course Outcomes:														Blooms Taxonomy	
CO1: Understand logic and fault simulation requirements and testability measures.														Understand	
CO2: Understand the Design for Testability.														Understand	
CO3: Develop interfacing and memory testing.														Create	
CO4: Perform testing with power management techniques.														Apply	
CO5: Carry-out fault Detection in analog circuits.														Apply	
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	2	-
CO2	3	3	3	2	1	1	-	-	-	-	-	1	3	1	-
CO3	2	3	3	3	3	-	-	-	-	-	-	-	3	3	1
CO4	2	2	3	2	2	1	3	-	-	-	1	-	2	2	1
CO5	2	3	2	3	3	-	-	-	-	-	-	-	3	3	-

23ECE005	MIXED SIGNAL IC DESIGN TESTING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					

Course Objectives: - To know about mixed-signal devices and the need for testing these devices. - To study the various techniques for testing. - To learn about ADC and DAC based testing. - To understand the Clock and Serial Data Communications Channels - To study general-purpose measuring devices.																
Unit I		MIXED – SIGNAL TESTING												9		
Common Types of Analog and Mixed- Signal Circuits – Applications of Mixed-Signal Circuits - Post- Silicon Production Flow - Test and Packing – Characterization versus Production Testing - Test and Diagnostic Equipment - Automated Test Equipment – Wafer Probers – Handlers – E-Beam Probers – Focused Ion Beam Equipment – Forced –Temperature																
Unit II		YIELD, MEASUREMENT ACCURACY, AND TEST TIME												9		
Yield - Measurement Terminology - Repeatability, Bias, and Accuracy - Calibrations and Checkers - Tester Specifications - Reducing Measurement Error with Greater Measurement Time – Guardbands - Effects of Measurement Variability on Test Yield - Effects of Reproducibility and Process Variation on Yield - Statistical Process Control																
Unit III		DAC TESTING												9		
Basics of Data Converters -Principles of DAC and ADC Conversion, Data Formats, Comparison of DACs and ADCs, DAC Failure Mechanisms - Basic DC Tests - Transfer Curve Tests - Dynamic DAC Tests - Tests for Common DAC Applications																
Unit IV		ADC TESTING												9		
ADC Testing Versus DAC Testing - ADC Code Edge Measurements - Edge Code Testing Versus Center Code Testing, Step Search and Binary Search Methods, Servo Method, Linear Ramp Histogram Method, Histograms to Code Edge Transfer Curves, Rising Ramps Versus Falling Ramps, Sinusoidal Histogram Method - DC Tests and Transfer Curve Tests - Dynamic ADC Tests - Tests for Common ADC Applications																
Unit V		CLOCK AND SERIAL DATA COMMUNICATIONS CHANNEL MEASUREME												9		
Synchronous and Asynchronous Communications - Time-Domain Attributes of a Clock Signal - Frequency-Domain Attributes of a Clock Signal - Communicating Serially Over a Channel - Bit Error Rate Measurement - Methods to Speed Up BER Tests in Production - Deterministic Jitter Decomposition - Jitter Transmission Tests.																
Total periods: 45																
Text Books:																
1. Gordon W.Roberts, Friedrich Taenzler, Mark Burns, “An Introduction to Mixed-signal IC Test and Measurement” Oxford University Press, Inc.2012 (Unit I - V)																
References:																
1. M.L.Bushnell and V.D.Agrawal, “Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits”, Kluwer Academic Publishers, 2002.																
2. BapirajuVinnakota, “Analog and mixed-signal test”, Prentice Hall, 1998.																
3. Digital and Analogue Instrumentation: Testing and Measurement by NihalKularatna																
Course Outcomes:														Blooms Taxonomy		
CO1: Learn the fundamentals of mixed signal circuits.														Understand		
CO2: Define the various measurement terminologies.														Apply		
CO3: Acquire knowledge of Analog to Digital Converters.														Apply		
CO4: Learn testing of Analog to Digital Converters.														Analyze		
CO5: Comprehend the attributes of a clock signal.														Analyze		
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	3	
CO2	3	3	2	2	1	2	-	-	-	-	-	2	3	2	3	
CO3	3	3	2	2	2	2	-	-	-	-	-	2	3	2	3	
CO4	3	3	3	2	2	1	-	-	-	-	-	2	1	2	2	

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

23ECE006	ASIC AND FPGA BASED DESIGN	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To understand the design flow of different types of ASIC. - To learn the different types of programming elements, programmable logic blocks, programmable input-output blocks and programmable interconnects of various types FPGA/CPLDs - To know various steps involved in ASIC implementation for specific targets. - To comprehend various steps involved in ASIC physical design					
Unit I	INTRODUCTION TO ASICs, ASIC LIBRARY DESIGN AND PROGRAMMING TECHNOLOGY				9
Introduction to ASICs: ASIC Design Flow, Types of ASIC - Full Custom, Semi-Custom – Standard Cell Based ASIC and Gate Array ASIC, Programmable ASIC – PROM, PLA, PAL, CPLD, FPGA. ASIC Cell Library Design: Combinational Logic Cell – Sequential Logic Cell - Data Path Logic Cell - Library Cell Design - Library Architecture Programming Technology: Antifuse, SRAM, EPROM, EEPROM, ASIC construction.					
Unit II	PROGRAMMABLE ASIC LOGIC CELLS, I/O CELLS AND INTERCONNECT				9
Programmable ASIC Logic Cells: Actel ACT - Xilinx LCA – Altera FLEX - Altera MAX, Vertex and Spartan FPGAs, Cyclone FPGAs Programmable ASIC I/O Cells: DC & AC Inputs and Outputs - Clock & Power Inputs - Xilinx I/O Blocks Programmable ASIC Interconnect: Actel ACT -Xilinx LCA - Xilinx EPLD - Altera MAX 5000 and 7000 - Altera MAX 9000 - Altera FLEX, Vertex and Spartan FPGAs, Cyclone FPGAs.					
Unit III	LOGIC SYNTHESIS, SIMULATION & TEST				9
Logic Synthesis: Logic Synthesis – FPGA Synthesis - Verilog and Logic Synthesis -VHDL and Logic Synthesis Simulation: Types of Simulation, Logic Simulation – Cell Models & Delay Models, Static Timing Analysis, Formal Verification, Switch Level Simulation, Transistor Level Simulation Test: Importance of Test, Boundary Scan Test, Faults, Fault Simulation, ATPG, Scan Test, BIST					
Unit IV	SYSTEM PARTITIONING, FLOORPLANNING AND PLACEMENT				9
System Partitioning: Measurement of Partitioning, Partitioning Algorithms – Constructive Partitioning, Iterative Partitioning Improvement Algorithms - K-L Algorithm, FM algorithm, Ratio-Cut Algorithm, Look-Ahead Algorithm, Simulated Annealing, FPGA Partitioning, Power Dissipation. Floor planning and Placement: Floor Planning Measurement and tools, I/O, Power and clock planning, Measurement of Placement, Placement Algorithms – Min-cut Placement, Eigen Value Placement, Iterative Placement Improvement and Timing Driven Placement Algorithms.					
Unit V	ROUTING AND CIRCUIT EXTRACTION				9
Routing and Circuit Extraction: Global Routing Measurement – Measurement of Interconnect Delay using Elmore’s constant, Global routing for CBIC and GA, Detailed Routing Measurement - Measurement of Channel Density, Detailed routing Algorithms – LEA, Lee Maze and High tower Algorithms, Circuit extraction process, Layout Design Rules and Technology related issues					
Total periods: 45					
Text Books:					
1. Michael John Sebastian Smith, Applications Specific Integrated Circuits, Pearson Education, Ninth Indian Reprint, 13th Edition, 2004 (UNIT I - V)					
References:					
1. Trimberger S, Edr. Field Programmable Gate Array Technology, Kluwer Academic Publishers, 1994.					
2. Old Field J, Dorf, R, Field Programmable Gate Arrays, John Wiley& Sons, New York, 1995.					

3. Chan P.K, & Mourad S, Digital Design using Field Programmable Gate Array, Prentice Hall, 1994.															
4. Sherwani N A, Algorithms for VLSI Physical Design Automation, Kluwer Academic, Publishers, 2002.															
5. Gerez, H, Algorithms for VLSI Design Automation, John Wiley, 1999.															
Course Outcomes:													Blooms Taxonomy		
CO1:	Explain the features of ASIC Design and various implementation methods of ASIC Design												Apply		
CO2:	Apply design concepts to construct the logic cells and programmable elements.												Apply		
CO3:	Describe the architectures of programmable logic block, programmable input-output Block and programmable interconnect of Xilinx, Altera and Actel FPGA/CPLD.												Apply		
CO4:	Apply the concepts of logic synthesis to implement an ASIC Design for a specific target.												Apply		
CO5:	Analyze performance of the ASIC using the concepts of simulation, verification and testing.												Analyze		
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	3
CO2	3	3	2	2	1	2	-	-	-	-	-	2	3	2	3
CO3	3	3	2	2	2	2	-	-	-	-	-	2	3	2	3
CO4	3	3	3	2	2	1	-	-	-	-	-	2	1	2	2
CO5	3	3	3	2	2	2	-	-	-	-	-	3	2	1	2

VERTICAL 2: SIGNAL PROCESSING

23ECE007	ADVANCED DIGITAL SIGNAL PROCESSING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To introduce the concepts of discrete time random signal processing - To know about multirate signal processing and its applications - To understand the spectrum estimation techniques - To learn the concept of prediction theory and filtering					
Unit I	MULTIRATE SIGNAL PROCESSING				9
Review of Convolution, DFT and ZT, Multirate Signal Processing - Decimation, Interpolation, Sampling Rate Conversion by a rational factor – digital filter banks, sub band coding, Quadrature Mirror Filter.					
Unit II	DISCRETE TIME RANDOM PROCESSES				9
Stationary random processes, Autocorrelation, Rational Power Spectra, Filters for generating random Processes from white noise and inverse filter – AR, MA and ARMA processes – relationship between autocorrelation and the filter parameters.					
Unit III	LINEAR PREDICTION AND FILTERING				9
Linear Prediction – Forward and Backward - Wiener filters for filtering and prediction – FIR Wiener Filter – IIR Wiener Filter – Kalman Filter.					
Unit IV	ADAPTIVE FILTERING				9
FIR adaptive filters – adaptive filters based on steepest descent method – LMS algorithm – Variants of LMS algorithm – adaptive echo cancellation – adaptive channel equalization – RLS Algorithm.					

Unit V	SPECTRUM ESTIMATION												9		
Estimation of power spectra from finite duration observations of signals – Non parametric methods of spectrum estimation – the Bartlett and the Welch method – Parametric spectrum estimation – AR, MA and ARMA.															
Total periods: 45															
Text Books:															
1. John G. Proakis & Dimitris G.Manolakis, —Digital Signal Processing – Principles, Algorithms & Applications, Fourth Edition, Pearson Education / Prentice Hall, 2007.															
2. P. Vaidyanathan, "Multirate systems and filter banks", Prentice Hall Inc. 1993.															
References:															
1. Monson H. Hayes, "Statistical digital signal processing and modeling", John Wiley and Sons Inc. New York, Indian reprint 2008.															
2. Haykin, Adaptive Filter Theory, 4th Edition, Pearson Education, New Delhi, 2006.															
3. Sophoncles J. Orfanidis, “Optimum Signal Processing “, McGraw Hill, 2000.															
Course Outcomes:														Blooms Taxonomy	
CO1: Comprehend multirate signal processing and demonstrate its applications														Apply	
CO2: Demonstrate an understanding of the power spectral density and apply to discrete random signals and systems														Apply	
CO3: Apply linear prediction and filtering techniques to discrete random signals for signal detection and estimation														Analyze	
CO4: Analyze adaptive filtering problems and demonstrate its application														Apply	
CO5: Apply power spectrum estimation techniques to random signals														Apply	
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	-	-	-	-	-	1	2	3	3
CO2	3	3	3	2	2	2	-	-	-	-	-	2	3	2	2
CO3	3	3	3	2	2	2	-	-	-	-	-	2	2	2	1
CO4	3	3	3	2	2	2	-	-	-	-	-	2	3	2	2
CO5	3	3	2	2	1	1	-	-	-	-	-	1	2	3	1

23ECE008	IMAGE PROCESSING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To become familiar with digital image fundamentals - To get exposed to simple image enhancement techniques in Spatial and Frequency domain. - To learn concepts of degradation function and restoration techniques. - To study the image segmentation and representation techniques. - To become familiar with image compression and recognition methods					
Unit I	DIGITAL IMAGE FUNDAMENTALS				9
Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.					
Unit II	IMAGE ENHANCEMENT				9

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement..															
Unit III		IMAGE RESTORATION												9	
Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering.															
Unit IV		IMAGE SEGMENTATION												9	
Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm															
Unit V		IMAGE COMPRESSION AND RECOGNITION												9	
Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.															
Total periods: 45															
Text Books:															
1. Rafael C. Gonzalez, Richard E. Woods, ‘Digital Image Processing’, Pearson, Third Edition,2010.															
2. Anil K. Jain, ‘Fundamentals of Digital Image Processing’, Pearson, 2002.															
References:															
1. Kenneth R. Castleman, ‘Digital Image Processing’, Pearson, 2006.															
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, ‘Digital Image Processing using MATLAB’, Pearson Education, Inc., 2011.															
3. D,E. Dudgeon and RM. Mersereau, ‘Multidimensional Digital Signal Processing’, Prentice Hall Professional Technical Reference, 1990.															
4. William K. Pratt, ‘Digital Image Processing’, John Wiley, New York, 2002															
5. Milan Sonka et al ‘Image processing, analysis and machine vision’, Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.															
Course Outcomes:														Blooms Taxonomy	
CO1:		Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.												Apply	
CO2:		Operate on images using the techniques of smoothing, sharpening and enhancement.												Apply	
CO3:		Understand the restoration concepts and filtering techniques.												Analyze	
CO4:		Learn the basics of segmentation, features extraction, compression and recognition methods for color models.												Apply	
CO5:		Comprehend image compression concepts												Apply	
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	-	-	-	-	-	3	2	-	2
CO2	3	3	3	2	2	2	-	-	-	-	-	2	2	-	2
CO3	3	3	3	2	2	2	-	-	-	-	-	2	2	-	2
CO4	3	3	3	2	2	2	-	-	-	-	-	2	2	-	2
CO5	3	3	3	2	2	2	-	-	-	-	-	2	2	-	2

23ECE009	SPEECH PROCESSING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
Course Objectives: • Study the fundamentals of speech signal and extracts various speech features • Understand different speech coding techniques for speech compression applications • Learn to build speech enhancement, text-to-speech synthesis system.					
Unit I	FUNDAMENTALS OF SPEECH				9
The Human speech production mechanism, Discrete-Time model of speech production, Speech perception - human auditory system, Phonetics - articulatory phonetics, acoustic phonetics, and auditory phonetics, Categorization of speech sounds, Spectrographic analysis of speech sounds, Pitch frequency, Pitch period measurement using spectral and cepstral domain, Formants, Evaluation of Formants for voiced and unvoiced speech.					
Unit II	SPEECH FEATURES AND DISTORTION MEASURES				9
Significance of speech features in speech-based applications, Speech Features – Cepstral Coefficients, Mel Frequency Cepstral Coefficients (MFCCs), Perceptual Linear Prediction (PLP), Log Frequency Power Coefficients (LFPCs), Speech distortion measures–Simplified distance measure, LPC-based distance measure, Spectral distortion measure, Perceptual distortion measure.					
Unit III	SPEECH CODING				9
Need for speech coding, Waveform coding of speech – PCM, Adaptive PCM, DPCM, ADPCM, Delta Modulation, Adaptive Delta Modulation, G.726 Standard for ADPCM, Parametric Speech Coding – Channel Vocoders, Linear Prediction Based Vocoders, Code Excited Linear Prediction (CELP) based Vocoders, Sinusoidal speech coding techniques, Hybrid coder, Transform domain coding of speech					
Unit IV	SPEECH ENHANCEMENT				9
Classes of Speech Enhancement Algorithms, Spectral-Subtractive Algorithms - Multiband Spectral Subtraction, MMSE Spectral Subtraction Algorithm, Spectral Subtraction Based on Perceptual Properties, Wiener Filtering - Wiener Filters in the Time Domain, Wiener Filters in the Frequency Domain, Wiener Filters for Noise Reduction, Maximum-Likelihood Estimators, Bayesian Estimators, MMSE and Log-MMSE Estimator, Subspace Algorithms .					
Unit V	SPEECH SYNTHESIS AND APPLICATION				9
A Text-to-Speech systems (TTS), Synthesizers technologies – Concatenative synthesis, Use of Formants for concatenative synthesis, Use of LPC for concatenative synthesis, HMM-based synthesis, Sinewave synthesis, Speech transformations, Watermarking for authentication of a speech, Emotion recognition from speech.					
Total periods: 45					
Text Books:					
1. Shaila D. Apte, Speech and Audio Processing, Wiley India (P) Ltd, New Delhi, 2012.					
2. Philipos C. Loizou, Speech Enhancement Theory and Practice, Second Edition, CRC Press, Inc., United States, 2013.					
References:					
1. Rabiner L. R. and Juang B. H, Fundamentals of speech recognition, Pearson Education, 2003					
Course Outcomes:					Blooms Taxonomy
CO1:	Understand the fundamentals of speech.				Understand

CO2:	Extract various speech features for speech related applications												Apply		
CO3:	Choose an appropriate speech coder for a given application.												Analyze		
CO4:	Build a speech enhancement system.												Apply		
CO5:	Build a text-to-speech synthesis system for various applications												Apply		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	1	2	1	-	-	-	-	-	2	3	3	3
CO2	1	2	1	1	2	1	-	-	-	-	-	2	2	2	2
CO3	1	2	1	1	2	1	-	-	-	-	-	1	1	2	2
CO4	3	-	3	3	-	3	-	-	-	-	-	2	2	3	3
CO5	3	-	3	3	-	3	-	-	-	-	-	2	2	2	2

23ECE010	SOFTWARE DEFINED RADIO	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To introduce the concepts of software radios - To know about RF implementation challenges for software defined radios - To understand the digital generation of signals - To learn the software and hardware requirements for software defined radios.					
Unit I	RF IMPLEMENTATION				9
The Need for Software Radios. Characteristics and Benefits of a Software Radio. Design Principles of a Software Radio.					
Unit II	SPEECH FEATURES AND DISTORTION MEASURES				9
Purpose of RF front – end, Dynamic range, RF receiver front – end topologies, Enhanced flexibility of the RF chain with software radios, Importance of the components to overall performance, Transmitter architectures and their issues, Noise and distortion in the RF chain, Hybrid DDS – PLL systems, Applications of Direct Digital Synthesis.					
Unit III	DIGITAL GENERATION OF SIGNALS				9
Comparison of direct digital synthesis with analog signal synthesis, Approaches to direct digital synthesis, Analysis of spurious signals, Performance of direct digital synthesis systems, Applications of direct digital synthesis.					
Unit IV	SMART ANTENNAS				9
Benefits of smart antennas, Structures for beamforming systems, Smart antenna algorithms, Hardware implementation of smart antennas, Digital Hardware Choices-Key hardware elements.					
Unit V	HARDWARE AND SOFTWARE FOR SDR & CASE STUDIES				9
DSP Processors, FPGA, ASICs. Trade-offs, Object oriented programming, Object Brokers, GNU Radio-USRP. Case Studies: SPEAK easy, JRTS, SDR-3000.					
Total periods: 45					
Text Books:					
1. Jeffrey Hugh Reed, “Software Radio: A Modern Approach to Radio Engineering,” Prentice Hall Professional, 2002.					

2. Tony J Roupheal, “RF and DSP for SDR,” Elsevier Newnes Press, 2008.															
References:															
1. P. Kenington, “RF and Baseband Techniques for Software Defined Radio,” Artech House, 2005.															
2. Paul Burns, “Software Defined Radio for 3G,” Artech House, 2002.															
3. Behrouz. F. Bourjney“ Signal Processing for Software defined Radios”, Lulu 2008.															
Course Outcomes:													Blooms Taxonomy		
CO1: Demonstrate an understanding in the evolving paradigm of Software defined implementation.													Apply		
CO2: Analyze Radio frequency implementation issues													Apply		
CO3: Implement Smart antenna techniques for software defined radio.													Analyze		
CO4: Compare various digital synthesis procedures.													Apply		
CO5: Comprehend various hardware and software requirements for software defined radios.													Apply		
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	-	-	-	1	-	3	3	2	2
CO2	3	3	3	2	2	2	-	-	-	1	-	2	3	2	2
CO3	3	3	3	2	2	2	-	-	-	1	-	2	3	2	3
CO4	3	3	3	2	2	2	-	-	-	1	-	2	2	2	2
CO5	3	3	3	3	2	2	-	-	-	1	-	2	2	2	2

23ECE011	DSP ARCHITECTURE AND PROGRAMMING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - Study the architecture of programmable DSP processors - Learn to implement various standard DSP algorithms in DSP Processors - Use the Programmable DSP Processors to build real-time DSP systems					
Unit I	ARCHITECTURES FOR PROGRAMMABLE DSP PROCESSORS				9
Basic Architectural features, DSP Computational building blocks, Bus architecture and memory, Data addressing capabilities, Address generation Unit, Programmability and program execution, Speed issues, Features for external interfacing					
Unit II	TMS320C5X PROGRAMMABLE DSP PROCESSOR				9
Architecture of TMS320C54xx DSP processors, Addressing modes – Assembly language Instructions - Memory space, interrupts, and pipeline operation of TMS320C54xx DSP Processor, On-Chip peripherals, Block Diagram of TMS320C54xx DSP starter kit.					
Unit III	TMS320C6X PROGRAMMABLE DSP PROCESSOR				9
Commercial TI DSP processors, Architecture of TMS320C6x DSP Processor, Linear and Circular addressing modes, TMS320C6x Instruction Set, Assembler directives, Linear Assembly, Interrupts, Multichannel buffered serial ports, Block diagram of TMS320C67xx DSP Starter Kit and Support Tools.					
Unit IV	IMPLEMENTATION OF DSP ALGORITHMS				9
DSP Development system, On-chip, and On-board peripherals of C54xx and C67xx DSP development boards, Code Composer Studio (CCS) and support files, Implementation of Conventional FIR, IIR, and					

Adaptive filters in TMS320C54xx/TMS320C67xx DSP processors for real-time DSP applications, Implementation of FFT algorithm for frequency analysis in real-time.															
Unit V		APPLICATIONS OF DSP PROCESSORS												9	
Voice scrambling using filtering and modulation, Voice detection and reverse playback, Audio effects, Graphic Equalizer, Adaptive noise cancellation, DTMF signal detection, Speech thesis using LPC, Automatic speaker recognition.															
Total periods: 45															
Text Books:															
1. Avtar Singh and S. Srinivasan, Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx, Cengage Learning India Private Limited, Delhi 2012															
2. RulphChassaing and Donald Reay, Digital Signal Processing and Applications with the TMS320C6713 and TMS320C6416 DSK, Second Edition, Wiley India (P) Ltd, New Delhi, 2008															
References:															
1. B.Venkataramani and M.Bhaskar, “Digital Signal Processors – Architecture, Programming and Applications”, Tata McGraw – Hill Publishing Company Limited. New Delhi, 2003.															
2. TMS320C5416/6713 DSK user manual at https://www.ti.com															
Course Outcomes:													Blooms Taxonomy		
CO1: Understand the architectural features of DSP Processors.													Apply		
CO2: Comprehend the organization of TMS320C54xx DSP processors													Apply		
CO3: Build solutions using TMS320C6x DSP Processor													Analyze		
CO4: Implement DSP Algorithms													Apply		
CO5: Study the applications of DSP Processors.													Apply		
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	-	-	-	1	-	3	3	3	3
CO2	3	3	2	2	2	2	-	-	-	1	-	2	3	3	3
CO3	3	3	3	2	2	2	-	-	-	1	-	2	2	2	2
CO4	3	3	3	3	2	2	-	-	-	1	-	2	2	3	2
CO5	3	3	3	2	2	2	-	-	-	1	-	2	2	3	2

23ECE012	COMPUTER VISION	Category: BSC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To understand the fundamental concepts related to Image formation and processing. - To learn feature detection, matching and detection - To become familiar with feature based alignment and motion estimation - To develop skills on 3D reconstruction - To understand image based rendering and recognition.					
Unit I	INTRODUCTION TO IMAGE FORMATION AND PROCESSING				9
Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighbourhood operators - Fourier transforms					

- Pyramids and wavelets - Geometric transformations - Global optimization.																
Unit II	FEATURE DETECTION, MATCHING AND SEGMENTATION													9		
Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.																
Unit III	FEATURE-BASED ALIGNMENT & MOTION ESTIMATION													9		
2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion.																
Unit IV	3D RECONSTRUCTION													9		
Shape from X - Active range finding - Surface representations - Point-based representations- Volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos.																
Unit V	IMAGE-BASED RENDERING AND RECOGNITION													9		
View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes - Video-based rendering-Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding- Recognition databases and test sets.																
Total periods: 45																
Text Books:																
1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer- Texts in Computer Science, Second Edition, 2022.																
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.																
References:																
1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004																
2. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006.																
3. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.																
Course Outcomes:													Blooms Taxonomy			
CO1:	To understand basic knowledge, theories and methods in image processing and computer vision.													Apply		
CO2:	To implement basic and some advanced image processing techniques in OpenCV.													Apply		
CO3:	To apply 2D a feature-based based image alignment, segmentation and motion estimations.													Analyze		
CO4:	To apply 3D image reconstruction techniques													Apply		
CO5:	To design and develop innovative image processing and computer vision applications.													Apply		
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	-	-	-	2	1	3	2	2	1	1	
CO2	3	3	3	2	3	-	1	-	2	1	2	2	3	1	2	
CO3	3	3	2	2	3	-	-	-	1	1	2	2	3	2	2	
CO4	2	3	3	2	3	-	-	-	2	1	2	3	2	2	3	
CO5	2	3	3	2	2	2	-	-	3	1	2	3	3	3	3	

VERTICAL 3: RF TECHNOLOGIES

23ECE013	RF TRANSCEIVERS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
COURSE OBJECTIVES: - To understand the fundamentals of RF system design - To acquaint with the various components of RF system for wireless communications - To know the basic techniques needed for analysis of RF systems - To enable the students to verify the basic principles and design aspects involved in RF systems components - To conduct experiments to analyze and interpret data to produce meaningful conclusion and match with theoretical concepts					
Unit I	CMOS PHYSICS, TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES				9
CMOS: Introduction to MOSFET Physics - Noise: Thermal, shot, flicker, popcorn noise -Transceiver Specifications: Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR - Phase noise - Transceiver Architectures: Receiver: Homodyne, Heterodyne, Image reject, Low-IF Architectures - Transmitter: Direct-up conversion, Two-step up conversion schemes.					
Unit II	IMPEDANCE MATCHING NETWORKS AND AMPLIFIERS				9
Review of S-parameters and Smith chart - Passive IC components - Impedance matching networks Amplifiers: Common Gate, Common Source Amplifiers - OC Time constants in bandwidth estimation and enhancement - High frequency amplifier design - Low Noise Amplifiers: Power match and Noise match, single-ended and differential LNAs.					
Unit III	FEEDBACK SYSTEMS AND POWER AMPLIFIERS				9
Feedback Systems: Stability of feedback systems, Gain and phase margin, Root-locus techniques, Time and Frequency domain considerations, Compensation - Power Amplifiers: General model - Class A, AB, B, C, D, E and F amplifiers - Linearization Techniques - Efficiency boosting techniques, ACPR metric.					
Unit IV	FILTERS, OSCILLATORS AND MIXERS				9
Overview - basic resonator and filter configuration, special filter realizations, filter implementation - Basic oscillator model, high-frequency oscillator configuration, Colpitt's oscillator - basic characteristics of mixers, single and double-balanced mixers					
Unit V	PLL AND FREQUENCY SYNTHESIZERS				9
PLL: Linearized Model, Noise properties, Phase detectors, Loop filters and Charge pumps- Frequency Synthesizers: Integer-N frequency synthesizers - Direct Digital Frequency Synthesizers.					
Total periods:45					
Text Books:					
2. Lee T, Design of CMOS RF Integrated Circuits, Cambridge, Second Edition, 2004.					
3. Razavi B, RF Microelectronics, Pearson Education, Second Edition, 2012					
References:					
4. Ludwig R, and Bretchko P, RF Circuit Design Theory and Applications, Prentice Hall, 2000					
5. Razavi B, Design of Analog CMOS Integrated Circuits, McGraw Hill, Second Edition, 2017.					
6. Kyung-WhanYeom, Microwave Circuit Design - A Practical Approach using ADS, Pearson Education, 2015					
Course Outcomes:					Blooms Taxonomy
CO1: Interpret the nonlinear effects in RF circuits.					Understand
CO2: Design RF circuits					Create

CO3:	To Analyze the performance of RF circuits.												Analyze		
CO4:	Apply knowledge to identify a suitable architecture and systematically design an RF System												Apply		
CO5:	Comprehensively record and report the measured data, and would be capable analyzing, interpreting the experimentally measured data and produce the conclusions												Evaluate		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	-	-	-	-	1	-	2	1	1	3
CO2	3	3	3	2	2	-	-	-	-	1	-	2	1	1	2
CO3	3	3	2	2	2	-	-	-	-	1	-	2	2	2	2
CO4	3	3	3	3	2	-	-	-	-	1	-	2	3	2	2
CO5	3	2	3	3	2	-	-	-	-	1	-	2	2	2	2

23ECE014	SIGNAL INTEGRITY		Category: PEC			
			L	T	P	C
			3	0	0	3
Prerequisites						
• Nil						
COURSE OBJECTIVES:						
• Understand characteristic impedance of transmission line and impedance matching techniques. • Understand plain signal reflection and cross talk noise in the transmission line and also explain the mathematical analysis method. • Understand Eye diagram and related measurement to test quality of Signal • Learn Jitter analysis and jitter decomposition • Work with high frequency differential signal and its applications						
Unit I	SIGNAL REFLECTION AND IMPEDANCE MATCHING TECHNIQUE					9
Phenomenon of signal reflection. Signal reflection at transmitting end. Signal reflection at branch point. Multiple reflection in transmission line. Prevention of signal reflection by using impedance matching technique.						
Unit II	CROSSTALK NOISE					9
Crosstalk definition and classification. Crosstalk mechanism. Analysis of crosstalk noise in transmission line. Main factor of cause.ng crosstalk noise.						
Unit III	DIFFERENTIAL SIGNAL TRANSMISSION CIRCUIT					9
Pros and cons of using differential signaling compared with that of single-ended signaling. High-speed differential interfaces. Theory of differential signaling. Differential signal termination techniques						
Unit IV	FREQUENCY RESPONSE OF A CIRCUIT					9
Frequency response of transmission line and circuit. Inter-symbol interference (ISI) and eye-pattern. Deterioration of a signal waveform due to ISI. Circuit techniques to prevent the deterioration. Linear time-invariant systems. Frequency response of pulse.						
Unit V	EYE DIAGRAM AND JITTER					9
Jitter Definition and Types of Jitter; Jitter decomposition; Eye diagram analysis and related measurement.						
Total periods:45						
Text books:						
1. Signal and Power integrity Simplified -Eric Bogatin, Pearson, 3rd Edition						

2. High Speed Digital Design by Howard Johnson and Martin Graham, Prentice Hall, 1st Edition															
References:															
1. High Speed Signal Propagation and Howard Johnson, Prentice Hall, 1st Edition															
Course Outcomes:													Blooms Taxonomy		
CO1: Familiarity with High speed design and related issues													Understand		
CO2: Understanding on critical design aspect													Understand		
CO3: Know about Jitter and related measurements which is critical for design.													Apply		
CO4: Practical application of high speed differential signals													Analyze		
CO5: Measurement expertise up to industry expectations													Evaluate		
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	-	-	-	-	-	3	3	2	2
CO2	3	3	3	2	2	2	-	-	-	-	-	2	3	2	2
CO3	3	3	3	2	2	2	-	-	-	-	-	2	3	2	3
CO4	3	3	3	2	2	2	-	-	-	-	-	2	2	2	2
CO5	3	3	3	3	2	2	-	-	-	-	-	2	2	2	2

23ECE015	ANTENNA AND MICROWAVE ENGINEERING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
COURSE OBJECTIVES: - To introduce and discuss the mechanism for antenna parameters, radiating principles, fundamental characteristics and design concepts of HF, UHF, Microwave antennas and arrays. - To design and analyze various passive and active microwave circuits. - To familiarize the operational principles of microwave sources and to characterize microwave networks					
Unit I	EM RADIATION AND ANTENNA PARAMETERS				9
Radiation mechanism - single wire, two wire and current distribution, Hertzian dipole, Dipole and monopole - Radiation pattern, beam width, field regions, radiation power density, radiation intensity, directivity and gain, bandwidth, polarization, input impedance, efficiency, antenna effective length and area, antenna temperature. Friis transmission equation, Radar range equation.					
Unit II	LINEAR AND PLANAR ARRAYS				9
Two element array, N-element linear array - broadside array, End fire array - Directivity, radiation pattern, pattern multiplication. Non-uniform excitation - Binomial, Chebyshev distribution, Arrays: Planar array, circular array, Phased Array antenna (Qualitative study).					
Unit III	HF, UHF AND MICROWAVE ANTENNAS				9
Wire Antennas - long wire, loop antenna - helical antenna. Yagi-Uda antenna, Frequency independent antennas - spiral and log periodic antenna - Aperture antennas – Horn antenna, Parabolic reflector antenna - Microstrip antenna					
Unit IV	MICROWAVE SOURCES				9
Microwave frequencies and applications, Microwave Tubes: TWT, Klystron amplifier, Reflex Klystron & Magnetron. Semiconductor Devices: Gunn diode, Tunnel diode, IMPATT – TRAPATT - BARITT diodes, PIN Diode.					
Unit V	MICROWAVE PASSIVE COMPONENTS AND CIRCUITS				9

Microwave Networks - ABCD, 'S' parameter and its properties. E-Plane Tee, H-Plane Tee, Magic Tee and Multi-hole directional coupler. Principle of Faraday rotation, isolator, circulator and phase shifter-T junction and resistive power divider, Wilkinson power divider, branch line coupler (equal & unequal), Rat Race Coupler															
															Total periods:45
Text Books:															
1. C.A. Balanis, Antenna Theory - Analysis and Design, 2016, 4th Edition, Wiley& Sons, New York, USA.															
2. D. M. Pozar, Microwave engineering, 2013, 4th Edition, Wiley & Sons, USA															
References:															
1. R Ludwig, Gene Bogdanov, RF Circuit design: Theory and applications, 2013, 2 nd Edition, Pearson India.															
2. John D Krauss, Antennas for all Applications, 2008, 4th Edition, Tata McGraw Hill, India															
Course Outcomes:													Blooms Taxonomy		
CO1: Examine the radiation mechanism of electromagnetic fields and identify the various antenna parameters													Analyze		
CO2: Apply the design criteria to Linear and Planar arrays													Apply		
CO3: Apply the design criteria to HF, UHF, microwave antenna and arrays													Apply		
CO4: Comprehend the performance of different microwave sources and ferrite devices													Understand		
CO5: Design and analyze the various passive components and circuits at microwave frequencies													Create		
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	–	–	–	–	2	–	1	3	2	1
CO2	3	2	3	2	2	–	–	–	1	1	–	1	3	2	1
CO3	3	2	3	2	2	–	–	–	1	1	–	2	3	3	1
CO4	2	3	2	3	1	–	–	–	–	2	–	2	2	3	2
CO5	3	3	3	3	2	–	–	–	1	2	–	3	3	3	3

23ECE16	MICS AND RF SYSTEM DESIGN	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
COURSE OBJECTIVES: - To study the characteristics of Active components and applications. - To design the RF filter and analyze the circuits operated at millimeter wavelength - To understand the basics of Microwave integrated circuits - To learn the concepts of non reciprocal components for MICs - To design the antenna and analyze its performance using measurement techniques					
Unit I	ACTIVE RF COMPONENTS AND APPLICATIONS				9
RF diodes, BJT, RF FET'S, High electron mobility transistors, matching and biasing networks- impedance matching using discrete components, microstripline matching networks, amplifier classes of operation and biasing networks.					
Unit II	RF FILTER DESIGN				9
Overview, Basic resonator and filter configuration, special filter realizations, smith chart based filter design, coupled filter.					
Unit III	INTRODUCTION TO MICROWAVE INTEGRATED CIRCUITS				9

Overview of ABCD and S parameters - Overview of Planar transmission lines (Stripline, Microstrip line, Slotline, CPW, Finline)-Design Parameters for Strip Line And Microstripline- Active Device Technologies- Design Approaches Multichip Module Technology- Substrates															
Unit IV		NON-RECIPROCAL COMPONENTS FOR MICs												9	
Microstrip on Ferrimagnetic substrates, Microstrip circulators. Isolators and phase shifters, Design of microstrip circuits – high power and low power circuits.															
Unit V		INTEGRATED ANTENNA DESIGN AND MEASUREMENTS												9	
Integrated Antenna Design- Photonic Band Gap Antennas - Micro Machined Antenna - Micro Electro Mechanical System Antennas - Test Fixture Measurements - Probe Station Measurements - Thermal and Cryogenic Measurements- Experimental Field Probing Techniques.															
Total periods:45															
Text books:															
1. Reinhold Ludwig and Powel Bretchko, RF Circuit Design – Theory and Applications, Pearson Education Asia, First Edition, 2001.(Unit – I, II).															
2. Bharathi Bhat, Shiban K. Koul, “Stripline-like Transmission Lines for Microwave Integrated Circuits”, New Age International Pvt Ltd Publishers, 2007.(Unit –III ,V)															
3. Gupta KC and Amarjit Singh, “Microwave Integrated circuits”, Wiley Eastern, 1974.(Unit – IV)															
References:															
1. MathewM. Radmanesh, Radio Frequency & Microwave Electronics, Pearson Education Asia, Second Edition, 2002															
2. Ulrich L. Rohde and David P. NewKirk, RF / Microwave Circuit Design, John Wiley & Sons USA 2000.															
3. RolandE. Best, Phase – Locked Loops: Design, simulation and applications, McGraw Hill Publishers 5TH edition 2003															
4. David Pozar ,Microwave Engineering, Addison Wesley 3rd Edition															
5. Ravender Goyal, “Monolithic MIC; Technology & Design”, Artech House, First Edition 1989															
Course Outcomes:													Blooms Taxonomy		
CO1:		Apply knowledge of S parameter theory to any RF active component design circuit for obtaining performance measure												Apply	
CO2:		Analyze microwave circuits for filters design.												Analyze	
CO3:		Evaluate the performance of any practical Microwave integrated circuits												Evaluate	
CO4:		Create communication circuits and subsystems with practical design parameters for non- reciprocal components in MICs												Understand	
CO5:		Design microwave integrated antenna design circuit for the required Performance using professional software tools.												Create	
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	2	2	-	2	1	-	1	3	2	2
CO2	3	3	3	2	3	2	2	-	2	1	-	1	3	2	2
CO3	3	3	2	2	3	2	2	-	2	1	-	1	3	2	2
CO4	3	3	2	2	3	2	2	-	2	1	-	1	3	2	2
CO5	3	3	1	2	3	2	2	-	2	1	-	1	3	2	2

23ECE17	EMI / EMC PRE COMPLIANCE TESTING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					

• Nil															
COURSE OBJECTIVES:															
• To introduce the basic concepts of Electromagnetic Interference															
• To teach the importance of measurement device for EMI.															
• To explain the EMI coupling & control principles															
• To understand receivers & Analyzer functionalities															
• To impart knowledge on design issues in EMI/EMC															
Unit I		NATURE AND ORIGINS OF ELECTROMAGNETIC COMPATIBILITY												9	
Introduction- Visualising the EMI problem-Source of EMI, EMI coupling to victim equipment, Inter system and Intra system EMI, EMC standards and specifications															
Unit II		TYPES of EMI COUPLING												9	
Conducted, radiated and transient coupling; Common ground impedance coupling; Common mode and ground loop coupling; Differential mode coupling, Near field cable to cable coupling; Field to cable coupling, Power mains and Power supply coupling; Transient EMI															
Unit III		MEASUREMENT DEVICES FOR EMI												9	
Introduction – Measurement by direct connection, Inductively coupled devices, EMC antennas – Basic antenna parameters, Antennas for radiated emission testing, Wideband antennas - Magnetic field antennas, Type of antennas used in susceptibility testing															
Unit IV		RECEIVERS, ANALYZERS AND MEASUREMENT EQUIPMENT												9	
EMI receiver, Spectrum Analyzers, RF power meter Frequency meters. Standards requiring immunity tests, Automatic EMC tests, Electromagnetic transient testing, Transient types, Continuous and transient signal, ESD-electrostatic discharge															
Unit V		PRE-COMPLIANCE TESTING TO AVOID EMC PROBLEMS												9	
Need for Pre-Compliance Testing; Intersystem and Intrasystem EMC - Developing an approach to EMC design - Process flow chart, - EMC strategy – Self certification; Solutions to avoid EMC: ESD Shielding, EMI Filters; Grounding; Bonding, Isolation transformer, Transient suppressors; EMI Suppression Cables.															
Total periods:45															
Text Books:															
1. David Morgan , "A Handbook for EMC Testing and Measurement", IET Electrical Measurement, 2012															
2. Tim Williams , "EMC for Product Designers", 5th Edition, Newnes Elsevier, 2017															
References:															
1. I.V.P.Kodali, “Engineering EMC Principles, Measurements and Technologies”, IEEE Press, Newyork, 1996															
2. Paul, C.R., “Introduction to Electromagnetic Compatibility”, 2nd ed., Wiley (2010)															
3. David K. Cheng, “Field and Wave Electromagnetics”, 2nd ed. Pearson Education, 2009															
Course Outcomes:													Blooms Taxonomy		
CO1: Perceive the various types and mechanisms of Electromagnetic Interference													Understand		
CO2: Propose a suitable EMI mitigation technique													Create		
CO3: Evaluate EMI coupling & control principles													Evaluate		
CO4: Explain the importance receivers & Analyzer functionalities													Understand		
CO5: Inspect the design issues in EMI/EMC													Analyze		
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	1	-	-	1	-	1	2	1	2
CO2	3	3	2	1	3	2	1	-	-	1	-	2	2	2	2
CO3	3	3	3	3	2	2	1	-	-	1	-	2	2	2	2
CO4	3	3	2	2	2	2	1	-	-	1	-	2	2	1	2
CO5	3	-	3	3	2	2	1	-	-	1	-	2	2	2	2

23ECE18	RFID SYSTEM DESIGN AND TESTING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
COURSE OBJECTIVES: - To discuss the fundamentals of near field and far field RFID communications - To articulate the standards and protocols used in RFID systems - To describe the operating principles of RFID tag and reader - To introduce the security aspects and system architecture of RFID systems - To illustrate the industrial and scientific applications of RFID systems					
Unit I	INTRODUCTION				9
RFID Principles: Near-field based RFID – Properties of Magnetic field – Far-field based RFID – Properties of Backscatter RF Systems – Modulation techniques – Frequency based property comparison of RFID Systems					
Unit II	RFID STANDARDS AND PROTOCOLS				9
RFID Industry standards: EPC global – ISO15693 Vicinity cards and RFID – ISO14443 Proximity cards and RFID – The NFC forum – Reading collocated RFID tags: Query Tree protocol – Query Slot protocol					
Unit III	OPERATING PRINCIPLES				9
RFID Tag components: RFID tag types – the 1-Bit Transponder and Chipless Tags – RFID readers and middleware component – Communication fundamentals: Coupling, Data encoding, multi-path effect – Tag, Reader and sensor communication					
Unit IV	DATA INTEGRITY AND SECURITY				9
The checksum procedure – Multiaccess procedures – Attacks on RFID Systems – Protection by Cryptographic measures					
Unit V	RFID ENABLED SENSORS AND APPLICATIONS				9
RFID enabled Sensors: Antenna design challenges – IC design – Integration of sensors and RFID – Power consumption and Link budget. Applications: Contactless smart cards – Access control – Electronic passport – Industrial Automation – Medical applications – Challenges and opportunities.					
Total periods:45					
Text Books:					
1. Roy Want, RFID Explained, Springer 2022.					
2. Amin Rida, Li Yang, Manos M. Tentzeris, RFID Enabled Sensor Design and Applications, Artech House, 2010					
References:					
1. Klaus Finkenzeller, RFID Handbook, 3rd Edition, Wiley, 2010					
2. Syed Ahson, Mohammad Ilyas, RFID Handbook, CRC Press, 2008					
3. Paris Kitsos, Security in RFID and Sensor Networks, CRC Press, 2016.					
Course Outcomes:					Blooms Taxonomy
CO1:	Classify RFID systems based on frequency, architecture and performance				Apply
CO2:	Define standards for RFID technology				Understand
CO3:	Illustrate the operation of various components of RFID systems				Apply
CO4:	Describe the privacy and security issues in RFID Systems				Understand
CO5:	Discuss the construction and applications of RFID enabled sensor				Apply
CO-PO Mapping					

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

VERTICAL 4: BIO MEDICAL TECHNOLOGIES

23ECE019	WEARABLE DEVICES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To know the hardware requirement of wearable systems - 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, Inductive plethysmography, Impedance plethysmography, pneumography, 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 Bonfiglio and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011					
2. Zhang and Yuan-Ting, Wearable Medical Sensors and Systems, Springer, 2013.					
3. Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014					

4. Mehmet R. Yuce and Jamil Y. Khan, Wireless Body Area Networks Technology, Implementation applications, Pan Stanford Publishing Pte.Ltd, Singapore, 2012															
References:															
1. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.															
2. Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.															
Course Outcomes:													Blooms Taxonomy		
CO1: To Describe the concepts of wearable system.													Understand		
CO2: To Explain the energy harvestings in wearable device.													Understand		
CO3: To Use the concepts of BAN in health care.													Apply		
CO4: To Illustrate the concept of smart textile													Apply		
CO5: To Compare the various wearable devices in healthcare system													Analyze		
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

23ECE20	HUMAN ASSIST DEVICES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
Course Objectives: The student should be made • To study the role and importance of machines that takes over the functions of the heart and lungs, • To study various mechanical techniques that helps a non-functioning heart. • To learn the functioning of the unit which does the clearance of urea from the blood • To understand the tests to assess the hearing loss and development of electronic devices to compensate for the loss. • To study about recent techniques used in modern clinical applications					
Unit I	HEART LUNG MACHINE AND ARTIFICIAL HEART				9
Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Schematic for temporary bypass of left ventricle.					
Unit II	CARDIAC ASSIST DEVICES				9
Assisted through Respiration, Right and left Ventricular Bypass Pump, Auxiliary ventricle, Open Chest and Closed Chest type, Intra Aortic Balloon Pumping, Prosthetic Cardiac valves, Principle of External Counter pulsation techniques					
Unit III	ARTIFICIAL KIDNEY				9
Indication and Principle of Haemodialysis, Membrane, Dialysate, types of filter and membranes, Different types of hemodialyzers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.					
Unit IV	RESPIRATORY AND HEARING AIDS				9

Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, SISI, masking techniques, wearable devices for hearing correction.															
Unit V		RECENT TRENDS												9	
Transcutaneous electrical nerve stimulator, bio-feedback, Diagnostic and point-of-care platforms.															
Total periods: 45															
Text Books:															
1. Gray E Wnek, Gray L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering –Marcel Dekker Inc New York 2004.															
2. John. G . Webster – Bioinstrumentation - John Wiley & Sons (Asia) Pvt Ltd - 2004															
3. Joseph D.Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press, 2006															
References:															
1. Andreas.F. Von racum, “Hand book of bio material evaluation”, Mc-Millan publishers, 1980.															
2. Gray E Wnek, Gray L Browlin, “Encyclopedia of Biomaterials and Biomedical Engineering” Marcel Dekker Inc New York 2004.															
3. D.S. Sunder, “Rehabilitation Medicine”, 3rd Edition, Jaypee Medical Publication, 2010															
Course Outcomes: On successful completion of this course, the student will be able														Blooms Taxonomy	
CO1: Explain the principles and construction of artificial heart														Understand	
CO2: Understand various mechanical techniques that improve therapeutic technology														Understand	
CO3: Explain the functioning of the membrane or filter that cleanses the blood.														Understand	
CO4: Describe the tests to assess the hearing loss and development of wearable devices for the same.														Understand	
CO5: Analyze and research on electrical stimulation and biofeedback techniques in rehabilitation and physiotherapy.														Analyze	
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	-	-	-	-	-	3	3	1	2
CO2	3	3	3	2	2	3	-	-	-	-	-	2	2	2	2
CO3	3	3	3	3	3	2	-	-	-	-	-	3	3	3	2
CO4	3	3	1	1	3	2	-	-	-	-	-	2	3	1	3
CO5	3	3	3	3	3	3	-	-	-	-	-	2	3	3	2

23ECE21	THERAPEUTIC EQUIPMENT	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: The student should be made - To learn the principles of cardiac assist devices. - To understand the need and use of extracorporeal devices, and the use of lasers in medicine. - To enable the students to gain knowledge on the working of therapeutic clinical equipment.					
Unit I	CARDIAC AND RESPIRATORY THERAPY EQUIPMENT				9

Cardiac Pacemaker: Internal and External Pacemaker– Programmable pacemakers. Cardiac Defibrillators: AC and DC Defibrillator- Internal and External Defibrillators - Protection Circuit, Defibrillator analyzers. Cardiac ablation catheter. Types of Ventilators – Pressure, Volume, and Time controlled. Basic principles of electromechanical, pneumatic and electronic ventilators, Patient Cycle Ventilators, Ventilator testing. Humidifiers, Nebulizers, Inhalators.																
Unit II		BIOMECHANICAL THERAPEUTIC EQUIPMENT												9		
Electro diagnosis, Therapeutic radiation, Electrotherapy, Electrodes, Stimulators for Nerve and Muscle, Functional Electrical Stimulation. peripheral nerve stimulator, ultrasonic stimulators, Stimulators for pain and relief - Inferential Therapy Unit, TENS. GAIT Assessment and Therapy. Continuous Passive Motion unit, Cervical / Lumber Traction Machine -Traction Table.																
Unit III		BODY CARE EQUIPMENT												9		
Skin Treatment: Ultrasonic spot remove, vacuum therapy unit, Skin tightening, Wrinkle Reduction, Facial and Rejuvenation. Laser hair therapy machine. Body Slimmer/Shaper – Deep Heat Therapy, Massager, Fitness – Treadmill, Bike.																
Unit IV		DENTAL CARE EQUIPMENT												9		
Dental Chair - Dental Hand pieces and Accessories: Evolution of rotary equipment, Low-speed handpiece, High-speed hand piece, Hand piece maintenance. Vacuum and Pneumatic techniques: Vacuum techniques, Oral evacuation systems, Vacuum pump, Pneumatic techniques, Dental compressor. Decontamination Unit and constant fumigation unit. Dental Radiography: Dental X-ray Machine.																
Unit V		HEAT & PHOTON THERAPY EQUIPMENT												9		
High frequency heat therapy, Principle, Short wave diathermy, Microwave diathermy, Ultrasonic therapy, Lithotripsy. Therapeutic UV and IR Lamps. Basic principles of Biomedical LASERS: Applications of lasers in medicine, CO2laser, He-Ne laser, Nd-YAG and Ruby laser.																
Total periods: 45																
Text Books:																
1. Khandpur. R.S.,“Handbook of Biomedical Instrumentation”. Second Edition. Tata McGrawHill Pub. Co., Ltd. 2003.																
2. John.G.Webster. “Medical Instrumentation, Application and Design”. Fourth Edition.Wiley &s ons, Inc., NewYork. 2009.																
References:																
1. Leslie Cromwell, Fred. J. Weibell & Erich. A.Pfeiffer. “Biomedical Instrumentation and Measurements”. Second Edition. Prentice Hall Inc.2000.																
2. John Low & Ann Reed. “Electrotherapy Explained, Principles and Practice”. Second Edition. Butterworth Heinemann Ltd. 2000.																
3. Joseph. J. Carr, John Michael Brown, “Introduction to Biomedical Equipment Technology”, Prentice Hall and Technology, 2008.																
Course Outcomes: On successful completion of this course, the student will be able														Blooms Taxonomy		
CO1: Suggest suitable therapeutic devices for ailments related to cardiology, pulmonology, neurology, etc														Apply		
CO2: Comprehend the principles of body care equipment														Understand		
CO3: Understand the operation of dental care equipment.														Understand		
CO4: Analyze the different types of therapies for suitable applications.														Analyze		
CO5: Appreciate the application of lasers in biomedical applications.														Evaluate		
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	3	2	-	-	-	-	2	3	3	3	
CO2	3	3	3	3	2	3	2	-	-	-	-	2	3	2	2	
CO3	3	3	3	3	2	3	2	-	-	-	-	2	3	2	2	
CO4	3	2	2	3	2	3	2	-	-	-	-	2	2	3	2	
CO5	3	3	2	3	2	3	2	-	-	-	-	2	2	3	3	

23ECE23	MEDICAL IMAGING SYSTEMS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: The student should be made - To understand the generation of X-ray and its uses in Medical imaging. - To describe the principle of Computed Tomography. - To know the techniques used for visualizing various sections of the body. - To learn the principles of different radio diagnostic equipment in Imaging. - To discuss the radiation therapy techniques and radiation safety					
Unit I	X RAYS				9
Nature of X-rays- X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X-Ray Tube, the collimator, Bucky Grid, power supply, Digital Radiography - discrete digital detectors, storage phosphor and film scanning, X-ray Image Intensifier tubes – Fluoroscopy – Digital Fluoroscopy. Angiography, cine Angiography. Digital subtraction Angiography. Mammography.					
Unit II	COMPUTED TOMOGRAPHY				9
Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors – Viewing systems – spiral CT scanning – Ultra fast CT scanners. Image reconstruction techniques – back projection and iterative method					
Unit III	MAGNETIC RESONANCE IMAGING				9
Fundamentals of magnetic resonance- properties of electromagnetic waves : speed , amplitude, phase, orientation and waves in matter - Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession – Induction of magnetic resonance signals – bulk magnetization – Relaxation processes T1 and T2. Block Diagram approach of MRI system – system magnet (Permanent, Electromagnet and Superconductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, Electronic components, fMRI.					
Unit IV	NUCLEAR IMAGING				9
Radioisotopes- alpha, beta, and gamma radiations. Radio Pharmaceuticals. Radiation detectors – gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors, Gamma camera – Principle of operation, collimator, photomultiplier tube, X-Y positioning circuit, pulse height analyzer. Principles of SPECT and PET					
Unit V	RADIATION THERAPY AND RADIATION SAFETY				9
Radiation therapy – linear accelerator, Telegamma Machine. SRS – SRT – Recent Techniques in radiation therapy – 3D CRT – IMRT – IGRT and Cyber knife – radiation measuring instruments Dosimeter, film badges, Thermo Luminescent dosimeters – electronic dosimeter – Radiation protection in medicine – radiation protection principles					
Total periods: 45					
Text Books:					
1. Isaac Bankman, I. N. Bankman , Handbook Of Medical Imaging: Processing and Analysis(Biomedical Engineering),Academic Press,2000					
2. Jacob Beutel (Editor), M. Sonka (Editor), Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis , SPIE Press 2000					
3. Khin Wee Lai, DyahEkashantiOctorinaDewi “Medical Imaging Technology”, Springer Singapore, 2015					
References:					
1. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw – Hill, New Delhi, 2003.					
2. Dougherty, Geoff (Ed.), “Medical Image Processing - Techniques and Applications “, Springer-Verlag New York, 2011					
Course Outcomes: On successful completion of this course, the student will be able					Blooms Taxonomy
CO1:	Describe the working principle of the X-ray machine and its application.				Understand

CO2:	Illustrate the principle computed tomography												Apply		
CO3:	Interpret the technique used for visualizing various sections of the body using Magnetic Resonance Imaging.												Analyze		
CO4:	Demonstrate the applications of radionuclide imaging.												Apply		
CO5:	Analyze different imaging techniques and choose appropriate imaging equipment for better diagnosis and outline the methods of radiation safety.												Analyze		
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	-	-	-	-	-	3	2	3	2
CO2	3	3	3	2	2	1	-	-	-	-	-	2	2	3	2
CO3	3	3	2	2	2	2	-	-	-	-	-	2	2	2	1
CO4	3	3	3	2	2	1	-	-	-	-	-	2	2	2	1
CO5	3	3	3	3	2	2	-	-	-	-	-	2	2	2	1

23ECE23	BRAIN COMPUTER INTERFACE AND APPLICATIONS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: The student should be made - To understand the basic concepts of brain computer interface - To study the various signal acquisition methods - To study the signal processing methods used in BCI					
Unit I	INTRODUCTION TO BCI				9
Fundamentals of BCI – Structure of BCI system – Classification of BCI – Invasive, Non-invasive and Partially invasive BCI – EEG signal acquisition - Signal Preprocessing – Artifacts removal.					
Unit II	ELECTROPHYSIOLOGICAL SOURCES				9
Sensorimotor activity – Mu rhythm, Movement Related Potentials – Slow Cortical Potentials-P300 - Visual Evoked Potential - Activity of Neural Cells - Multiple Neuromechanisms					
Unit III	FEATURE EXTRACTION METHODS				9
Time/Space Methods – Fourier Transform, PSD – Wavelets – Parametric Methods – AR,MA,ARMA models – PCA – Linear and Non-Linear Features.					
Unit IV	FEATURE TRANSLATION METHODS				9
Linear Discriminant Analysis – Support Vector Machines - Regression – Vector Quantization– Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks.					
Unit V	APPLICATIONS OF BCI				9
Functional restoration using Neuroprosthesis - Functional Electrical Stimulation, Visual Feedback and control - External device control, Case study: Brain actuated control of mobile Robot.					
Total periods: 45					
Text Books:					
1. Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, “Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction”, Springer, 2010.					
References:					
1. R. Spehlmann, “EEG Primer”, Elsevier Biomedical Press, 1981.					
2. Arnon Kohen, “Biomedical Signal Processing”, Vol I and II, CRC Press Inc, Boca Rato, Florida, 1986.					
3. Bishop C.M., “Neural Networks for Pattern Recognition”, Oxford, Clarendon Press, 1995					

Course Outcomes: On successful completion of this course, the student will be able													Blooms Taxonomy		
CO1: Describe BCI system and its potential applications.													Understand		
CO2: Analyze event related potentials and sensory motor rhythms.													Analyze		
CO3: Compute features suitable for BCI.													Apply		
CO4: Design classifier for a BCI system.													Create		
CO5: Implement BCI for various applications.													Apply		
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	-	-	-	-	-	2	3	3	3
CO2	3	3	3	2	2	1	-	-	-	-	-	2	2	2	2
CO3	3	3	3	2	2	1	-	-	-	-	-	1	1	2	2
CO4	3	3	3	1	3	2	-	-	-	-	-	2	2	3	3
CO5	3	3	3	3	3	2	-	-	-	-	-	2	2	2	2

23ECE24	BODY AREA NETWORKS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: The student should be made - To know the hardware requirement of BAN - To understand the communication and security aspects in the BAN - To know the applications of BAN in the field of medicine					
Unit I	INTRODUCTION				9
Definition, BAN and Healthcare, Technical Challenges- Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability, BAN Architecture – Introduction.					
Unit II	HARDWARE FOR BAN				9
Processor-Low Power MCUs, Mobile Computing MCUs, Integrated processor with radio transceiver, Memory, Antenna-PCB antenna, Wire antenna, Ceramic antenna, External antenna, Sensor Interface, Power sources- Batteries and fuel cells for sensor nodes.					
Unit III	WIRELESS COMMUNICATION AND NETWORK				9
RF communication in Body, Antenna design and testing, Propagation, Base Station-Network topology-Stand –Alone BAN, Wireless personal Area Network Technologies-IEEE 802.15.1, IEEE P802.15.13, IEEE 802.15.14, Zigbee.					
Unit IV	COEXISTENCE ISSUES WITH BAN				9
Interferences – Intrinsic - Extrinsic, Effect on transmission, Counter measures- on physical layer and data link layer, Regulatory issues-Medical Device regulation in USA and Asia, Security and Self-protection-Bacterial attacks, Virus infection, Secured protocols, Self-protection.					
Unit V	APPLICATIONS OF BAN				9
Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrhythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill.					
Total periods: 45					
Text Books:					
1. Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkata Subramanian, “Body Area Networks Safety, Security, and Sustainability”, Cambridge University Press, 2013					
2. Mehmet R. Yuce, Jamil Y.Khan, “Wireless Body Area Networks Technology,					

Implementation, and Applications”, Pan Stanford Publishing Pte. Ltd., Singapore, 2012.															
References:															
1. Zhang, Yuan-Ting, “Wearable Medical Sensors and Systems”, Springer, 2013.															
2. Guang-Zhong Yang(Ed.), “Body Sensor Networks”, Springer, 2006.															
3. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011.															
Course Outcomes: On successful completion of this course, the student will be able														Blooms Taxonomy	
CO1:	Comprehend and appreciate the significance and role of this course in the present contemporary world													Understand	
CO2:	Design a BAN for appropriate application in medicine.													Create	
CO3:	Assess the efficiency of communication and the security parameters.													Evaluate	
CO4:	Understand the need for medical device regulation and regulations followed in various regions													Understand	
CO5:	Extend the concepts of BAN for medical applications.													Apply	
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	1	1	-	-	-	-	1	3	3	3
CO2	3	3	3	3	1	2	2	-	-	-	-	1	3	3	3
CO3	3	2	1	1	1	1	1	-	-	-	-	1	3	3	3
CO4	2	2	1	1	1	1	1	-	-	-	-	1	3	3	3
CO5	2	2	1	1	1	2	2	-	-	-	-	1	3	3	3

VERTICAL 5: UNDERWATER TECHNOLOGIES

23ECE25	UNDERWATER INSTRUMENTATION SYSTEM	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To learn basics of underwater vehicle control system - To know the basic sensors and transducers used in underwater vehicles - To learn the types of communication systems - To learn different types of underwater vehicles and their applications. - To learn about subsea battery and power management system					
Unit I	INTRODUCTION ON DATA ACQUISITION AND CONTROL SYSTEM				9
Introduction on PLC& various Input / Output modules, SCADA and HMI, Real time Controller, Signal conditioning circuits and associated components: Ethernet Modem, SMPS, Media converters, Ethernet switches, Fuses & Fuse holders, Power supply units, Power management system, Pressure Compensator, Pressure compensated batteries, Volve amplifiers, Actuators, Types of valves- proportional valves and solenoid valves, Types of relays- Solid State Relay and Electromagnetic relay, Pressure casing for underwater DACS,					
Unit II	UNDERWATER SENSORS AND TRANSDUCERS				9
Navigation and Auxiliary sensors and Transducers Inertial Navigation System, FOG/RLG, GPS, DGPS, Gyroscope, Motion Reference Unit, Doppler Velocity Log, Acoustic Transponder, Beacon, Positioning System- LBL, SBL, SSBL, Underwater Encoder, Proximity switches, Conductivity sensor, Temperature sensor, Depth sensor, Accelerometer, Tilt sensor, LVDT, Vaccum sensor, Current meters. Scientific Instruments Acoustic Doppler Current Profiler, Echosounder, Hydrophones, SONAR- Forward looking SONAR, Bottom Looking SONAR, Altimeter, Swell and wave sensor, PH sensor, Turbidity sensor, Oxygen sensor, Water samplers, Nitrogen sensor, CTD					

Unit III	TELEMETRY SYSTEM	9													
Telemetry system for tethered vehicles, Fiber optic communication, Single mode fiber, Multimode fiber, Fiber optics in oceanographic applications, Basis of optical fiber transmission, Fiber losses and signal attenuation, Slip rings, Umbilical cables, Underwater cables and connectors, Field installable Termination Assembly Acoustic communication: Acoustic wave propagation, Optical communication, Satellite communication- Iridium, Inmarsat, Argos for surface Tracking.															
Unit IV	TYPES OF UNDERWATER VEHICLES	9													
Type of vehicles, manned and unmanned vehicles, Tethered and untethered vehicles, Remotely Operable Vehicle (ROV), Autonomous Underwater vehicle (AUV), Gliders, Solar powered Gliders, Manned submersible, Submarines, Deep Sea Rescue vehicle (DSRV), Various Propulsion systems.															
Unit V	CASE STUDY	9													
Design of low power DAC system for portable instrument, Design of power module for autonomous system, Design consideration on wireless sensor network and its important, MEMS systems used in underwater systems and its merits and demerits.															
Total periods: 45															
Text Books:															
1. The Ocean engineering Handbook, Ferial El- Hawary															
2. Guidance and control of Ocean Vehicles, Thor I Fossen															
3. Instrumentation and metrology in Oceanography by Marc Le mann															
References:															
1. Jane’s Underwater technology,, Technology and applications of AUV by Gwyn Griffiths															
2. Fundamentals of Marine Vehicle Control, Karl Von Ellenrieder															
3. Instrumentation & control G J Roy															
4. Handbook of ocean and underwater engineering, Myers, J J; Holm, C H; McAllister, R F															
5. Underwater communication and Network, Yi Lou, Niaz Ahmed															
Course Outcomes:													Blooms Taxonomy		
CO1: Design of DAC system for various underwater Applications													Understand		
CO2: Understand sensors used underwater and their working principle													Understand		
CO3: Undersatnd about Underwater communication system and their application													Remember		
CO4: Knowledge about different types of underwater vehicles													Understand		
CO5: Subsea battery and Battery Management System													Understand		
CO-PO 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

23ECE26	UNDERWATER IMAGING SYSTEMS AND IMAGE PROCESSING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
• Nil					

Course Objectives:		
- To learn the fundamental components of optical imaging - To understand the challenges involved in Underwater imaging - To understand the fundamental of Ocean Acoustics - To Understand the principle of image processing techniques - To Learn the SONAR Systems and various applications		
Unit I	FUNDAMENTAL COMPONENTS OF OPTICAL IMAGE PROCESSING SYSTEM	9
Fundamentals and application of image processing, Human and Computer Vision, Introduction on Digital Camera: Focal length, Aperture, Shutter Speed, Spatial Resolution, Underwater lights and its importance, Halogen, LED, Colour Temperature, lumens, Beam angle. Image File format: JPEG, PNG, TIFF, BMP, GIF.		
Unit II	OPTICAL IMAGE PROCESSING	9
Image Formation, Digitization, Sampling and Quantization, Geometric Transformation, Interpolation, Image Reconstruction, Spatial Filtering, Histogram, Binary Image, Color Fundamentals, Color transformations, Color Interpolation, Morphology, Image segmentation, Pattern Recognition. Challenges involved in underwater optical imaging		
Unit III	FUNDAMENTALS OF UNDERWATER ACOUSTICS	9
Acoustic waves, Acoustic pressure, Velocity and density, Frequency and wavelength, Intensity and power, Logarithmic notation- Decibels, absolute references and levels, Source Level, Basics of propagation losses, Target Strength, Back scattering, Acoustic noise, Multiple paths, Doppler effect, Time characteristics of echoes, Active and passive sonar equations, Underwater electro acoustic transducers- projectors and hydrophones, General Structure of SONAR systems		
Unit IV	SONAR SIGNAL PROCESSING	9
Spatial signals-Signals in space and time, Co-ordinate systems, Propagating waves, Wave number- frequency space, Finite continuous apertures, Spatial sampling, Directivity, Beamforming, Time and frequency domain beamforming, Array gain, Angular resolution, Transmitting signals- Narrowband Vs Chirp, Matched filtering, Range resolution, Time Varying Gain (TVG), Signal intensity to image conversion.		
Unit V	DIFFERENT TYPES OF SONAR SYSTEMS	9
Passive and active sonars, Single beam echo sounder, Multi beam echo sounder, Sub-bottom profiler, Sediment profiler, Side scan sonar, Synthetic aperture sonar, Forward looking sonar.		
Total periods: 45		
Text Books:		
1. Bernd Jahne, "Digital Image processing, Sixth Edition, Springer, 2005		
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB, Third Edition, Gatesmark Publishing, 2020		
3. P.K. Thiruvikraman, "A Course on Digital Image processing with MATLAB, First Edition, IOP Publishing, 2020		
References:		
1. Tinku & Ajoy K. Ray, "Image Processing principles & Applications, First Edition, Wiley- Interscience, 2005		
2. Xavier Lurton, "An Introduction to Underwater Acoustics (Principles and applications), Second Edition, Springer, 2010		
3. Don H. Johnson and Dan E. Dudgeon, "Array Signal Processing: Concepts and Techniques, First Edition, Prentice Hall, 1993		
4. Harry L. Van Trees, "Optimum Array Processing, First Edition, Wiley-Interscience, 2002		
5. Richard O. Nielsen, "Sonar Signal Processing, First Edition, Artech House, 1991		
6. A. D. Waite, "SONAR for Practicing Engineers, Third Edition, Wiley, 2002		
Course Outcomes:		Blooms Taxonomy
CO1:	Understand the techniques for underwater imaging	Understand
CO2:	Understand the fundamentals of underwater acoustics and ambient noise	Understand
CO3:	Exposer for array processing techniques for underwater imaging applications	Understand
CO4:	Design of Filter and impedance matching circuits.	Understand
CO5:	Know about SONAR system and its applications.	Understand
CO-PO Mapping		

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

23ECE27	UNDERWATER COMMUNICATION	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To learn about fiber optic communication for underwater application - To learn underwater MI communication and sensor networking - To understand underwater acoustic communication - To understand the challenges in underwater communication - To learn underwater cables and handing system for various application					
Unit I	UNDERWATER FIBRE OPTICS COMMUNICATION				9
Basics of Fibre Optics communication: Working Principle, Single Mode, Multi-Mode, Effect on Fibre bending, Standard FO Connectors, Cable Requirement for Underwater Application, Cable Characteristics, Basic design for Electro-Optical(E-O) Underwater Cable, Handling system for E-O cables, Optical slip ring and its application, An insight into Fibre Optic Telemetry					
Unit II	UNDERWATER OPTICAL COMMUNICATION				9
Introduction, Classification of Underwater Wireless Optical Communication Links, Underwater Optical Communication (UWOC) System: Modulation, Coding, Light Source Technology, Common Lasers in UWOC, Signal Detectors and its merits and demerits, Alignment and Compensation, UWC Network, Absorption and Scattering Losses, UWOC Channel Modeling, UWOC Link Turbulence, Noise in the UWOC Channel. UWOC Networks.					
Unit III	UNDERWATER MI COMMUNICATION & SENSOR NETWORKS				9
Fundamental Principles of Magnetic Induction, Basic Element of Magnetism, Magnetic Induction, Lenz’s Law, Mutual and Self Induction, Inductive and Capacitive Reactance of the coil, MI Communication System: MI Coil, Matching Network, Communication Block: MI Wireless Sensor Networks: UW sensor network Application and Its Architecture, Localization, Medium Access protocols, Routing Protocols, Cross-layer Protocols, Recent trend on MI communication					
Unit IV	BASIC PRINCIPLES OF UNDERWATER ACOUSTIC COMMUNICATION				9
Ocean Acoustic environment; Measuring sound levels and relevant units; Sound propagation in the ocean – sound velocity profiles in the deep water and shallow water Speed of underwater sound, Underwater Sound Transmission Loss, Acoustic Field Model: Ray Theory Model, Structure and Performance of UWAC System: Basic Structure of UWAC System, Performance Indicators of UWAC System, Characteristics of the UWA Channel.					
Unit V	UNDERWATER ACOUSTIC NETWORK TECHNOLOGY				9
Basics on Underwater Acoustic Modem and its construction, Bandwidth and its limitations, Characteristics of UWA Network, Topology of UWA Network, Network Protocol Architecture of UWA Network, UWAC Challenges and Research Trends, Comparison study on RF, Optical and Acoustic Communication in Underwater. Underwater telephone, Acoustic Positioning System, Underwater beacon.					
Total periods: 45					
Text Books:					
1. Yi Lou, Niaz Ahmed, Underwater Communications and Networks, First Edition, Springer,2021					
References:					

1. Ferial El-Hawary, The Ocean Engineering Hand book, First Edition, CRC Press, 2001															
2. L.M. Brekhovskikh and Yu. P. Lysanov, Fundamentals of ocean acoustics, Third Edition, Springer,2003															
3. Robert J Urick, Principles of underwater sound, Third Edition, Peninsula Publishing,2013															
4. Rahul Sharma, Deep Sea Mining Handbook, First Edition, Springer,2017															
Course Outcomes:													Blooms Taxonomy		
CO1: To get an explore to different underwater communication system													Understand		
CO2: To design of MI coil for wireless sensor networks													Understand		
CO3: To know the important of underwater communication and its challenges													Understand		
CO4: To understand the strength of Underwater acoustic communication													Create		
CO5: To understand the sensor network concepts and its application													Apply		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	-	-	-	-	-	-	2	3	3	3
CO2	3	3	2	2	2	-	-	-	1	1	-	2	3	3	3
CO3	3	3	2	2	2	-	-	-	-	-	-	3	3	3	3
CO4	3	3	3	2	3	-	-	-	1	1	2	3	3	3	3
CO5	3	3	2	2	2	-	-	-	1	1	-	3	3	3	3

23ECE28	OCEAN OBSERVATION SYSTEMS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To learn the important variables of ocean - To learn the sensors used for ocean observation and its interfaces - To study about various platforms used for ocean observation - To understand data telemetry system for real time observation of Ocean. - To study about data handling and processing techniques.					
Unit I	INTRODUCTION TO ESSENTIAL OCEAN VARIABLES				9
Ocean – Dynamics of upper ocean, Air sea interaction, Waves, Currents, Tides, Salinity, Conductivity, Pressure, Temperature, Wind amplitude & Direction, Humidity, Ocean circulation, Sea states, Importance of Ocean observation: Coastal Zones-Cyclones-Tsunami.					
Unit II	INSTRUMENTATION AND OBSERVATION SYSTEMS				9
General measurement system, Principles, Measurement of Meteorological and Oceanographic Surface & Sub Surface Parameters, Remote measurements. Measurement Techniques, Sensors and instruments: Oceanic Parameters and their conversion to Electrical signals. Sensors for wave, Salinity, Temperature, Rainfall, Water current & Direction. Pressure sensors for Tide and Waves. Acoustic sensors for measurement of Current speed & Direction, Platform Speed Correction- GPS/DGPS					
Unit III	OCEAN OBSERVATION PLATFORMS				9
Eulerian-Langragian - Ship Based Observations, Surface Drifters, Moored Data Buoys, Tsunami Buoys, Argo float, Gliders, Satellite Based Observations, Challenges Associated with Underwater Measurements, Fouling-Corrosion.					
Unit IV	OCEAN DATA TELEMETRY				9
Data telemetry, Wire telemetry, Modems, Wireless telemetry- Acoustic communications- Underwater Optic communication - Satellite Telemetry-LEO-GEO-MEO, GSM-GPRS, Inmarsat, INSAT, Iridium. ARGOS					
Unit V	OCEAN DATA PROCESSING				9

Data processing and storage: Raw and processed data. Storage systems and methods- Data presentation, charts, electronic and graphic presentation, Data exchange, data formats															
Total periods: 45															
Text Books:															
1. James Irish, and Albert Williams III. 2.693, —Principles of Oceanographic Instrument Systems – Sensors and Measurements (13.998), Springer, 2004.															
2. Observing the Oceans in Real Time, —R. Venkatesan and Amit Tandon, Springer, 2017															
References:															
1. Ocean Instrumentation, Electronics, and Energy, — S. R. Vijayalakshmi and S. Muruganand, Mercury Learning & Information, 2016.															
2. Data analysis methods in Physical Oceanography, —Richard E. Thomson and William J. Emery, Elsevier Science,2014															
Course Outcomes:													Blooms Taxonomy		
CO1: Get an Explore on Ocean Dynamics and parameters													Understand		
CO2: Different sensor interface for marine applications													Understand		
CO3: Identification of suitable platform for various measurement & applications													Understand		
CO4: To Know about various telemetries for ocean data transfer													Understand		
CO5: Apply data processing and plotting methods for ocean parameters													Apply		
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	1	1	1	1	1	1	3	3	3
CO2	3	3	2	2	2	1	1	1	2	1	1	1	3	3	3
CO3	3	3	2	2	2	1	1	1	2	1	1	1	3	3	3
CO4	2	3	3	2	2	1	1	1	2	1	1	1	3	3	3
CO5	2	2	2	2	3	1	1	1	2	1	1	1	3	3	3

23ECE29	UNDERWATER NAVIGATION SYSTEMS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To Understand the relationship between autonomy, sensing, navigation and control on an un-manned marine subsea vehicle. - To understand about various types of navigational equipment & sensors - To understand the basic communication methods and signal losses, attenuation. - To understand the types of Acoustic transponders, Beacon and Responder					
Unit I	BASICS OF UNDERWATER COMMUNICATION				9
Introduction to underwater acoustics, Understanding Thermoclines in Ocean Waters, subsea communication sensors, Instruments and applications, Sound propagation in the ocean – Sound Velocity Profiles (SVP) in the deep water and shallow water; Sound attenuation in the sea – absorption, scattering, transmission loss, reverberation, Snell’s law, target strength; Laser communication and limitations..					
Unit II	UNDERWATER NAVIGATION & ITS AIDING SENSOR AND DEVICES				9
Different types of navigational sensors, Accelerometers, Fiber Optic Gyroscopes (FOGs), Ring Laser Gyroscope (RLG) types and Working principles, and their applications, Doppler Velocity Log, Error sources in subsea navigation, Calibration overview for subsea navigation. Attitude Heading and Reference Systems (AHRS) & IMU					
Unit III	ACOUSTIC POSITIONING SYSTEMS				9
Subsea navigation possible solutions, Vehicle positioning, Acoustic Positioning systems, Short Base Line (SBL), Super Short Base Line (SSBL), Long Base line (LBL) Configurations and Positioning overview					
Unit IV	SUBSEA VEHICLE NAVIGATION				9

Subsea navigation, Uses of subsea navigation, challenges of subsea navigation. Basics of underwater navigation, Types of underwater Navigations, Aided navigational systems, Inertial Navigational systems. role of dead-reckoning navigation in subsea navigation, Kalman filters (XKF) and Invariant extended Kalman filters for navigation.															
Unit V		CASE STUDY												9	
- Tethered vehicle deployment guidelines and preparedness. - AUV /ROV based search operation requirements and planning. - Tethered crawling vehicle sensors, data acquisition and maneuvering. - Acoustic positioning system transponder deployment and recovery - Aided and unaided navigation system study. - Understand the basic tools needed to effectively develop software for robotic platforms in a group environment, and resolve conflicts and adhere to group goals in the software cycle.															
Total periods: 45															
Text Books:															
1. Fundamentals of ocean acoustics by L.M.Brekhovskikh and Yu. P. Lysanov															
2. An Underwater Vehicle Navigation System Using Acoustic and Inertial Sensors by Norvald Kjerstad															
3. Underwater Acoustic Positioning Systems by P. H. Milne															
References:															
1.Electronic and Acoustic Navigation systems for Maritime Studies by Norvald Kjerstad															
2.Guidance & Control of Ocean Vehicles by TT Fossen															
3.Dynamic Positioning of Offshore Vessels. By Morgan, M.															
Course Outcomes:													Blooms Taxonomy		
CO1:		To know about the Underwater Navigation System												Understand	
CO2:		To know about the INS and its aiding sensor												Analyze	
CO3:		To know about the challenges involved in underwater navigation.												Understand	
CO4:		To study about how navigation system is integrated with manned and unmanned underwater vehicles.												Understand	
CO5:		To know about underwater positioning system												Analyze	
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	1	1	1	1	1	1	3	2	1
CO2	3	3	2	2	2	1	1	1	2	1	1	1	3	3	2
CO3	3	3	2	2	2	1	1	1	2	1	1	1	3	3	2
CO4	2	3	3	2	2	1	1	1	2	1	1	1	3	3	2
CO5	2	2	2	2	3	1	1	1	2	1	1	1	3	1	3

23ECE30	OCEAN ACOUSTICS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To enable the student to understand the importance of ocean acoustics for marine applications. - To understand the physics of sound propagation and the factors affecting sound signal in the ocean - To study the types and characteristics of acoustic transducers and arrays - To understand the sources of ambient noise present in the sea and impacts of sound on marine diversity - To expose the student in the basics of underwater acoustic signal processing and image processing					
Unit I	FUNDAMENTALS OF UNDERWATER ACOUSTICS				9

Ocean Acoustic environment; Measuring sound levels and relevant units; Sound propagation in the ocean – sound velocity profiles in the deep water and shallow water; Sound attenuation in the sea – absorption, scattering, transmission loss, reverberation, Snell’s law, target strength;SONAR systems- active, passive SONAR equations and system parameters.																
Unit II	UNDERWATER ACOUSTIC TRANSDUCERS AND DEVICES													9		
Principles of transduction and SONAR transducer design; Electromechanical Analog circuits, coupling coefficient, efficiency, Directivity characteristics of receivers, frequency response characteristics of transducers, Transducer measurement techniques; Physical geometry of arrays - linear, planar, cylindrical, spherical, beam patterns, array gain																
Unit III	AMBIENT NOISE IN THE OCEAN													9		
Sources of noise, Natural and Physical sounds - Seismic, Wind, Wave, Rain and Turbulence; Biological sounds - Dolphin, Whales, Fishes; Man made Noises- Shipping Machinery noises, Pile driving, Wind Mlls; Variability of Ambient noises; Frequency Bands, Noise levels of all above; Impacts of Sound on Marine Animals.																
Unit IV	PROCESSING OF UNDERWATER ACOUSTIC SIGNALS AND IMAGES													9		
Representations of the signals – Fourier representations, Spatial filtering; Matched filters and Autocorrelations, Temporal resolution; Signal to Noise Ratio, Estimation of Auto Covariance, Cross Covariance; Power spectra of different Underwater Signals, Classification of signals; Concept and Types of beamforming techniques; Image segmentation, Filtering, Equalization and Restoration																
Unit V	UNDERWATER ACOUSTIC INSTRUMENTS AND ITS APPLICATION													9		
Principles of Sonar systems, Echosounder – single beam, multi beam; Side scan sonars – Imaging, Underwater acoustic camera; Sub bottom profilers –Sediment classification; Acoustic modem – Tsunami systems; Acoustic Positioning system- Transponders, USBL, SSBL systems, HiPAP; Underwater telephone; Underwater noise recorders; Underwater Beacons.																
Total periods: 45																
Text Books:																
1. Robert J Urick,—Principles of underwater sound, Third Edition, Peninsula Publishing,2013																
2. Herman Medwin and Clarence S. Clay, —Fundamental of acoustical oceanography, First Edition, Academic Press,1998.																
References:																
1. L.M. Brekhovskikh and Yu. P. Lysanov,—Fundamentals of ocean acoustics, Third Edition, Springer,2003																
2. John G Proakis and Manolakis, —Digital Signal Processing Principles Algorithms and Applications, Fourth Edition, Pearson, 2006																
3. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, —Digital Image Processing using MATLAB, Third Edition, Gatesmark Publishing,2020.																
Course Outcomes:													Blooms Taxonomy			
CO1:	Understand the basics of underwater sound and its propagation in ocean.													Understand		
CO2:	To simulate / design any underwater SONAR systems for ocean application													Apply		
CO3:	To identify different kinds of noises present in the ocean and its impacts on the marine biodiversity.													Apply		
CO4:	Ability to get exposure in analyzing and applying suitable techniques for underwater acoustic signals and images													Apply		
CO5:	To recognize different types of SONAR systems used practically													Analyze		
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	
CO2	3	2	1	1	2	-	-	-	-	-	-	-	1	-	1	
CO3	3	2	1	1	2	-	-	-	-	-	-	-	1	-	1	
CO4	3	2	1	1	2	-	-	-	-	-	-	-	1	-	1	
CO5	3	2	1	1	2	-	-	-	-	-	-	-	1	-	1	

VERTICAL VI: SENSOR TECHNOLOGIES AND IOT

23ECE31	IOT PROCESSORS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - Learn the architecture and features of ARM. - Study the exception handling and interrupts in CORTEX M3 - Program the CORTEX M3 - Learn the architecture of STM 32L15XXX ARM CORTEX M3/M4 microcontroller. - Understand the concepts of System – On – Chip(SoC)					
Unit I	OVERVIEW OF ARM AND CORTEX-M3				9
ARM Architecture – Versions, Instruction Set Development, Thumb 2 and Instruction Set Architecture, Cortex M3 Basics: Registers, Stack Pointer, Link Register, Program Counter, Special Registers, Operation Mode, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence , CORTEX M3 Instruction Sets: Assembly Basics, Instruction List, Instruction Descriptions, CORTEX M3 – Implementation Overview: Pipeline, Block Diagram. Bus Interfaces, I – Code Bus, D – Code Bus, System Bus- External PPB and DAP Bus.					
Unit II	CORTEX EXCEPTION HANDLING AND INTERRUPTS				9
Exception Types, Priority, Vector Tables, Interrupt Inputs and Pending behaviour, Fault Exceptions, Supervisor Call and Pendable Service Call, NVIC: Nested Vector Interrupt Controller, Overview, Basic Interrupts, SYSTICK Time, Interrupt Behaviour Interrupt/Exception Sequences, Exception Exits, Nested Interrupts, Tail – Chaining Interrupts, Late Arrivals and Interrupt Latency.					
Unit III	CORTEX M3/M4 PROGRAMMING				9
Cortex M3/M4 Programming: Overview, Typical Development Flow, Using C, CMSIS Using Assembly, Exception Programming Using Interrupts, Exception/Interrupt Handlers, Software Interrupts, Vector Table Relocation, Memory Protection Unit and other CORTEX M3 Features, MPU Registers, Setting up the MPU, Power Management, Multiprocessor Configuration.					
Unit IV	STM32L15XXX ARMCORTEX M3/M4 MICROCONTROLLER AND DEBUGGING TOOLS				9
STM32L15XXX ARM CORTEX M3/M4 Microcontroller: Memory and Bus Architecture, Power Control, Reset and Clock Control, STM32L15XXX Peripherals: GPIOs, System Configuration Controller, NVIC, ADC, Comparators, GP Timers, USART Development and Debugging Tools: Software and Hardware tools like Cross Assembler Compiler, Debugger, Simulator, In – Circuit Emulator(ICE), Logic Analyser.					
Unit V	INTRODUCTION TO SYSTEM – ON – CHIP				9
System Architecture: An Overview, Components of the System Processors, Memories and Interconnects, Processor Architectures, Memory and Addressing, System Level Interconnection – An Approach for SOC Design – Chip basics – Cycle Time – Die Area – Power and Cost – Area, Power and Time Trade – Offs in Processor Design – Reliability and Configurability – SOC Design Approach – Application Studies – AES, 3D Graphics Processor. Image Compression and Video Compression.					
Total periods: 45					
Text Books:					
5. Joseph Yiu, The Definitive Guide to the ARM CORTEX M3/M4, Second Edition, Elsevier, 2010.(Unit – I, II)					
6. Andrew N Sloss, Dominic Symes, Chris Wright, ARM System Developers Guide Designing and Optimising System Software, Elsevier, 2006 (Unit – III, IV)					
7. Michael J Flynn and Wayne Luk, Computer System Design, System On Chip, Wiley India 2011.(Unit – V)					
References:					
3. Steve Furber, ARM System – on – Chip Architecture, 2nd Edition, Pearson, 2015.					
4. CORTEX M Series ARM Reference Manual					
5. CORTEX M3 Technical Reference Manual					

6. STM32L152XX ARM CORTEX M3 Microcontroller Reference Manual 5/97																
Course Outcomes:														Blooms Taxonomy		
CO1: Explain the architecture and features of ARM.														Understand		
CO2: List the concepts of exception handling.														Remember		
CO3: Write a program using ARM CORTEX M3/M4.														Apply		
CO4: Learn the architecture of STM32L15XXX ARM CORTEX M3/M4.														Understand		
CO5: Design an SoC for any application.														Create		
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	-	-	-	-	-	3	3	3	3	
CO2	3	3	3	3	2	2	-	-	-	-	-	2	3	3	3	
CO3	3	3	3	3	2	2	-	-	-	-	-	2	2	2	2	
CO4	3	3	2	2	2	2	-	-	-	-	-	2	2	2	2	
CO5	3	3	2	2	2	1	-	-	-	-	-	3	3	2	2	

23ECE32	IOT BASED SYSTEMS DESIGN	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
Course Objectives: • To understand the basics of IoT. • To get knowledge about the various services provided by IoT. • To familiarize themselves with various communication techniques and networking. • To know the implementation of IoT with different tools. • To understand the various applications in IoT.					
Unit I	INTRODUCTION TO INTERNET OF THINGS				9
Rise of the machines – Evolution of IoT – Web 3.0 view of IoT – Definition and characteristics of IoT – IoT Enabling Technologies – IoT Architecture – Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects - IoT levels and deployment templates – A panoramic view of IoT applications.					
Unit II	MIDDLEWARE AND PROTOCOLS OF IOT				9
Middleware technologies for IoT system (IoT Ecosystem Overview – Horizontal Architecture Approach for IoT Systems – SOA based IoT Middleware) Middleware architecture of RFID,WSN,SCADA,M2M –Interoperability challenges of IoT-Protocols for RFID,WSN,SCADA,M2M- Zigbee, KNX,BACNet,MODBUS - Challenges Introduced by 5G in IoT Middleware(Technological Requirements of 5G Systems - Perspectives and a Middleware Approach Toward 5G (COMPaaS Middleware) – Resource management in IoT.					
Unit III	COMMUNICATION AND NETWORKING				9
IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition –Application Layer Protocols: CoAP and MQTT- Data aggregation & dissemination.					
Unit IV	IOT IMPLEMENTATION TOOLS				9
Introduction to Python, Introduction to different IoTtools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python, Implementation of IoT with Raspberry Pi.					
Unit V	APPLICATIONS AND CASE STUDIES:				9

Home automations - Smart cities – Environment – Energy – Retail – Logistics – Agriculture – Industry - Health and life style – Case study.															
															Total periods: 45
Text Books:															
1. Honbo Zhou, “Internet of Things in the cloud:A middleware perspective”, CRC press, 2012.															
2.Vijay Madiseti and Arshdeep Bahga, “Internet of Things (A Hands-onApproach)”, VPT, 1st Edition, 2014.															
References:															
1. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.															
2. Constandinos X. Mavromoustakis, George Mastorakis, Jordi MongayBatalla, “Internet of Things (IoT) in 5G Mobile Technologies” Springer International Publishing Switzerland 2016.															
3. Dieter Uckelmann, Mark Harrison, Florian Michahelles, “Architecting the Internet of Things” Springer-Verlag Berlin Heidelberg, 2011.															
Course Outcomes:													Blooms Taxonomy		
CO1: Articulate the main concepts, key technologies, strength and limitations of IoT.													Understand		
CO2: Identify the architecture, infrastructure models of IoT.													Remember		
CO3: Analyze the networking and how the sensors are communicated in IoT .													Analyze		
CO4: Analyze and design different models for IoT implementation.													Analyze		
CO5: Identify and design the new models for market strategic interaction.													Create		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	3	2	2	1	3	-	-	-	-	2	3	3	3
CO2	2	3	3	2	2	1	-	-	-	-	-	1	2	3	3
CO3	3	3	3	3	2	1	2	-	-	-	-	3	2	3	2
CO4	4	3	3	2	2	3	-	-	-	-	-	-	1	3	3
CO5	5	3	2	3	3	2	1	-	-	-	-	2	1	3	2

23ECE33	WIRELESS SENSOR NETWORK DESIGN	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
Course Objectives: • To understand the fundamentals of wireless sensor network • To gain knowledge on the MAC and Routing Protocols of WSN • To get exposed to 6LOWPAN technology • To acquire knowledge on the protocols required for developing real time applications using WSN and 6LOWPAN. • To gain knowledge about operating system related to WSN and 6LOWPAN					
Unit I	INTRODUCTION				9
Principle of Wireless Sensor Network -Introduction to wireless sensor networks- Challenges, Comparison with ad hoc network, Node architecture and Network architecture, design principles, Service interfaces, Gateway, Short range radio communication standards-IEEE 802.15.4, Zigbee and Bluetooth. Physical layer and transceiver design considerations.					
Unit II	MAC AND ROUTING PROTOCOLS				9
MAC protocols – fundamentals, low duty cycle protocols and wakeup concepts, contention and Schedule-based protocols - SMAC, BMAC, TRAMA, Routing protocols – Requirements, Classification -SPIN, Directed Diffusion, COUGAR, ACQUIRE, LEACH, PEGASIS.					

Unit III	6LOWPAN												9		
6LoWPAN Architecture - protocol stack, Adaptation Layer, Link layers – Addressing, Routing - Mesh- Under - Route-Over, Header Compression - Stateless header compression - Context- based header compression, Fragmentation and Reassembly , Mobility – types, Mobile IPv6, Proxy Home Agent, Proxy MIPv6, NEMO –Routing – MANET, ROLL, Border routing.															
Unit IV	APPLICATION												9		
Design issues, protocol paradigms- End-to-end, Real-time streaming and sessions, Publish/subscribe, Web service paradigms, Common Protocols -Web service protocols, MQ telemetry transport for sensor networks (MQTT-S), ZigBee compact application protocol (CAP), Service discovery, Simple network management protocol (SNMP), Real-time transport and sessions, Industry- Specific protocols.															
Unit V	TOOLS												9		
TinyOS – Introduction, NesC, Interfaces, modules, configuration, Programming in TinyOS using NesC, TOSSIM, Contiki – Structure, Communication Stack, Simulation environment – Cooja simulator, Programming															
Total periods: 45															
Text Books:															
1. Holger Karl , Andreas willig, “Protocol and Architecture for Wireless Sensor Networks”, John Wiley Publication, 2006.															
References:															
1. Anna Forster, “Introduction to Wireless Sensor Networks”, Wiley, 2017.															
2. Zach Shelby Sensinode and Carsten Bormann, “ 6LoWPAN: The Wireless Embedded Internet” John Wiley and Sons, Ltd, Publication, 2009.															
3. Philip Levis, “TinyOS Programming”, 2006 –www.tinyos.net.															
4. The Contiki Operating System. http://www.sics.se/contiki .															
Course Outcomes:													Blooms Taxonomy		
CO1: To be able to design solutions for WSNs applications													Apply		
CO2: To be able to develop efficient MAC and Routing Protocols													Apply		
CO3: To be able to design solutions for 6LOWPAN applications													Apply		
CO4: To be able to develop efficient layered protocols in 6LOWPAN													Apply		
CO5: To be able to use Tiny OS and Contiki OS in WSNs and 6LOWPAN applications													Apply		
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	1	-	-	-	-	2	2	3	1	1
CO2	3	3	2	2	2	1	-	-	-	-	-	2	3	2	2
CO3	3	3	3	2	2	1	-	-	-	-	-	3	3	2	2
CO4	3	3	3	3	2	2	-	-	-	-	-	2	2	1	2
CO5	2	-	1	1	3	2	-	-	-	-	-	2	2	2	1

23ECE34	INDUSTRIAL IOT AND INDUSTRY 4.0	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - IoT Nodes & Sensors - IoT Gateways - IoT Cloud Systems - IoT Cloud Dashboards - Challenges in Iot system Design – Hardware & Software					

Unit I	UNDERSTANDING IOT CONCEPT AND DEVELOPMENT PLATFORM												9			
IOT Definition, Importance of IoT, Applications of IOT, IoT architecture, Understanding working of Sensors, Actuators, Sensor calibration, Study of Different sensors and their characteristics.																
Unit II	ANALYZING & DECODING OF COMMUNICATION PROTOCOL USED IN IOT DEVELOPMENT PLATFORM												9			
UART Communication Protocol, I2C Protocol device interfacing and decoding of signal, SPI Protocol device interfacing and decoding of signal, WIFI and Router interfacing, Ethernet Configuration, Bluetooth study and analysis of data flow, Zigbee Interfacing and study of signal flow.																
Unit III	IOT PHYSICAL DEVICES AND ENDPOINTS AND CONTROLLING HARDWARE AND SENSORS												9		9	
IoT Physical Devices and Endpoints- Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C), Programming – Python program with Raspberry PI with focus on interfacing external gadgets, controlling output, reading input from pins. Controlling Hardware- Connecting LED, Buzzer, Switching High Power devices with transistors, Controlling AC Power devices with Relays, Controlling servo motor, speed control of DC Motor, unipolar and bipolar Stepper motors; Sensors- Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors, Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasound sensor.																
Unit IV	CLOUD SERVICES USED IN IOT DEVELOPMENT PLATFORM												9			
Configuration of the cloud platform, Sending data from the IOT nodes to the gateways using different communication options; Transferring data from gateway to the cloud; Exploring the web services like mail, Messaging (SMS) and Twitter etc.;Tracking of cloud data as per the requirement; Google Cloud service architect; AWS clod Services architect; Microsoft Azure cloud services Architect; OEN source Cloud Services; Initial State Iot Dashboard & Cloud Services.																
Unit V	CHALLENGES IN IOT SYSTEM DESIGN – HARDWARE & SOFTWARE												9			
Antenna design and placement, Chip-package system development, Power electronics, electromagnetic interference/compatibility (EMI/EMC), Electronics reliability; Battery simulation.																
Total periods: 45																
Text Books:																
1 Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madiseti, Universities Press, 2015, ISBN: 9788173719547																
2 Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759																
References:																
1. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895																
2. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.																
3. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors Ovidiu Vermesan																
Course Outcomes:													Blooms Taxonomy			
CO1:	Understand the building blocks of IoT technology and explore the vast spectrum of IoT applications												Understand			
CO2:	Use processors & peripherals to design & build IoT hardware												Apply			
CO3:	Assess, select and customize technologies for IoT applications												Evaluate			
CO4:	Connect numerous IOT applications with the physical world of humans and real life problem solving.												Apply			
CO5:	Design and implement IOT applications that manage big data												Create			
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	2	2	
CO2	3	2	2	2	1	2	-	-	-	-	-	2	3	3	2	
CO3	3	2	2	2	2	2	-	-	-	-	-	2	3	3	2	

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

23ECE35	MEMS DESIGN	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To understand the basic electrical and mechanical concepts of MEMS design - To understand the design aspects of electrostatic sensors and actuators - To understand the design aspects of thermal sensors and actuators - To understand the design aspects of piezoelectric sensors and actuators - To understand the design aspects of magnetic sensors and actuators					
Unit I	ESSENTIAL ELECTRIC AND MECHANICAL CONCEPTS				9
Conductivity of semiconductors, Crystal planes and orientations, stress and strain, flexural beam bending analysis under simple loading conditions, Dynamic system, resonant frequency and quality factor					
Unit II	ELECTRO STATIC SENSING AND ACTUATION				9
Parallel plate capacitor, Applications of parallel plate capacitors- inertial sensor, pressure sensor, flow sensor, tactile sensor, parallel plate actuators, interdigitated finger capacitors, applications of comb drive devices.					
Unit III	THERMAL SENSING AND ACTUATION				9
Fundamentals of thermal transfer, Sensors and actuators based on thermal expansion, Thermal couples, Thermal resistors, Applications- Infrared sensors, flow sensors, Inertial sensors, other sensors.					
Unit IV	PIEZOELECTRIC SENSING AND ACTUATION				9
Mathematical description of piezoelectric effects, Cantilever piezoelectric actuator model, properties of piezoelectric materials –Quartz, PZT,PVDF, ZnO , Applications – Acoustic sensors, Tactile sensors.					
Unit V	MAGNETIC SENSING AND ACTUATION				9
Concepts and principles- magnetization and nomenclatures, principles of micromagnetic actuators, fabrication of micro magnetic components- deposition, design and fabrication of magnetic coil, MEMS magnetic actuators.					
Total periods: 45					
Text Books:					
1. Chang Liu, “Foundations of MEMS”, Pearson education India limited, 2006					
References:					
1. Murty B.S, Shankar P, Raj B, Rath, B.B, Murday J, Textbook of Nanoscience and Nanotechnology, Springer publishing, 2013.					
2. Sergey Edward Lyshevski, “MEMS and NEMS: Systems, Devices, and Structures”, CRC Press, 2002					
3. Tai Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata Mcgraw Hill, 2002					
4. Vinod Kumar Khanna Nanosensors: Physical, Chemical, and Biological, CRC press,2012.					
Course Outcomes:					Blooms Taxonomy
CO1:	Understand the basics of MEMS design aspects.				Understand
CO2:	Apply the knowledge in the development of electro static sensors and actuators.				Apply
CO3:	Apply the knowledge in the development of thermal sensors and actuators.				Apply
CO4:	Apply the knowledge in the development of piezoelectric sensors and actuators.				Apply
CO5:	Apply the knowledge in the development of magnetic sensors and actuators.				Apply
CO-PO Mapping					

CO3: Understand the basics of nano transistors.													Understand		
CO4: Analyze the key performance aspects of tunneling and superconducting nano electronic devices													Analyze		
CO5: Apply the knowledge in the development of nanotubes and nanostructure devices													Apply		
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	1	-	-	-	-	-	2	2	1	1
CO2	3	3	3	2	2	2	-	-	-	-	-	2	3	1	1
CO3	3	3	3	2	2	2	-	-	-	-	-	2	3	1	1
CO4	3	3	2	2	2	2	-	-	-	-	-	2	3	1	1
CO5	3	3	3	3	3	3	-	-	-	-	-	2	3	1	2

VERTICAL 7 : SPACE TECHNOLOGIES

23ECE37	RADAR TECHNOLOGIES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - Understand the basics of Radar and Radar equation - Understand the types of Radar - understand tracking Radar - Understand the various signal processing in Radar - Understand the Subsystems in Radar					
Unit I	INTRODUCTION TO RADAR EQUATION				9
The Origins of Radar ,Radar principles, Basic Block Diagram, Radar classifications based on Frequencies, Wave form and application, Radar Fundamentals: Detection, Range, velocity, The simple form of the Radar Equation, Pulsed Radar equation, Detection of Signals in Noise- Receiver Noise, Signal-to-Noise Ratio, Probabilities of Detection and False Alarm, Integration of Radar Pulses, Radar Cross Section of Targets,Transmitter Power,Pulse Repetition Frequency, Antenna Parameters, System losses.					
Unit II	CW, MTI AND PULSE DOPPLER RADAR				9
CW and Frequency Modulated Radar, Doppler and MTI Radar- Delay Line Cancellers, Staggered Pulse Repetition Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target Detector, Limitations to MTI Performance, MTI from a Moving Platform (AMIT), Pulse Doppler Radar.					
Unit III	TRACKING RADAR				9
Tracking with Radar, Monopulse Tracking, Conical Scan, Sequential Lobing, Limitations to Tracking Accuracy, Low-Angle Tracking - Comparison of Trackers, Track while Scan (TWS) Radar- Target prediction , state estimation, Measurement models, alpha – beta tracker, Kalman Filtering, Extended Kalman filtering.					
Unit IV	RADAR SIGNAL PROCESSING				9
Radar Signal Processing Fundamentals, Detection strategies, Optimal detection, Threshold detection, Constant False alarm rate detectors, Adaptive CFAR, pulse compression waveforms, compression gain, LFM waveforms matched filtering, radar ambiguity functions, radar resolution, Detection of radar signals in Noise and clutter, detection of non fluctuating target in noise, Doppler spectrum of fluctuating targets, Range Doppler spectrum of stationary and moving radar.					
Unit V	RADAR TRANSMITTERS AND RECEIVERS				9
Radar Transmitter, Linear Beam Power Tubes, Solid State RF Power Sources, Magnetron, Crossed Field Amplifiers, Other RF Power Sources. The Radar Receiver ,Receiver noise power, Super heterodyne Receiver, Duplexers and Receiver Protectors- Radar Displays. Radar Antenna - Reflector Antennas - Electronically Steered Phased Array Antennas – Phase Shifters					
Total periods: 45					

Text Books:															
8. Habibur Rahman, Fundamental Principles of Radar, CRC press, Taylor and Francis, 2019.															
9. M. R. Richards, J. A. Scheer, W. A. Holm, Editors “Principles of Modern Radar, Basic Principles”, SciTech Publishing, 2012															
References:															
7. Nathansan, “Radar design principles-Signal processing and environment”, PHI, 2nd Edition, 2007.															
8. M.I.Skolnik, “Introduction to Radar Systems”, Tata McGraw Hill 2006.															
9. Mark A. Richards, “Fundamentals of Radar Signal Processing”, McGraw-Hill, 2005.															
Course Outcomes:													Blooms taxonomy		
CO1: Identify the Radar parameters													Remember		
CO2: Differentiate various radar types													Analyze		
CO3: Evaluate different tracking and filtering schemes													Evaluate		
CO4: Apply signal processing in target detection													Apply		
CO5: Design Radar transmitter and receiver blocks													Create		
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	2	3	3	2
CO2	3	3	3	3	2	2	-	-	-	-	2	2	2	2	2
CO3	3	3	3	3	2	2	-	-	-	-	2	2	1	2	3
CO4	3	3	3	2	3	2	-	-	-	-	1	2	2	1	2
CO5	3	2	2	2	3	2	-	-	-	-	1	2	2	2	1

23ECE38	AVIONICS SYSTEMS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Nil					
Course Objectives:					
- To impart knowledge on the needs for avionics for both Civil and military aircraft. - To impart knowledge on avionics architecture and Avionics data bus. - To impart knowledge understand the various cockpit displays and human interfaces. - To impart knowledge on the concepts of flight control systems, FMS and their importance - To impart knowledge on different navigation aids and need for certification					
Unit I	INTRODUCTION TO AVIONICS				9
Basics of Avionics-Basics of Cockpits – Need for Avionics in civil and military aircraft and space systems – Integrated Avionics Architecture –Military and Civil system – Typical avionics System and Sub systems – Design and Technologies – Requirements and Importance of illities of Avionic Systems.					
Unit II	DIGITAL AVIONICS BUS ARCHITECTURE				9
Evolution of Avionics architecture– Avionics Data buses MIL-STD-1553, MIL-STD-1773, ARINC- 429, ARINC-629, AFDX/ARINC-664, ARINC-818 – Aircraft system Interface					
Unit III	COCKPIT DISPLAYS AND MAN-MACHINE INTERACTION				9
Trends in display technology- CRT, LED, LCD, EL and plasma panel - Touch screen - Direct voice input (DVI) – Civil cockpit and military cockpit: MFD, MFK, HUD, HDD, HMD, HOTAS – Glass cockpit.					
Unit IV	FLIGHT CONTROL SYSTEMS				9
Introduction to Flight control systems and FMS– Longitudinal control – Lateral Control –Autopilot – Flight planning – Radar Electronic Warfare - Certification-Military and civil aircrafts.					
Unit V	NAVIGATION SYSTEMS				9

Overview of navigation systems - Communication Systems Radio navigation – Types & Principles – Fundamentals of Inertial Sensors – INS – GNSS -- GPS – Approach and Landing Aids – ILS & MLS – Hybrid Navigation															
Total periods: 45															
Text Books:															
1. R.P.G. Collinson, “Introduction to Avionics”, Springer Publications, Third Edition, 2011.															
References:															
1. Cary R .Spitzer, “The Avionics Handbook”, CRC Press, 2000.															
2. Middleton, D.H. “Avionics Systems”, Longman Scientific and Technical, Longman Group UK Ltd., England, 1989.															
3. Spitzer, C.R. “Digital Avionics Systems”, Prentice Hall, Englewood Cliffs, N.J., U.S.A., 1987.															
4. Myron Kayton , Walter R. Fried “Avionics Navigation Systems” 2nd Edition, Wiley Publication, 2008.															
5. Jim Curren, “Trend in Advanced Avionics”, IOWA State University, 1992.															
Course Outcomes:													Blooms Taxonomy		
CO1: Explain the different of Avionics Systems and its need for civil and military aircrafts considering the reliability and safety aspects													ANALYZE		
CO2: Select a suitable architecture and data bus based on the requirements													EVALUATE		
CO3: Compare the different display technologies used in cockpit													ANALYZE		
CO4: Explain the principles of flight control systems and the importance of FMS													UNDERSTAND		
CO5: Explain the communication and navigation techniques													UNDERSTAND		
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	-	-	-	-	-	3	3	3	2
CO2	3	3	3	2	2	2	-	-	-	-	-	3	3	2	2
CO3	3	3	3	3	1	2	-	-	-	-	-	3	2	3	2
CO4	2	3	3	2	2	1	-	-	-	-	-	2	2	1	2
CO5	3	3	2	2	2	1	-	-	-	-	-	2	2	2	2

23ECE39	POSITIONING AND NAVIGATION SYSTEMS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
Course Objectives: • To explain the fundamentals of navigation systems. • To understand the inertial navigation systems • To acquire knowledge on radio navigation. • To have an overview of global positioning systems • To learn the hybrid navigation systems.					
Unit I	NAVIGATION CONCEPTS				9
Fundamentals of navigation systems and Position Fixing – Categories of navigation - Geometric concepts of Navigation – The Earth in inertial space - Different Coordinate Systems – Coordinate Transformation - Euler angle formulations - Direction cosine matrices formulation - Quaternion formulation.					
Unit II	INERTIAL NAVIGATION SYSTEMS				9
Inertial sensors - Gyroscopes -Types - Mechanical - Electromechanical-Optical Gyro -Ring Laser gyro- Fiber optic gyro- Accelerometers – Pendulous type – Force Balance type – MEMs - Basic Principles of Inertial Navigation – Types - Platform and Strap down - Mechanization INS system - Rate Corrections - Acceleration errors – Schuler Tuning.					
Unit III	RADIO NAVIGATION & AIR TRAFFIC MANAGEMENT				9

Different types of radio navigation- ADF, VOR, DME, TACAN,VORTAC - Doppler – Hyperbolic Navigations – Air Traffic Management – RADAR Surveillance - Airborne Collision Avoidance Systems															
Unit IV		GLOBAL POSITIONING SYSTEM												9	
Overview of GPS: Basic concept, system architecture, , GPS Signals Signal structure, anti-spoofing (AS), selective availability, GPS for position and velocity determination, GPS aided Geo-augmented navigation (GAGAN) architecture -GPS error sources-clock error, ionospheric error, tropospheric error, multipath, ionospheric error estimation using dual frequency GPS receiver															
Unit V		HYBRID NAVIGATION & RELATIVE NAVIGATION SYSTEMS												9	
Hybrid Navigation - Introduction to Kalman filtering – Case Studies -Integration of GPS and INS using Kalman Filter - Relative Navigation – fundamentals – Equations of Relative Motion for circular orbits (Clohessy_ Wiltshire Equations) - Sensors for Rendezvous Navigation - Relative positioning - Point positioning and differential positioning - Differential GPS (DGPS) and Space based Augmentation system (SBAS)- Concepts - Relative GPS -Formation Flying - Figure of Merit (FOM)															
Total periods: 45															
Text Books:															
1. Myron Kyton, Walfred Fried, ‘Avionics Navigation Systems’, John Wiley & Sons,2 edition,1997.															
2. Nagaraja, N.S. “Elements of Electronic Navigation”, Tata McGraw-Hill Pub. Co., New Delhi, 2nd edition, 1975.															
References:															
1. George M Siouris, ‘Aerospace Avionics System; A Modern Synthesis’, Academic Press Inc., 1993.															
2. Albert Helfrick, ‘Practical Aircraft Electronic Systems’, Prentice Hall Education, Career & Technology, 1995.															
3. Albert D. Helfrick, ‘Modern Aviation Electronics’, Second Edition, Prentice Hall Career & Technology, 1994.															
4. Paul. D. Groves. ‘Principles of GNSS, Inertial, and Multisensor Integrated Navigation Systems’, Artech House, 2013.															
5. Maxwell Noton, ”Spacecraft navigation and guidance”, Springer (London, New York), 1998															
Course Outcomes:													Blooms Taxonomy		
CO1:	Understand the advanced concepts of Positioning and Navigation systems and exposure on various Navigation systems												Understand		
CO2:	Know about Gyroscopes and accelerometers and Inertial Navigation systems and its types and Mechanisation												Remember		
CO3:	Explain the different Radio Navigation aids and its usage for civil and military aircrafts and satellites												Understand		
CO4:	Explain the Satellite Navigation – GPS and its usage in aircraft and spacecraft applications												Understand		
CO5:	Deploy these skills effectively in the analysis and understanding of hybrid navigation systems and Relative navigation in a spacecraft.												Evaluate		
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	-	-	-	-	-	3	3	2	2
CO2	3	3	3	2	2	2	-	-	-	-	-	2	3	2	2
CO3	3	3	3	2	2	2	-	-	-	-	-	2	3	2	3
CO4	3	3	3	2	2	2	-	-	-	-	-	2	2	2	2
CO5	3	3	3	3	2	2	-	-	-	-	-	2	2	2	2

23ECE40	SATELLITE COMMUNICATION											Category: PEC			
												L	T	P	C

														3	0	0	3
Prerequisites																	
• Nil																	
Course Objectives:																	
- Understand the basics of satellite orbits - Understand the satellite segment and earth segment - understand Link Power budget calculation - Understand the various satellite access and coding technology - Understand the applications of satellite																	
Unit I		SATELLITE ORBITS												9			
Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geo stationary and non Geo-stationary orbits – Look Angle Determination- Limits of visibility – eclipse- Sub satellite point –Sun transit outage-Launching Procedures - launch vehicles and propulsion.																	
Unit II		SPACE SEGMENT												9			
Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command-Transponders Antenna																	
Unit III		SATELLITE LINK DESIGN												9			
Basic link analysis, Uplink and Downlink Design equation, Free space loss-Atmospheric effects, Ionospheric scintillation, Rain induced attenuation and interference, system noise temperature, Link Design with and without frequency reuse.																	
Unit IV		SATELLITE ACCESS AND CODING TECHNIQUES												9			
Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, PAMA and DAMA Assignment Methods, compression – encryption, Coding Schemes.																	
Unit V		SATELLITE APPLICATIONS												9			
INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, LEO, MEO, Satellite Navigational System. GPS-Position Location Principles, Differential GPS, Direct Broadcast satellites (DBS/DTH).																	
																Total periods: 45	
Text Books:																	
1. Dennis Roddy, “Satellite Communication”, 4th Edition, Mc Graw Hill International, 2017.																	
2. Timothy Pratt, Charles, W.Bostain,Jeremy E.Allnutt,"SatelliteCommunication",3rd Edition, Wiley Publications,2021.																	
References:																	
1. Tri T. Ha, “Digital Satellite Communications”, 2 nd edition, Mc Graw Hill education, 2017.																	
2. Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, “Satellite Communications Systems Engineering”, 2 nd edition , Prentice Hall/Pearson , 2013.																	
3. M.Richharia, “Satellite Communication Systems-Design Principles”, Macmillan, 1999.																	
4. Brian Ackroyd, “World Satellite Communication and earth station Design”, BSP professional Books, 1990.																	
5. Bruce R. Elbert, “The Satellite Communication Applications”, Hand Book, Artech House Bostan London, 2003.																	
Course Outcomes:														Blooms Taxonomy			
CO1: Identify the satellite orbits														Remember			
CO2: Analyze the satellite subsystems														Analyze			
CO3: Evaluate the satellite link power budget														Evaluate			
CO4: Identify access technology for satellite														Understand			
CO5: Design various satellite applications														Create			
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	3	-	-	-	-	-	1	3	-	-
CO2	3	2	2	3	2	3	-	-	-	-	-	1	3	-	-
CO3	3	3	3	2	1	3	-	-	-	-	-	1	3	-	-
CO4	3	3	2	3	2	3	-	-	-	-	-	1	3	-	-
CO5	3	2	3	2	2	1	-	-	-	-	-	1	3	-	-

23ECE41	REMOTE SENSING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
Course Objectives: • Understand remote sensing fundamentals and radiation principles • Explain EMR interactions and analyze spectral properties • Understand orbital mechanics and satellite platforms • Identify sensing techniques and describe sensor characteristics • Interpret and analyze data products and apply image processing methods					
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, Air borne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Lgrange Orbit					
Unit IV	SENSING TECHNIQUES				9
Classification of remote sensors – Resolution concept: spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors – High Resolution Sensors - LIDAR, UAV – Orbital and sensor characteristics of live Indian earth observation satellites.					
Unit V	DATA PRODUCTS AND INTERPRETATION				9
Photographic and digital products – Types, levels and open-source satellite data products – selection and procurement of data – Visual interpretation: basic elements and interpretation keys - Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification.					
Total periods: 45					
Text Books:					
1. Thomas M. Lillesand, Ralph W. Kieferand 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. Stanley A Morain; Amelia M Budge; Michael S Renslow. Manual of Remote Sensing. Vol. I, American Society for Photogrammetry and Remote Sensing, Virginia, USA,2019, 4th edition															
2. Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press,2022 first edition.															
3. Paul Curran P. J. Principles of Remote Sensing Longman, RLBS, 1996.															
4. Introduction to Physics and Techniques of Remote Sensing, Charles Elachi and Jacob Van Zyl, 2021 Edition3, Wiley Publication.															
Course Outcomes:													Blooms Taxonomy		
CO1: To understand the principles of electromagnetic radiation													Understand		
CO2: To learn the atmospheric radiation interactions.													Understand		
CO3: To study the laws of planetary motion.													Understand		
CO4: To classify the different types of resolution.													Remember		
CO5: To know the concepts of digital interpretation													Apply		
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	3	2	-	-	-	-	1	3	3	3
CO2	3	2	2	3	1	3	2	-	-	-	-	1	3	3	3
CO3	1	2	1	3	2	3	2	-	-	-	-	1	3	3	3
CO4	1	2	3	1	3	3	2	-	-	-	-	1	3	3	3
CO5	2	2	2	-	3	3	2	-	-	-	-	1	3	3	3

23ECE42	ROCKETRY AND SPACE MECHANICS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - This course presents the fundamental aspects of rocket motion along with detailed estimation of rocket trajectories. - This course also imparts knowledge on optimization of multistage rockets. - This course provides the basics of space mechanics required for an aeronautical student - This course helps students to provide with the basics of orbit transfer of satellites. - This course will help students to gain knowledge on various control methods of rockets.					
Unit I	ORBITAL MECHANICS				9
Description of solar system – Kepler’s Laws of planetary motion – Newton’s Law of Universal gravitation – Two body and Three-body problems – Jacobi’s Integral, Librations points – Estimation of orbital and escape velocities.					
Unit II	SATELLITE DYNAMICS				9
Geosynchronous and geostationary satellites- factors determining life time of satellites – satellite perturbations – orbit transfer and examples –Hohmann orbits – calculation of orbit parameters– Determination of satellite rectangular coordinates from orbital elements.					
Unit III	ROCKET MOTION				9
Principle of operation of rocket motor – thrust equation – one dimensional and two dimensional rocket motions in free space and homogeneous gravitational fields – Description of vertical, inclined and gravity turn trajectories – determinations of range and altitude – simple approximations to burnout velocity.					
Unit IV	ROCKET AERODYNAMICS				9
Description of various loads experienced by a rocket passing through atmosphere – drag estimation – wave drag, skin friction drag, form drag and base pressure drag – Boat-tailing in missiles – performance at various altitudes – rocket stability – rocket dispersion – launching problems.					
Unit V	STAGING AND CONTROL OF ROCKET VEHICLES				9

Need for multi staging of rocket vehicles – multistage vehicle optimization – stage separation dynamics and separation techniques- aerodynamic and jet control methods of rocket vehicles – SITVC.															
															Total periods: 45
Text Books:															
1. Cornelisse,JW, “Rocket Propulsion and Space Dynamics”, J.W. Freeman & Co., Ltd., London, 1982.															
2. Parker,ER, “Materials for Missiles and Spacecraft”, McGraw-Hill Book Co., Inc., 1982.															
References:															
1. Suresh. B N & Sivan. K, “Integrated Design for Space Transportation System”, Springer India, 2015.															
2. Sutton,GP, “Rocket Propulsion Elements”, John Wiley & Sons Inc., New York, 8 th Edition, 2010.															
3. Van de Kamp, “Elements of Astromechanics”, Pitman Publishing Co., Ltd., London, 1980.															
Course Outcomes:														Blooms Taxonomy	
CO1:	To knowledge on the fundamental laws of orbital mechanics with particular emphasis on interplanetary trajectories.													Understand	
CO2:	To calculate orbital parameters and perform conceptual trajectory designs for geocentric or interplanetary missions.													Analyze	
CO3:	To familiarize themselves with trajectory calculations for planar motion of rockets.													Understand	
CO4:	To determine forces and moments acting on airframe of a missile.													Analyze	
CO5:	To acquire knowledge on the need for staging and stage separation dynamics of rocket vehicles.													Understand	
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	-	-	-	-	-	3	3	2	2
CO2	3	3	3	2	2	2	-	-	-	-	-	2	3	2	2
CO3	3	3	3	2	2	2	-	-	-	-	-	2	3	2	3
CO4	3	3	3	2	2	2	-	-	-	-	-	2	2	2	2
CO5	3	3	3	3	2	2	-	-	-	-	-	2	2	2	2

VERTICAL 8 : HIGH SPEED COMMUNICATIONS

23ECE43	OPTICAL COMMUNICATION & NETWORKS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To Study About The Various Optical Fiber Modes, Configuration Of Optical Fibers - To Study Transmission Characteristics Of Optical Fibers. - To Learn About The Various Optical Sources, Detectors And Transmission Techniques. - To Explore Various Idea About Optical Fiber Measurements And Various Coupling Techniques. - To Enrich The Knowledge About Optical Communication Systems And Networks.					
Unit I	INTRODUCTION TO OPTICAL FIBER COMMUNICATION				9
Introduction - The General Systems - Advantages of Optical Fiber Communication- Ray Theory Transmission : Total Internal Reflection, Acceptance Angle, Numerical Aperture, Skew Rays - Electromagnetic Mode Theory for Optical Propagation: Modes in a Planar Guide, Phase and group velocity - Cylindrical Fiber: Step index fibers, Graded index fibers - Single mode fibers: Cutoff wavelength.					

Unit II	TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS												9		
Attenuation - Material absorption losses in silica glass fibers: Intrinsic absorption, Extrinsic absorption - Linear scattering losses: Rayleigh Scattering, Mie Scattering -Nonlinear scattering losses: Stimulated Brillouin Scattering, Stimulated Raman Scattering – Fiber Bend Loss – Dispersion- Chromatic dispersion: Material dispersion, Waveguide dispersion- Intermodal dispersion : Multimode step index fiber, Multimode graded index fiber.															
Unit III	OPTICAL SOURCES AND OPTICAL DETECTORS												9		
The laser : Introduction - Basic concepts: Absorption and emission of radiation, Population inversion , Optical feedback and laser oscillation, Threshold condition for laser oscillation- Optical emission from semiconductors: The PN junction, Spontaneous emission, Carrier recombination, Stimulated emission and lasing, Hetero junctions- LED: Introduction- Power and Efficiency - LED structures: Planar LED, Dome LED, Surface emitter LED, Edge emitter LED- LED Characteristics. Optical Detectors: Introduction ,Optical Detection Principles, Quantum Efficiency, Responsivity, P-N Photodiode ,P-I-N Photo Diode and Avalanche Photodiode.															
Unit IV	OPTICAL FIBER MEASUREMENTS												9		
Introduction- Total Fiber Attenuation Measurement, Fiber Dispersion Measurements In Time Domain and Frequency Domain, Fiber Cut off Wavelength Measurements, Numerical Aperture Measurements. Fiber Diameter Measurements, Reflectance and Optical Return Loss, Field Measurements															
Unit V	OPTICAL NETWORKS												9		
Introduction- Optical Network Concepts: Optical Networking Terminology, Optical Network Node And Switching Elements, Wavelength Division Multiplexed Networks, Public Telecommunications Network Overview- Optical Network Transmission Modes, Layers And Protocols: Synchronous Networks, Asynchronous Transfer Mode, Open System Interconnection Reference Model, Optical Transport Network, Internet Protocol- Wavelength Routing Networks: Routing And Wavelength Assignment- Optical Switching Networks: Optical Circuit Switched Networks, Optical Packet Switched Networks, Multiprotocol Label Switching, Optical Burst Switching Networks- Optical Network Deployment : Long Haul Networks, Metropolitan area networks, Access networks, Local Area Networks- Optical Ethernet: Network protection, restoration and survivability.															
															Total periods: 45
Text Books:															
1. John M.Senior, “Optical Fiber Communication”, Pearson Education, Fouth Edition.2010.															
References:															
1. Gred Keiser,"Optical Fiber Communication”, McGraw Hill Education (India) Private Limited. Fifth Edition, Reprint 2013.															
2. Govind P. Agrawal, “Fiber-Optic Communication Systems”, Third Edition, John Wiley & Sons, 2004.															
3. J.Gower, “Optical Communication System”, Prentice Hall Of India, 2001															
4. Rajiv Ramaswami, “Optical Networks “ , Second Edition, Elsevier , 2004.															
5. P Chakrabarti, "Optical Fiber Communication”, McGraw Hill Education (India)Private Limited, 2016															
Course Outcomes:													Blooms Taxonomy		
CO1:	Realize Basic Elements in Optical Fibers, Different Modes and Configurations.												Understand		
CO2:	Analyze The Transmission Characteristics Associated with Dispersion and Polarization Techniques.												Analysis		
CO3:	Design Optical Sources and Detectors with their use in Optical Communication System.												Apply		
CO4:	Construct Fiber Optic Receiver Systems, Measurements and Techniques.												Apply		
CO5:	Design Optical Communication Systems and its Networks.												Apply		
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	-	-	-	-	-	1	2	-	2
CO2	3	3	2	1	3	2	-	-	-	-	-	2	2	-	2

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

23ECE44	WIRELESS BROAD BAND NETWORKS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To study the various network layer and transport layer protocols for wireless networks - To study the architecture and interference mitigation techniques in 3G standards - To learn about 4G technologies and LTE-A in mobile cellular network. - To learn about the layer level functionalities in interconnecting networks. - To study the emerging techniques in 5G network.					
Unit I	WIRELESS PROTOCOLS				9
Mobile network layer- Fundamentals of Mobile IP, data forwarding procedures in mobile IP, IPv4, IPv6, IP mobility management, IP addressing - DHCP, Mobile transport layer-Traditional TCP, congestion control, slow start, fast recovery/fast retransmission, classical TCP improvements- Indirect TCP, snooping TCP, Mobile TCP.					
Unit II	3G EVOLUTION				9
IMT-2000 - W-CDMA, CDMA 2000 - radio & network components, network structure, packet-data transport process flow, Channel Allocation, core network, interference-mitigation techniques, UMTS-services, air interface, network architecture of 3GPP, UTRAN – architecture, High Speed Packet Data-HSDPA,HSUPA.					
Unit III	4G EVOLUTION				9
Introduction to LTE-A – Requirements and Challenges, network architectures – EPC, E- UTRAN architecture - mobility management, resource management, services, channel -logical and transport channel mapping, downlink/uplink data transfer, MAC control element, PDU packet formats, scheduling services, random access procedure.					
Unit IV	LAYER-LEVEL FUNCTIONS				9
Characteristics of wireless channels - downlink physical layer, uplink physical layer, MAC scheme - frame structure, resource structure, mapping, synchronization, reference signals and channel estimation, SC-FDMA, interference cancellation – CoMP, Carrier aggregation, Services - multimedia broadcast/multicast, location-based services.					
Unit V	5G EVOLUTION				9
5G Roadmap - Pillars of 5G - 5G Architecture, The 5G internet - IoT and context awareness - Networking reconfiguration and virtualization support - Mobility QoS control - emerging approach for resource over provisioning, Small cells for 5G mobile networks- capacity limits and achievable gains with densification - Mobile data demand, Demand Vs Capacity, Small cell challenges, conclusion and future directions.					
Total periods: 45					
Text Books:					
1. Kaveh Pahlavan, “Principles of wireless networks”, Prentice-Hall of India, 2008					
References:					
1. Vijay K.Garg, “Wireless Network Evolution - 2G & 3G”. Prentice Hall, 2008.					
2. Clint Smith,P.E, Dannel Collins, “3G Wireless Networks” Tata McGraw- Hill, 2nd Edition, 2011.					

3. Sassan Ahmadi, "LTE-Advanced – A practical systems approach to understanding the 3GPP LTE Releases 10 and 11 radio access technologies", Elsevier, 2014.															
4. Jonathan Rodriguez, "Fundamentals of 5G Mobile networks", John Wiley, 2015.															
Course Outcomes:													Blooms Taxonomy		
CO1: Design and implement the various protocols in wireless networks.													Create		
CO2: Analyze the architecture of 3G network standards.													Analysis		
CO3: Analyze the difference of LTE-A network design from 4G standard.													Analysis		
CO4: Design the interconnecting network functionalities by layer level functions													Create		
CO5: Explore the current generation (5G) network architecture.													Analysis		
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	1	1
CO2	3	3	2	1	3	2	-	-	-	-	-	-	3	2	2
CO3	3	3	3	3	2	1	-	-	-	-	-	3	3	2	2
CO4	2	3	3	3	2	2	-	-	-	-	-	3	2	1	2
CO5	2	-	3	3	2	2	-	-	-	-	-	3	2	2	1

23ECE45	4G / 5G COMMUNICATION NETWORKS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To learn the evolution of wireless networks. - To get acquainted with the fundamentals of 5G networks. - To study the processes associated with 5G architecture. - To study spectrum sharing and spectrum trading. - To learn the security features in 5G networks.					
Unit I	EVOLUTION OF WIRELESS NETWORKS				9
Networks evolution: 2G,3G,4G, evolution of radio access networks, need for 5G. 4G versus 5G, Next Generation core(NG-core), visualized Evolved Packet core(vEPC).					
Unit II	5G CONCEPTS AND CHALLENGES				9
Fundamentals of 5G technologies, overview of 5G core network architecture,5G new radio and cloud technologies, Radio Access Technologies (RATs), EPC for 5G.					
Unit III	NETWORK ARCHITECTURE AND THE PROCESSES				9
5G architecture and core, network slicing, multi access edge computing(MEC)visualization of 5G components, end-to-end system architecture, service continuity, relation to EPC, and edge computing. 5G protocols: 5G NAS,NGAP, GTP-U, IPSec and GRE.					
Unit IV	DYNAMIC SPECTRUM MANAGEMENT AND MM-WAVES				9
Mobility management, Command and control, spectrum sharing and spectrum trading, cognitive radio based on 5G, millimeter waves.					
Unit V	SECURITY IN 5G NETWORKS				9

Security features in 5G networks, network domain security, user domain security, flow based QoS framework, mitigating the threats in 5G.															
Total periods: 45															
Text Books:															
1. 5G Core networks: Powering Digitalization , Stephen Rommer, Academic Press,2019															
2. An Introduction to 5G Wireless Networks : Technology, Concepts and Use cases, Saro Velrajan, First Edition, 2020.															
References:															
1. 5G Simplified: ABCs of Advanced Mobile Communications Jyrki. T.J.Penttinen, Copyrighted Material.															
2. 5G system Design: An end to end Perspective , Wan Lee Anthony, Springer Publications,2019.															
Course Outcomes:														Blooms Taxonomy	
CO1: To understand the evolution of wireless networks.														Understand	
CO2: To learn the concepts of 5G networks														Understand	
CO3: To comprehend the 5G architecture and protocols														Understand	
CO4: To understand the dynamic spectrum management.														Understand	
CO5: To learn the security aspects in 5G networks.														Understand	
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	-	-	-	-	-	-	-	3	-	3
CO2	3	3	3	2	2	-	-	-	-	-	-	-	2	-	2
CO3	3	3	2	2	2	-	-	-	-	-	-	-	2	-	2
CO4	3	3	3	3	2	-	-	-	-	-	-	-	2	-	2
CO5	3	2	3	3	2	-	-	-	-	-	-	-	2	-	2

23ECE46	SOFTWARE DEFINED NETWORKS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To understand the need for SDN and its data plane operations - To understand the functions of control plane - To comprehend the migration of networking functions to SDN environment - To explore various techniques of network function virtualization - To comprehend the concepts behind network virtualization					
Unit I	SDN: BACKGROUND AND DATA PLANE				9
Evolving Network Requirements – The SDN Approach – SDN and NFV-Related Standards – SDN Data Plane – OpenFlow Logical Network Device – OpenFlow Protocol.					
Unit II	SDN CONTROL PLANE				9
SDN Control Plane Architecture: Southbound Interface, Northbound Interface – Control Plane Functions – ITU-T Model – OpenDaylight – REST – Cooperation and Coordination among Controllers.					
Unit III	UNIT TITLE				9
SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking -- -Mobility and Wireless – Information-centric Networking					

Unit IV	NETWORK FUNCTION VIRTUALIZATION												9		
NFV Concepts – Benefits and Requirements – Reference Architecture – NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use cases – SDN and NFV															
Unit V	NETWORK VIRTUALIZATION												9		
Virtual LANs – OpenFlow VLAN Support – Virtual Private Networks – Network Virtualization – Open Daylight’s Virtual Tenant Network – CoSoftware-Defined Infrastructure															
Total periods: 45															
Text Books:															
1. William Stallings, “Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud”, Pearson Education, 1 st Edition, 2015.															
2. Thomas D Nadeau, Ken Gray, “SDN: Software Defined Networks”, O’Reilly Media, 2013.															
References:															
1. Fei Hu, “Network Innovation through OpenFlow and SDN: Principles and Design”, 1 st Edition, CRC Press, 2014															
2. Paul Goransson, Chuck Black Timothy Culver, “Software Defined Networks: A Comprehensive Approach”, 2 nd Edition, Morgan Kaufmann Press, 2016															
3. Oswald Coker, Siamak Azodolmolky, “Software-Defined Networking with OpenFlow”, 2 nd Edition, O’Reilly Media, 2017.															
Course Outcomes:													Blooms Taxonomy		
CO1:	Describe the motivation behind SDN and its data plane (K2)												Remember		
CO2:	Identify the functions of control plane (K3)												Analysis		
CO3:	Apply SDN to networking applications (K3)												Apply		
CO4:	Apply various operations of network function virtualization												Apply		
CO5:	Explain various use cases of SDN												Undersatnd		
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	-	-	-	-	-	3	3	3	2
CO2	3	3	3	2	2	2	-	-	-	-	-	3	3	2	2
CO3	3	3	3	3	1	2	-	-	-	-	-	3	2	3	2
CO4	2	3	3	2	2	1	-	-	-	-	-	2	2	1	2
CO5	3	3	2	2	2	1	-	-	-	-	-	2	2	2	2

23ECE47	MASSIVE MIMO NETWORKS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					

Course Objectives:		
- To gain knowledge about massive MIMO networks. - To understand the massive MIMO propagation channels. - To learn about channel estimation in single cell and multicell massive MIMO systems. - To comprehend the concepts of massive MIMO deployment in the context of single cell and multicell deployment		
Unit I	MASSIVE MIMO NETWORKS	9
Definition of Massive MIMO, Correlated Rayleigh Fading, System Model for Uplink and Downlink, Basic Impact of Spatial Channel Correlation, Channel Hardening and Favorable Propagation, Local Scattering Spatial Correlation Model		
Unit II	THE MASSIVE MIMO PROPAGATION CHANNEL	9
Favorable Propagation and Deterministic Channels-Capacity Upper Bound-Distance from Favorable Propagation-Favorable Propagation and Linear Processing-Singular Values and Favorable Propagation, Favorable Propagation and Random Channels-Independent Rayleigh Fading-Uniformly Random Line-of-Sight (UR-LoS)-Independent Rayleigh Fading versus UR-LoS - Finite-Dimensional Channels		
Unit III	SINGLE-CELL SYSTEMS	9
Uplink Pilots and Channel Estimation - Orthogonal Pilots- De-Spreading of the Received Pilot Signal-MMSE Channel Estimation, Uplink Data Transmission - Zero-Forcing -Maximum-Ratio, Downlink Data Transmission-Linear Precoding-Zero-Forcing-Maximum-Ratio, Discussion- Interpretation of the Effective SINR Expressions-Implications for Power Control-Scaling Laws and Upper Bounds on the SINR - Near-Optimality of Linear Processing when $M \gg K$ - Net Spectral Efficiency - Limiting Factors: Number of Antennas and Mobility		
Unit IV	MULTI-CELL SYSTEMS	9
Uplink Pilots and Channel Estimation, Uplink Data Transmission - Zero-Forcing -Maximum-Ratio, Downlink Data Transmission -Zero-Forcing - Maximum-Ratio, Discussion -Asymptotic Limits with Infinite Numbers of Base Station Antennas - The Effects of Pilot Contamination - Non-Synchronous Pilot Interference		
Unit V	CASE STUDIES	9
Single-Cell Deployment Example: Fixed Broadband Access in Rural Area, Multi-Cell Deployment: Preliminaries and Algorithms, Multi-Cell Deployment Examples: Mobile Access - Dense Urban Scenario - Suburban Scenario - Minimum Per-Terminal Throughput Performance –Additional Observations - Comparison of Power Control Policies		
Total periods: 45		
Text Books:		
1. Thomas L. Marzetta, Erik G. Larsson, Hong Yang, Hien Quoc Ngo, “Fundamentals of Massive MIMO”, Cambridge University Press 2016. (UNITS II-V)		
2. Emil Björnson, Jakob Hoydis and Luca Sanguinetti (2017), “Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency”, Foundations and Trends, Now, 2017. (UNIT I)		
References:		
1. Long Zhao, Hui Zhao, Kan Zheng, “Wei Xiang Massive MIMO in 5G Networks: Selected Applications”, Springer 2018.		
2. Leibo Liu, Guiqiang Peng, Shaojun Wei, “Massive MIMO Detection Algorithm and VLSI Architecture”, Springer 2019.		
3. Shahid Mumtaz, Jonathan Rodriguez, Linglong Dai, “mmWave Massive MIMO A Paradigm for 5G”, Elsevier, 2017		
Course Outcomes:		Blooms Taxonomy
CO1:	Understand and explain massive MIMO networks	Understand
CO2:	Analyze massive MIMO propagation channels and their capacity bounds	Analysis
CO3:	Examine channel estimation techniques for single cell system.	Analysis
CO4:	Analyze channel estimation techniques for multi cell system.	Analysis
CO5:	Explain the concepts underlining the deployment of single and multicell massive MIMO systems.	Understand

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

23ECE48	ADVANCED WIRELESS COMMUNICATION TECHNIQUES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To understand the evolving paradigm of cooperative communication - To understand concepts related to green wireless communication - To enable the student to understand the different power saving strategies and energy efficient signal, system and network design. - To expose the student to the energy saving techniques adopted in existing wireless components - To provide understanding on protocols and networks related to green future wireless communication technologies.					
Unit I	COOPERATIVE COMMUNICATIONS AND GREEN CONCEPTS				9
Network architectures and research issues in cooperative cellular wireless networks ; Cooperative communications in OFDM and MIMO cellular relay networks: issues and approaches; Fundamental trade-offs on the design of green radio networks, Green modulation and coding schemes.					
Unit II	COOPERATIVE TECHNIQUES				9
Cooperative techniques for energy efficiency, Cooperative base station techniques for cellular wireless networks; Turbo base stations; Antenna architectures for cooperation; Cooperative communications in 3GPP LTE-Advanced, Partial information relaying and Coordinated multi-point transmission in LTE-Advanced.					
Unit III	RELAY-BASED COOPERATIVE CELLULAR NETWORKS				9
Distributed space-time block codes ; Collaborative relaying in downlink cellular systems ; Radio resource optimization; Adaptive resource allocation ; Cross-layer scheduling design for cooperative wireless two-way relay networks ; Network coding in relay-based networks.					
Unit IV	GREEN RADIO NETWORKS				9
Base Station Power-Management Techniques- Opportunistic spectrum and load management, Energy-saving techniques in cellular wireless base stations , Power-management for base stations in smart grid environment, Cooperative multi cell processing techniques for energy-efficient cellular wireless communications.					
Unit V	ACCESS TECHNIQUES FOR GREEN RADIO NETWORKS				9
Cross-layer design of adaptive packet scheduling for green radio networks; Energy-efficient relaying for cooperative cellular wireless networks ; Energy performance in TDD-CDMA multihop cellular networks ; Resource allocation for green communication in relay-based cellular networks ; Green Radio Test-Beds and Standardization Activities.					
Total periods: 45					
Text Books:					
1. Ekram Hossain, Dong In Kim, Vijay K. Bhargava , “Cooperative Cellular Wireless Networks”, Cambridge University Press, 2011.					

2. Ekram Hossain, Vijay K. Bhargava(Editor), Gerhard P. Fettweis (Editor), “Green Radio Communication Networks”, Cambridge University Press, 2012.															
References:															
1. F. Richard Yu, Yu, Zhang and Victor C. M. Leung “Green Communications and Networking”, CRC press, 2012.															
2. Ramjee Prasad and Shingo Ohmori, Dina Simunic, “Towards Green ICT”, River Publishers,2010.															
3. Jinsong Wu, Sundeep Rangan and Honggang Zhang, “Green Communications: Theoretical Fundamentals, Algorithms and Applications”, CRC Press, 2012.															
Course Outcomes:													Blooms Taxonomy		
CO1: The student would be able to appreciate the necessity and the design aspects of cooperative communication													Create		
CO2: The student would be able to appreciate the necessity and the design aspects of green wireless communication.													Create		
CO3: The student would be able to evolve new techniques in wireless communication													Analysis		
CO4: The students would be able to demonstrate the feasibility of using mathematical models using simulation tools.													Apply		
CO5: The student would be able to demonstrate the impact of the green engineering solutions in a global, economic, environmental and societal context.													Apply		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	1	-	-	-	-	-	2	3	3	3
CO2	3	3	3	2	2	1	-	-	-	-	-	2	3	2	3
CO3	3	2	2	1	2	1	-	-	-	-	-	2	2	1	1
CO4	3	3	3	3	2	1	-	-	-	-	-	2	3	1	2
CO5	3	3	3	2	1	2	-	-	-	-	-	2	2	3	1

OPEN ELECTIVE -I

23ECO001	SPACE SCIENCE	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites :Nil					
Course Objectives: - To outline the space environment and their effects. - To extend the origin of universe and development. - To classify the galaxies and their evolution. - To interpret the variable stars in the galaxies. - To explain theory of formation of our solar system.					
Unit I	INTRODUCTION				9
Introduction to space science and applications – historical development – Space Environment- Vacuum and its Effects, Plasma & Radiation Environments and their Effects, Debris Environment and its Effects - Newton's Law of gravitation – Fundamental Physical Principles.					
Unit II	ORIGIN OF UNIVERSE				9
Early history of the universe – Big-Bang and Hubble expansion model of the universe – cosmic microwave background radiation – dark matter and dark energy.					
Unit III	GALAXIES				9

Galaxies, their evolution and origin – active galaxies and quasars – Galactic rotation – Stellar populations – galactic magnetic field and cosmic rays..																
Unit IV		STARS													9	
Stellar spectra and structure – stellar evolution – Nucleo-synthesis and formation of elements – Classification of stars – Harvard classification system – Hertsprung-Russel diagram – Luminosity of star – variable stars – composite stars (white dwarfs, Neutron stars, black hole, star clusters, supernova and binary stars) – Chandrasekhar limit.																
Unit V		SOLAR SYSTEM													9	
Nebular theory of formation of our Solar System – Solar wind and nuclear reaction as the source of energy – Sun and Planets: Brief description about shape size – period of rotation about axis and period of revolution – distance of planets from sun – Bode's law – Kepler's Laws of planetary motion – Newton's deductions from Kepler's Laws – correction of Kepler's third law – determination of mass of earth – determination of mass of planets with respect to earth – Brief description of Asteroids – Satellites and Comets.																
Total periods: 45																
Text Books:																
10. Hess W., “Introduction to Space Science”, Gordon & Breach Science Pub; Revised Ed., 1968.																
11. Krishnaswami K. S., “Astrophysics: A modern Perspective”, New Age International, 2006.																
References:																
6. Arnab Rai Choudhuri, “Astrophysics for Physicists”, Cambridge University Press, New York, 2010.																
7. Krishnaswami K. S., “Understanding cosmic Panorama”, New Age International, 2008.																
Course Outcomes:													Blooms Taxonomy			
CO1: Obtain a broad, basic knowledge of the space sciences.													Understand			
CO2: Explain the scientific concepts such as evolution by means of natural selection, age of the Earth and solar system and the Big-Bang.													Remember			
CO3: Describe the main features and formation theories of the various types of observed galaxies, in particular the Milky Way.													Understand			
CO4: Explain stellar evolution, including red giants, supernovas, neutron stars, pulsars, white dwarfs and black holes, using evidence and presently accepted theories;.													Apply			
CO5: Describe the presently accepted formation theories of the solar system based upon observational and physical constraints;													Apply			
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	1	2				
CO2		1		3	3			3	2	1	1	2				
CO3		2		1				1	2	1	1	2				
CO4		1		3	1			3	2	1	1	2				
CO5		1	1	3	2			1	2	1	1	2				

23MEO022	INTRODUCTION TO INDUSTRIAL INSTRUMENTATION AND CONTROL	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites :Nil					

Course Objectives:		
- To introduce common unit operations carried out in process industries. - To impart knowledge about the important unit operations taking place in process industries To - To prepare them to take up a case study on selected process industries like petrochemical industry, power plant industry and paper & pulp industry to make the students understand the different measurement and control techniques for important processes. - Facilitate the students to apply knowledge to select appropriate measurement technique and control strategy for a given process.		
Unit I	COMMON UNIT OPERATIONS IN PROCESS INDUSTRIES -I	9
Unit Operation, Measurement and Control:-Transport of solid, liquid and gases - Evaporators – Crystallizers-Dryers.		
Unit II	COMMON UNIT OPERATIONS IN PROCESS INDUSTRIES -II	9
Unit Operation, Measurement and Control: - Distillation – Refrigeration processes – Chemical reactors		
Unit III	PROCESS MEASUREMENT AND CONTROL IN PETROCHEMICAL INDUSTRY	9
Process flow diagram of Petro Chemical Industry - Gas oil separation in production platform – wet gas processing – Fractionation Column – Catalytic Cracking unit – Catalytic reforming unit		
Unit IV	PROCESS MEASUREMENT AND CONTROL IN THERMAL POWER PLANT INDUSTRY	9
Process flow diagram of Coal fired thermal Power Plant– Coal pulverizer - Deaerator – Boiler drum – Super heater – Turbines.		
Unit V	PROCESS MEASUREMENT AND CONTROL IN PAPER & PULP INDUSTRY	9
Process flow diagram of paper and pulp industry – Batch digester – Continuous sulphated digester – Control problems on the paper machine.		
Total periods: 45		
Text Books:		
1. Balchen ,J.G., and Mumme, K.J., “ Process Control structures and applications”, Van Nostrand Reinhold Co., New York, 1988		
2. Warren L. McCabe, Julian C. Smith and Peter Harriot, “Unit Operations of Chemical Engineering”, McGraw-Hill International Edition, New York, Sixth Edition, 2001.		
References:		
1. Liptak B.G., “Instrument and Automation Engineers' Handbook: Process Measurement and Analysis”, Fifth Edition, CRC Press, 2016.		
2. James R.couper, Roy Penny, W., James R.Fair and Stanley M.Walas, “Chemical Process Equipment: Selection and Design”, Gulf Professional Publishing, 2010.		
3. Austin G.T and Shreeves, A.G.T., “Chemical Process Industries”, McGraw–Hill International student, Singapore, 1985.		
4. Luyben W.C., “Process Modeling, Simulation and Control for Chemical Engineers”, McGraw-Hill International edition, USA, 1989.		
5. K. Krishnaswamy, Process Control, new age publishers , 2009.		
Course Outcomes:		Blooms Taxonomy
CO1:	Understand common unit operations in process industries. L2	Understand
CO2:	Identify the dynamics of important unit operations in petro chemical industry. L2	Apply

CO3: Develop understanding of important processes taking place selected case studies namely petrochemical industry, power plant industry and paper & pulp industry. L5													Analyse		
CO4: Select appropriate measurement techniques for selective processes. L5.													Apply		
CO5: Develop controller structure based on the process knowledge. L5													Apply		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1					1		1					
CO2	3	3	1					1		1	2				2
CO3	3	3	1					1		1					
CO4	3	3	1		3			1		1			3	3	
CO5	3	3	3			3		1		1			3	3	3

23CE0013	CLIMATE CHANGE AND ITS IMPACT		Category: OEC			
			L	T	P	C
			3	0	0	3
Prerequisites Nil						
Course Objectives: - To understand the basics of weather and climate - To have an insight on Atmospheric dynamics and transport of heat - To develop simple climate models and evaluate climate changes using models .						
Unit I	Basics Of Weather And Climate					9
Shallow film of Air– stratified & disturbed atmosphere – law – atmosphere Engine. Observation of parameters: Temperature – Humidity – Wind – Pressure – precipitation-surface – networks. Constitution of atmosphere: well stirred atmosphere – process around turbopause – in dry air – ozone – carbon Dioxide – Sulphur Dioxide– Aerosol – water. Evolution of Atmosphere. State of atmosphere: Air temperature – pressure – hydrostatic – Chemistry – Distribution – circulation						
Unit II	Atmospheric Dynamics					9
Atmosphere dynamics: law – isobaric heating and cooling – adiabatic lapse rates – equation of motion – solving and forecasting. Forces – Relative and absolute acceleration – Earth’s rotation coriolis on sphere – full equation of motion – Geostrophy;- Thermal winds –departures – small- scale motion. Radiation, convection and advections: sun & solar radiation – energy balance – terrestrial radiation and the atmosphere – Green house effect- Global warming – Global budget – radiative fluxes – heat transport. Atmosphere and ocean systems convecting & advecting heat. Surface and boundary layer – smaller scale weather system – larger scale weather system.						
Unit III	Global Climate					9
Components and phenomena in the climate system: Time and space scales – interaction and parameterization problem. Gradients of Radiative forcing and energy transports by atmosphere and ocean – atmospheric circulation – latitude structure of the circulation – latitude – longitude dependence of climate features. Ocean circulation: latitude – longitude dependence of climate features – ocean vertical structure – ocean thermohaline circulation – land surface processes – carbon cycle.						
Unit IV	Climate System Processes					9
Conservation of motion: Force – coriolis – pressure gradient- velocity equations – Application – geotropic wind – pressure co-ordinates. Equation of State – atmosphere – ocean. Application: thermal circulation – sea level rise. Temperature equation: Ocean – air – Application – decay of sea surface temperature. Continuity equation: ocean – atmosphere. Application: coastal upwelling – equatorial upwelling – conservation of warm water mass. Moisture and salinity equation: conservation of mass – moisture. Source & sinks – latent heat. Moist processes – saturation – convection – Wave processes in atmosphere and ocean.						
Unit V	Climate Change Models					9

Constructing a climate model – climate system modeling – climate simulation and drift – Evaluation of climate model simulation – regional (RCM) – global (GCM) – Global average response to warming – climate change observed to date.															
Total periods: 45															
Text Books:															
1. Fundamentals of weather and climate (2nd Edition) Robin Moilveen (2010), Oxford University Press 2.															
References:															
1. Climate change and climate modeling, J. David Neelin (2011) Cambridge University press.															
Course Outcomes:													Blooms Taxonomy		
CO1: Describe the constitution and structure of the atmosphere													Understand		
CO2: Apply the fundamental laws of atmospheric dynamics,													Apply		
CO3: Analyze the major components and phenomena of the global climate system.													Analyse		
CO4: Utilize the core mathematical principles of conservation													Apply		
CO5: Evaluate the methodology for constructing and evaluating climate models													Evaluate		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	1	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	1	-	-
CO5	3	2	3	-	-	-	-	-	-	-	-	-	1	-	-

23EE0011	RENEWABLE ENERGY SYSTEM	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To Provide knowledge about various renewable energy technologies - To enable students to understand and design a PV system. - To provide knowledge about wind energy system. - To Provide knowledge about various possible hybrid energy systems - To gain knowledge about application of various renewable energy technologies					
Unit I	INTRODUCTION				9
Primary energy sources, renewable vs. non-renewable primary energy sources, renewable energy resources in India, Current usage of renewable energy sources in India, future potential of renewable energy in power production and development of renewable energy technologies.					
Unit II	SOLAR ENERGY				9
Solar Radiation and its measurements, Solar Thermal Energy Conversion from plate Solar Collectors, Concentrating Collectors and its Types, Efficiency and performance of collectors,. Direct Solar Electricity Conversion from Photovoltaic, types of solar cells and its application of battery charger, domestic lighting, street lighting, and water pumping, power generation schemes. Recent Advances in PV Applications: Building Integrated PV, Grid Connected PV Systems.					
Unit III	WIND ENERGY				9
Wind energy principles, wind site and its resource assessment, wind assessment, Factors influencing wind, wind turbine components, wind energy conversion systems (WECS), Classification of WECS devices, wind electric generating and control systems, characteristics and applications..					

Unit IV	BIO-ENERGY												9		
Energy from biomass, Principle of biomass conversion technologies/process and their classification, Bio gas generation, types of biogas plants, selection of site for biogas plant, classification of biogas plants, Advantage and disadvantages of biogas generation, thermal gasification of biomass, biomass gasifies, Application of biomass and biogas plants and their economics.															
Unit V	OTHER TYPES OF ENERGY												9		
Energy conversion from Hydrogen and Fuel cells, Geo thermal energy Resources, types of wells, methods of harnessing the energy, potential in India. OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini- hydel power plants and their economics..															
Total periods: 45															
Text Books:															
1. Twidell & Wier,‘Renewable Energy Resources’ CRC Press(Taylor & Francis).															
2. Tiwari and Ghosal/ Narosa,‘Renewable energy resources’.															
References:															
1. D.P.Kothari, K.C.Singhal,‘Renewable energy sources and emerging technologies’, P.H.I.															
2. D.S.Chauhan, S.K. Srivastava, ‘Non – Conventional Energy Resources’, New Age Publishers, 2006.															
3. B.H.Khan, ‘Non – Conventional Energy Resources’, Tata Mc Graw Hill, 2006.															
Course Outcomes:													Blooms Taxonomy		
CO1: Attained knowledge about various renewable energy technologies													Apply		
CO2: Ability to understand and design a PV system.													Understand		
CO3: Understand the concept of various wind energy system.													Understand		
CO4: Gained knowledge about various possible hybrid energy systems													Apply		
CO5: Attained knowledge about various application of renewable energy technologies													Apply		
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	-	-	3
CO2	3	2	-	-	-	3	3	3	-	-	-	2	-	-	3
CO3	3	2	-	-	-	3	3	3	-	-	-	2	-	-	3
CO4	2	2	-	-	-	3	3	3	-	-	-	2	-	-	3
CO5	2	2	-	-	-	3	3	3	-	-	-	2	-	-	3

23EE0012	INTRODUCTION TO INDUSTRIAL INSTRUMENTATION AND CONTROL	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites :Nil					
Course Objectives:					
- To introduce common unit operations carried out in process industries. - To impart knowledge about the important unit operations taking place in process industries To - To prepare them to take up a case study on selected process industries like petrochemical industry, power plant industry and paper & pulp industry to make the students understand the different measurement and control techniques for important processes. - Facilitate the students to apply knowledge to select appropriate measurement technique and control strategy for a given process.					

•		
Unit I	COMMON UNIT OPERATIONS IN PROCESS INDUSTRIES -I	9
Unit Operation, Measurement and Control:-Transport of solid, liquid and gases - Evaporators – Crystallizers-Dryers.		
Unit II	COMMON UNIT OPERATIONS IN PROCESS INDUSTRIES -II	9
Unit Operation, Measurement and Control: - Distillation – Refrigeration processes – Chemical reactors		
Unit III	PROCESS MEASUREMENT AND CONTROL IN PETROCHEMICAL INDUSTRY	9
Process flow diagram of Petro Chemical Industry - Gas oil separation in production platform – wet gas processing – Fractionation Column – Catalytic Cracking unit – Catalytic reforming unit		
Unit IV	PROCESS MEASUREMENT AND CONTROL IN THERMAL POWER PLANT INDUSTRY	9
Process flow diagram of Coal fired thermal Power Plant– Coal pulverizer - Deaerator – Boiler drum – Super heater – Turbines.		
Unit V	PROCESS MEASUREMENT AND CONTROL IN PAPER & PULP INDUSTRY	9
Process flow diagram of paper and pulp industry – Batch digester – Continuous sulphate digester – Control problems on the paper machine.		
Total periods: 45		
Text Books:		
1. Balchen ,J.G., and Mumme, K.J., “ Process Control structures and applications”, Van Nostrand Reinhold Co., New York, 1988		
2. Warren L. McCabe, Julian C. Smith and Peter Harriot, “Unit Operations of Chemical Engineering”, McGraw-Hill International Edition, New York, Sixth Edition, 2001.		
References:		
1. Liptak B.G., “Instrument and Automation Engineers' Handbook: Process Measurement and Analysis”, Fifth Edition, CRC Press, 2016.		
2. James R.couper, Roy Penny, W., James R.Fair and Stanley M.Walas, “Chemical Process Equipment: Selection and Design”, Gulf Professional Publishing, 2010.		
3. Austin G.T and Shreeves, A.G.T., “Chemical Process Industries”, McGraw–Hill International student, Singapore, 1985.		
4. Luyben W.C., “Process Modeling, Simulation and Control for Chemical Engineers”, McGraw-Hill International edition, USA, 1989.		
5. K. Krishnaswamy, Process Control, new age publishers , 2009.		
Course Outcomes:		Blooms Taxonomy
CO1:	Understand common unit operations in process industries. L2	Understand
CO2:	Identify the dynamics of important unit operations in petro chemical industry. L2	Apply
CO3:	Develop understanding of important processes taking place selected case studies namely petrochemical industry, power plant industry and paper & pulp industry. L5	Analyse
CO4:	Select appropriate measurement techniques for selective processes. L5.	Apply
CO5:	Develop controller structure based on the process knowledge. L5	Apply

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

23MAO007	GRAPH THEORY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites: Nil					
Course Objectives: - To understand the graph models and basic concepts of graphs. - To study the characterization and properties of trees and graph connectivity. - To provide an exposure to the Eulerian and Hamiltonian graphs - To introduce Graph colouring and explain its significance. - To provide an understanding of Optimization Graph Algorithms.					
Unit I	INTRODUCTION TO GRAPHS				9
Graphs and Graph Models – Connected graphs – Common classes of graphs – Multi graphs and Digraphs – Degree of a vertex – Degree Sequence – Graphs and Matrices – Isomorphism of graphs.					
Unit II	TREES AND CONNECTIVITY				9
Bridges – Trees – Characterization and properties of trees – Cut vertices – Connectivity.					
Unit III	TRAVERSABILITY				9
Eulerian graphs – Characterization of Eulerian graphs – Hamiltonian graphs – Necessary condition for Hamiltonian graphs – Sufficient condition for Hamiltonian graphs.					
Unit IV	PLANARITY AND COLOURING				9
Planar Graphs – The Euler Identity – Non planar Graphs – Vertex Colouring – Lower and Upper bounds of chromatic number.					
Unit V	OPTIMIZATION GRAPH ALGORITHMS				9
Dijkstra’s shortest path algorithm – Kruskal’s and Prim’s minimum spanning tree algorithms – Transport Network – The Max-Flow Min-Cut Theorem – The Labeling Procedure – Maximum flow problem.					
Total periods: 45					
Text Books:					
1. Gary Chatrand and Ping Zhang, “Introduction to Graph Theory”, Tata McGraw – Hill companies Inc., New York, 2006.					
2. Ralph P. Grimaldi, “Discrete and Combinatorial Mathematics, An applied introduction" Fifth edition, Pearson Education, Inc, Singapore, 2004.					
References:					
1. BalakrishnanR. and Ranganathan K.,“A Text Book of Graph Theory”, Springer – Verlag, New York, 2012.					

2. Douglas B. West, "Introduction to Graph Theory", Pearson, Second Edition, New York, 2018															
Course Outcomes:													Blooms Taxonomy		
CO1: Apply graph models for solving real world problem.													Apply		
CO2: Understand the importance the natural applications of trees and graph connectivity.													Understand		
CO3: Understand the characterization study of Eulerian graphs and Hamiltonian graphs													Understand		
CO4: Apply the graph colouring concepts in partitioning problems.													Apply		
CO5: Apply the standard optimization graph algorithms in solving application problems													Apply		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3												
CO2		2	2		2										
CO3		2	2	2						2					
CO4	2	2	2												
CO5		3	2		2					3					

23CSO006	NEURAL NETWORKS AND DEEP LEARNING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites: Nil					
Course Objectives: - To understand the basics in deep neural networks - To understand the basics of associative memory and unsupervised learning networks - To apply CNN architectures of deep neural networks - To analyze the key computations underlying deep learning, then use them to build and train deep neural networks for various tasks. - To apply autoencoders and generative models for suitable applications.					
Unit I	INTRODUCTION				9
Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: An Introduction- Evolution of Neural Networks-Basic Models of Artificial Neural Network- Important Terminologies of ANNs-Supervised Learning Network.					
Unit II	ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS				9
Training Algorithms for Pattern Association-Autoassociative Memory Network-Heteroassociative Memory Network-Bidirectional Associative Memory (BAM)-Hopfield Networks-Iterative Auto associative Memory Networks-Temporal Associative Memory Network-Fixed Weight Competitive Nets-Kohonen Self-Organizing Feature Maps-Learning Vector Quantization-Counter propagation Networks-Adaptive Resonance Theory Network					
Unit III	THIRD-GENERATION NEURAL NETWORKS				9
Spiking Neural Networks-Convolutional Neural Networks-Deep Learning Neural Networks-Extreme Learning Machine Model-Convolutional Neural Networks: The Convolution Operation – Motivation – Pooling – Variants of the basic Convolution Function – Structured Outputs – Data Types – Efficient Convolution Algorithms – Neuroscientific Basis – Applications: Computer Vision, Image Generation, Image Compression					
Unit IV	DEEP FEEDFORWARD NETWORKS				9
History of Deep Learning- A Probabilistic Theory of Deep Learning- Gradient Learning – Chain Rule and Backpropagation - Regularization: Dataset Augmentation – Noise Robustness -Early Stopping, Bagging and Dropout - batch normalization- VC Dimension and Neural Nets.					
Unit V	RECURRENT NEURAL NETWORKS				9

Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Applications: Image Generation, Image Compression, Natural Language Processing. Complete Auto encoder, Regularized Autoencoder, Stochastic Encoders and Decoders, Contractive Encoders															
Total periods: 45															
Text Books:															
1. Ian Good fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.															
2. Francois Chollet, “Deep Learning with Python”, Second Edition, Manning Publications, 2021.															
References:															
1. Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and Tensor Flow”, Oreilly, 2018															
2. Josh Patterson, Adam Gibson, “Deep Learning: A Practitioner’s Approach”, O’Reilly Media, 2017.															
3. Charu C. Aggarwal, “Neural Networks and Deep Learning: A Textbook”, Springer International Publishing, 1st Edition, 2018.															
4. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018															
5. Deep Learning Projects Using Tensor Flow 2, Vinita Silaparasetty, Apress, 2020															
6. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017.															
7. S Rajasekaran, G A Vijayalakshmi Pai, “Neural Networks, FuzzyLogic and Genetic Algorithm, Synthesis and Applications”, PHI Learning, 2017.															
8. Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017															
9. James A Freeman, David M S Kapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Addison Wesley, 2003.															
Course Outcomes:													Blooms Taxonomy		
CO1: To understand the basics in deep neural networks													Understand		
CO2: To understand the basics of associative memory and unsupervised learning networks													Understand		
CO3: To apply CNN architectures of deep neural networks													Apply		
CO4: To analyze the key computations underlying deep learning, then use them to build and train deep neural networks for various tasks.													Analyze		
CO5: To apply auto encoders and generative models for suitable applications.													Apply		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	1	-	-	2	1			2	2	1
CO2	3	1	2	1	-	-	-	-	-	1	2	2	-	1	-
CO3	3	3	3	3	3	1	-	-	2	1			2	2	1
CO4	3	3	3	3	3	-	-	-	2	-	2	3	2	2	2
CO5	1	1	3	2	3	-	-	-	2	-			1	1	-

23CSO006	DIGITAL MARKETING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites: Nil					

Course Objectives:		
- The primary objective of this module is to examine and explore the role and importance of digital marketing in today's rapidly changing business environment. - It also focuses on how digital marketing can be utilized by organizations and how its effectiveness can be measured.		
Unit I	INTRODUCTION TO ONLINE MARKET	9
Online Market space- Digital Marketing Strategy- Components - Opportunities for building Brand Website - Planning and Creation - Content Marketing.		
Unit II	SEARCH ENGINE OPTIMISATION	9
Search Engine optimisation - Keyword Strategy- SEO Strategy - SEO success factors -On-Page Techniques - Off-Page Techniques. Search Engine Marketing- How Search Engine works- SEM components- PPC advertising - Display Advertisement		
Unit III	E- MAIL MARKETING	9
E- Mail Marketing - Types of E- Mail Marketing - Email Automation - Lead Generation - Integrating Email with Social Media and Mobile- Measuring and maximizing email campaign effectiveness. Mobile Marketing- Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns-Profiling and targeting		
Unit IV	SOCIAL MEDIA MARKETING	9
Social Media Marketing - Social Media Channels- Leveraging Social media for brand conversations and buzz. Successful /benchmark Social media campaigns. Engagement Marketing- Building Customer relationships - Creating Loyalty drivers - Influencer Marketing.		
Unit V	DIGITAL TRANSFORMATION	9
Digital Transformation & Channel Attribution- Analytics- Ad-words, Email, Mobile, social media, Web Analytics - Changing your strategy based on analysis- Recent trends in Digital marketing.		
Total periods: 45		
Text Books:		
1. Fundamentals of Digital Marketing by Puneet Singh Bhatia;Publisher: Pearson Education;		
2. First edition (July 2017);ISBN-10: 933258737X;ISBN-13: 978-9332587373.		
References:		
1. Digital Marketing by Vandana Ahuja ;Publisher: Oxford University Press (April 2015). ISBN-10: 0199455449		
2. Marketing 4.0: Moving from Traditional to Digital by Philip Kotler;Publisher: Wiley; 1st edition (April 2017); ISBN10: 9788126566938;ISBN 13: 9788126566938;ASIN: 8126566930.		
3. Ryan, D. (2014). Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, Kogan Page Limited.		
4. Barker, Barker, Bormann and Neher(2017), Social Media Marketing: A Strategic Approach, 2E South-Western ,Cengage Learning.		
5. Pulizzi,J Beginner's Guide to Digital Marketing , Mcgraw Hill Education		
1.		
Course Outcomes:		Blooms Taxonomy
CO1:	To examine and explore the role and importance of digital marketing in today's rapidly changing business environment	Analyze
CO2:	To focuses on how digital marketing can be utilized by organizations and how its effectiveness can be measured.	Apply
CO3:	To know the key elements of a digital marketing strategy	Analyse
CO4:	To study how the effectiveness of a digital marketing campaign can be measured.	Understanding

CO5: To demonstrate advanced practical skills in common digital marketing tools such as SEO, SEM, Social media and Blogs.													Apply		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	3				1	2	3	3	3	3	3
CO2	2	2	2	1	3				1	2	3	3	3	3	3
CO3	1	1	1	2	2				1	2	1	1	3	2	1
CO4	3	2	2	3	1				1	3	2	3	2	3	2
CO5	2	3	1	3	3				2	3	1	2	1	2	1

OPEN ELECTIVES – II

23MGO008	RESOURCE MANAGEMENT TECHNIQUES	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - Learn to formulate linear programming problems and solve LPP using simple algorithm - Learn to solve networking problems - Learn to formulate and solve integer programming problems - Learn to solve Non Linear programming problems - Learn to understand and solve project management problems					
Unit I	LINEAR PROGRAMMING				9
Principal components of decision problem – Modeling phases – LP formulation and graphic solution – Resource allocation problems – simplex method – sensitivity analysis.					
Unit II	DUALITY AND NETWORKS				9
Definition of dual problems – primal – Dual relationships – Dual simplex method –post optimality analysis – Transportation and assignment model – Shortest route problem.					
Unit III	INTEGER PROGRAMMING				9
Cutting plan algorithm – Branch and bound methods, Multistage (Dynamic) programming.					
Unit IV	CLASSICAL OPTIMISATION THEROY:				9
Unconstrained external problems, Newton – Ralphson method – Equality constraints –Jacobean methods – Lagrangian method – Kuhn – Tucker conditions – Simple problems.					
Unit V	OBJECT SCHEDULOING:				9
Network diagram representation – Critical path method – Time charts and resource leveling – PERT.					
Total periods: 45					
Text Books:					
12. H.A. Taha, “Operation Research”, Prentice Hall of India, 2002.					
References:					
8. Paneer selvam, ‘Operations Research’ Prentice Hall of India, 2002.					
9. Anderson ‘Quantitative Methods for Business’, 8th Edition, Thomson Learning, 2002.					
10. Winston ‘Operations Research for Business’, Thomson Learning, 2003.					
11. Vohra, ‘Quantitative Techniques in Management’, Tata Mc Graw Hill, 2002.					
12. Anand sarma, ‘Operation Research’ Himalaya Publishing House, 2003.					
Course Outcomes:					Blooms Taxonomy
CO1:	Understand to formulate linear programming problems and solve LPP using simple algorithm				Apply

CO2: Understand to solve networking problems													Analyze		
CO3: Understand to formulate and solve integer programming problems													Apply		
CO4: Understand to solve Non Linear programming problems													Apply		
CO5: Understand to understand and solve project management problems													Analyze		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1				1				3	2	1
CO2	3	3	2	2	2				1				3	2	1
CO3	3	3	2	2	2				1				3	2	1
CO4	3	3	2	2	2				1				3	2	1
CO5	3	3	2	2	3	1			2				3	2	1

23MGO009	FINTECH REGULATION		Category: OEC			
			L	T	P	C
			3	0	0	3
Prerequisites Nil						
Course Objectives: - To learn about Laws and Regulation - To acquire the knowledge of Regulations of Fintech firm and their role in Market						
Unit I	INTRODUCTION					9
The Role of the Regulators, Equal Treatment and Competition, Need for a regulatory assessment of Fintech, India Regulations, The Risks to Consider, Regtech and SupTech, The rise of TechFins, Regulatory sandboxes, compliance and whistleblowing.						
Unit II	INNOVATION AND REGULATION					9
The technology, market and the law, Regulation and Innovation in Banking and Finance, Regulations of Fintech Firms and their role in Market-Based Chains, Current Regulatory Approach, Fintech Innovations in Banking, Asset Management, Insurance, Pensions and Healthcare Schemes, Patentability of FinTech inventions						
Unit III	CROWDFUNDING AND DIGITAL ASSETS					9
Types of crowdfunding, The Jobs Act, Regulation crowdfunding, Regulation A+, Regulation D crowdfunding, Intrastate offerings, Digital Assets – Three uses of Digital Assets, A world of Altcoins, Stablecoins, Digital Asset Forks, Initial Coin Offerings, Regulatory Framework for Digital and Crypto Assets, Central Bank Digital Currencies						
Unit IV	MARKETPLACE LENDING AND MOBILE PAYMENTS					9
Online Lending Business Models, Payday Loans, Consumer Protection Laws, Debt Collection, Equal Credit Opportunity Act, Contract Formation and the E-Sign Act, Military Lending Act, Securities Laws Considerations, Mobile Devices, Payment Cards and the Law, Truth in Lending Act and Regulation Z, Card Act, Electronic Fund Transfer Act and Regulation E, Fair Credit Reporting Act, Federal Bank Secrecy Act, State Money Transmitter Laws.						
Unit V	ANTI-MONEY LAUNDERING AND CYBERSECURITY					9
Reporting requirements under the Bank Secrecy Act, Patriot Act, Panalties for violating the BSA, Virtual currencies and the Bank Secrecy Act, Cybersecurity Frameworks, Cybersecurity Act of 2015, Contractual and Self Regulatory obligations						
Total periods: 45						
Text Books:						
1. JelenaMadir, FinTech – Law and Regulation, Edward Elgar Publishing Limited, 2019						
References:						
1. Valerio Lemma, Fintech Regulation : Exploring New Challenges of the Capital Markets						

Union, Palgrave Macmillan, 2020															
2. Chris Brummer, Fintech Law in a Nutshell, West Academic Publishing, 2020															
3. Bernardo Nicoletti, The Future of Fintech, Integrating Finance and Technology in Financial Services, Springer Nature, 2017															
4. Kevin C. Taylor, FinTech Law : A Guide to Technology Law in the Financial Services Industry, BNA Books, 2014															
5. Lee Reiners, FinTech Law and Policy, 2018															
Course Outcomes:													Blooms Taxonomy		
CO1: Understand the role of regulators, regulatory frameworks, and the emerging concepts of Regtech, SupTech, and TechFins in the FinTech ecosystem.													Understand		
CO2: Analyze the impact of innovation and technology in financial services													Analyze		
CO3: Examine crowdfunding models, digital assets, crypto-assets, and regulatory frameworks, including Central Bank Digital Currencies (CBDCs).													Evaluate		
CO4: Evaluate marketplace lending models, mobile payment systems, and compliance with consumer protection and financial laws.													Evaluate		
CO5: Apply regulatory knowledge to assess risks and compliance measures for FinTech operations, innovation, and digital financial services.													Apply		
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				2	2		3	3	
CO2	3	3	2	2	2					2	3		3	3	
CO3	3	3	2	2	2					2	3		3	3	
CO4	3	3	3	2	2	2			2	2	3		3	3	3
CO5	3	3		2	2	3				2	3	2	3	3	3

23BTO007	HOLISTIC NUTRITION	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - Understand the fundamentals of nutrition Explore holistic and traditional health systems - Analyze the relationship between nutrition and the environment - Evaluate various dietary approaches and comparative diets - Apply preventive nutrition principles					
Unit I	NUTRITION AND HEALTH				9
Introduction to the principles of nutrition; Basics of nutrition including; micronutrients (vitamins and minerals), the energy-yielding nutrients (Carbohydrates, Lipids and Proteins), metabolism, digestion, absorption and energy balance. Lipids: their functions, classification, dietary requirements, digestion & absorption, metabolism and links to the major fatal diseases, heart disease and cancer.					
Unit II	AYURVEDA – MIND/BODY HEALING				9
Philosophy of Holistic Nutrition with spiritual and psychological approaches towards attaining optimal health; Principles and practical applications of Ayurveda, the oldest healing system in the world. Three forces – Vata, Pitta and Kapha, that combine in each being into a distinct constitution. Practical dietary and lifestyle recommendations for different constitutions will also be explored in real case studies					

Unit III	NUTRITION AND ENVIRONMENT												9		
Based on an underlying philosophy that environments maintain and promote health and that individuals have a right to self-determination and self-knowledge, Nutrition principles which promote health and prevent disease. Safety of our food supply, naturally occurring and environmental toxins in foods, microbes and food poisoning.															
Unit IV	COMPARATIVE DIETS												9		
Evaluating principles of food dynamics, nutrient proportions, holistic individuality, the law of opposites, food combining, and more. Therapeutic benefits and limitations of several alternative diet approaches, including: modern diets (intermittent fasting, macrobiotics), food combining (colour-therapy/rainbow diet), high protein diets (Ketogenic, Paleo), Vegetarian approaches (plant- based/vegetarian/vegan variations, fruitarian, raw food), as well as cleansing and detoxification diets (caffeine, alcohol, and nicotine detoxes, juice fasts).															
Unit V	PREVENTIVE HEALTH CARE												9		
Proper nutrition protection against, reverse and/or retard many ailments including: osteoporosis, diabetes, atherosclerosis and high blood pressure, arthritis, cancer, anemia, kidney disease and colon cancer. Current research developments on phytochemicals, antioxidants and nutraceuticals will be explored.															
Total periods: 45															
Text Books:															
1. Desai, B. B., Handbook of Nutrition and Diet. Marcel Dekker, New York. 2000															
13. Macrae, R., Rolonson Roles and Sadlu, M.J. 1994. Encyclopedia of Food Science & Technology & Nutrition. Vol. XI. Academic Press															
References:															
1. Modern Nutrition in Health & Disease by Young & Shils.															
2. Food, Nutrition and Diet Therapy – by Krause and Mahan 1996, Publisher- W.B. Saunders, ISBN: 0721658350															
3. Nutritive Value of Indian Foods.- by C. Gopalan, B. V. Rama Sastri, S. C. Balasubramanian Published by National Institute of Nutrition, Indian Council of Medical Research, 1989															
Course Outcomes:													Blooms Taxonomy		
CO1: Discuss the role of essential nutrients in physical, mental and emotional wellness													Understand		
CO2: Discuss the role of deficiencies in essential nutrients in the disease process													Understand		
CO3: Explain how the standard American diet relates to the disease process													Analyze		
CO4: Identify five contemporary eating “styles” and lists the pros and cons of each													Analyze		
CO5: Discuss the concept of whole foods nutrition and its relationship to wellness													Apply		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	2	2				2	1	2	3	3	1
CO2	3	2	2	2	2	2	1	1		2	2	2	3	3	2
CO3	3	3	2	3	2	2				2	2	2	3	3	2
CO4	3	3	3	2	2	2	1	1		2	3	2	3	3	2
CO5	3	3	3	3	2	3	2	2	2	2	3	3	3	3	3

23CSO008	IT IN AGRICULTURE SYSTEM	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
• Nil					

Course Objectives:																
- To introduce the students to areas of agricultural systems in which IT and computers play a major role. - To also expose the students to IT applications in precision farming, environmental control systems, agricultural systems management and weather prediction models.																
Unit I		PRECISION FARMING												9		
Precision agriculture and agricultural management – Ground based sensors, Remote sensing, GPS, GIS and mapping software, Yield mapping systems, Crop production modeling.																
Unit II		ENVIRONMENT CONTROL SYSTEMS												9		
Artificial light systems, management of crop growth in greenhouses, simulation of CO ₂ consumption in greenhouses, on-line measurement of plant growth in the greenhouse, models of plant production and expert systems in horticulture																
Unit III		AGRICULTURAL SYSTEMS MANAGEMENT												9		
Agricultural systems - managerial overview, Reliability of agricultural systems, Simulation of crop growth and field operations, Optimizing the use of resources, Linear programming, Project scheduling, Artificial intelligence and decision support systems.																
Unit IV		WEATHER PREDICTION MODELS												9		
Importance of climate variability and seasonal forecasting, Understanding and predicting world’s climate system, Global climatic models and their potential for seasonal climate forecasting, General systems approach to applying seasonal climate forecasts.																
Unit V		E-GOVERNANCE IN AGRICULTURAL SYSTEMS												9		
Expert systems, decision support systems, Agricultural and biological databases, e-commerce, e- business systems & applications, Technology enhanced learning systems and solutions, e- learning, Rural development and information society.																
Total periods: 45																
Text Books:																
1. National Research Council, “Precision Agriculture in the 21st Century”, National Academies Press, Canada, 1997.																
2. H. Krug, Liebig, H.P. “International Symposium on Models for Plant Growth, Environmental Control and Farm Management in Protected Cultivation”, 1989.																
References:																
1. Peart, R.M., and Shoup, W. D., “Agricultural Systems Management”, Marcel Dekker, New York, 2004																
2. Hammer, G.L., Nicholls, N., and Mitchell, C., “Applications of Seasonal Climate”, Springer, Germany, 2000.																
Course Outcomes:														Blooms Taxonomy		
CO1:	The students shall be able to understand the applications of IT in remote sensing applications such as Drones etc.													Understand		
CO2:	The students will be able to get a clear understanding of how a greenhouse can be automated and its advantages.													Analyze		
CO3:	The students will be able to apply IT principles and concepts for management of field operations.													Apply		
CO4:	The students will get an understanding about weather models, their inputs and applications.													Analyze		
CO5:	The students will get an understanding of how IT can be used for e-governance in agriculture.													Apply		
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	

CO1	3	2	1	2	3	1	-	-	-	2	2	2	1	-	1
CO2	3	3	2	3	2	2	1	1	-	2	2	2	1	-	2
CO3	3	3	3	2	3	2	1	2	2	2	3	2	1	-	3
CO4	3	3	2	3	2	1	1	-	-	2	2	2	1	-	2
CO5	3	3	3	2	3	2	1	2	2	2	3	2	1	-	3

23EEO013	INTRODUCTION TO CONTROL ENGINEERING	Category: OBE			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To introduce the control system components and transfer function model with their graphical representation - To understand the analysis of system in time domain along with steady state error. - To introduce frequency response analysis of systems. - To accord basic knowledge in design of compensators. - To introduce the state space models.					
Unit I	MATHEMATICAL MODELLING				9
Introduction – transfer function – simple electrical, mechanical, ,pneumatic , hydraulic and thermal systems–analogies					
Unit II	FEEDBACK CONTROL SYSTEMS				9
Control system components - Block diagram representation of control systems, Reduction of block diagrams, Signal flow graphs, Output to input ratios					
Unit III	TIME DOMAIN ANALYSIS				9
Response of systems to different inputs viz., Step impulse, pulse, parabolic and sinusoidal inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuit.					
Unit IV	STABILITY ANALYSIS				9
Necessary and sufficient conditions, Routh- Hurwitz criteria of stability, Root locus and Bode techniques, Concept and construction, frequency response					
Unit V	STATE SPACE TECHNIQUE				9
State vectors–state space models-Digital Controllers–design aspects.					
Total periods: 45					
Text Books:					
1. Nagarath, I.J. and Gopal, M., “Control Systems Engineering”, New Age International Publishers,2017.					
2. Benjamin C. Kuo, “Automatic Control Systems”, Wiley, 2014					
References:					
1. Katsuhiko Ogata, “Modern Control Engineering”, Pearson, 2015.					
2. Richard C. Dorf and Bishop, R.H., “Modern Control Systems”, Pearson Education,2009.					
3. John J.D., Azzo Constantine, H. and HouppisSttuart, N Sheldon, “Linear Control System Analysis and Design with MATLAB”, CRC Taylor& Francis Reprint 2009.					
4. RamesC.Panda and T. Thyagarajan, “An Introduction to Process Modelling Identification and Control of Engineers”, Narosa Publishing House, 2017					
5. M. Gopal, “Control System: Principle and design”, McGraw Hill Education, 2012.					

6. NPTEL Video Lecture Notes on “Control Engineering “by Prof. S. D. Agashe, IIT Bombay.															
Course Outcomes:													Blooms Taxonomy		
CO1: To represent and develop systems in different forms using the knowledge gained (L5).													Create		
CO2: To analyses the system in time and frequency domain (L4).													Analyze		
CO3: To analyses the system in time and frequency domain (L4).													Analyze		
CO4: Ability to Obtain the transfer Function by the Reduction of Block diagram & Signal flow graph (L3)													Apply		
CO5: To analyses the stability of physical systems(L4).													Analyze		
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	1	2	3	2	1
CO2	3	3	2	2	2		1	1		2	2	2	3	3	2
CO3	3	3	2	2	2		1	1		2	2	2	3	3	2
CO4	3	3	3	3	2		1	1		2	3	2	3	3	2
CO5	3	3	3	3	3		1	2	2	2	3	2	3	3	3

23BMO005	PHARMACEUTICAL NANOTECHNOLOGY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: The goal of this course is to provide an insight into the fundamentals of nanotechnology in biomedical and Pharmaceutical research. It will also guide the students to understand how nanomaterials can be used for a diversity of analytical and medicinal rationales.					
Unit I	NANOSTRUCTURES				9
Preparation, properties and characterization - Self-assembling nanostructure - vesicular and micellar polymerization-nanofilms - Metal Nanoparticles- lipid nanoparticles- nanoemulsion - Molecular nanomaterials: dendrimers, etc.,					
Unit II	NANOTECHNOLOGY IN BIOMEDICAL INDUSTRY				9
Reconstructive Intervention and Surgery- Nanomaterials in bone substitutes and dentistry – Implants and Prosthesis -in vivo imaging- genetic defects and other disease states — Nanorobotics in Surgery – Nanocarriers: sustained, controlled, targeted drug delivery systems.					
Unit III	NANOTECHNOLOGY IN CANCER THERAPY				9
Cancer Cell Targeting and Detection- Polymeric Nanoparticles for cancer treatment – mechanism of drug delivery to tumors -advantages and limitations - Multifunctional Agents - Cancer Imaging – Magnetic Resonance Imaging- Cancer Immunotherapy					
Unit IV	NANOTECHNOLOGY IN COSMETICS				9
Polymers in cosmetics: Film Formers – Thickeners – Hair Colouring – Conditioning Polymers: conditioning, Cleansing – Silicons – Emulsions – Stimuli Responsive Polymeric Systems - Formulation of Nano Gels, Shampoos, Hair-conditioners -Micellar self-assembly Sun-screen dispersions for UV protection – Color cosmetics.					
Unit V	NANOTOXICITY				9

NanoToxicology- introduction, dose relationship- Hazard Classification-Risk assessment and management - factors affecting nano toxicity- Dermal Effects of Nanomaterials, Pulmonary, Neuro and Cardiovascular effects of Nanoparticles - Gene–Cellular and molecular Interactions of Nanomaterials.															
															Total periods: 45
Text Books:															
1. Springer Handbook of Nanotechnology- Ed. by B. Bhushan, Springer-Verlag 2004															
2. Nanobiotechnology: Concepts, Applications and Perspectives,. CM.Niemeyer C A. Mirkin, (Eds) , Wiley, 2004															
3. Nanotechnology: Health and Environmental Risks, Jo Anne Shatkin, Second Edition, CRC Press, 2013															
4. Sarah E. Morgan, Kathleen O. Havelka, Robert Y. Lochhead “Cosmetic Nanotechnology: Polymers and Colloids in Cosmetics”, American Chemical Society, 2006.															
References:															
1. Nanotechnology in Biology and Medicine: Methods, Devices and Applications, Tuan VoDinh, CRC Press, 2007															
2. The Chemistry of Nanomaterials: Synthesis, Properties and Applications, C.N.R. Rao, A. Muller, A. K. Cheetham (Eds), Wiley-VCH Verlag 2004															
3. Nanotechnology: Environmental Health and safety, Risks, Regulation and Management, Matthew Hull and Diana Bowman, Elsevier, 2010.															
Course Outcomes:													Blooms Taxonomy		
CO1: Identify the process for the preparation and characterization of the different nanostructured materials.													Understand		
CO2: Apply the nanotechnology in biomedical discipline with related to drug delivery and disease diagnosis													Apply		
CO3: Develop the process, experiments and apply in identifying in a societal and global context.													Create		
CO4: Design and develop the process with suitable equipment for the preparation of nano materials in developing cosmetic products.													Create		
CO5: Understand the ethical principles to confirm the safety of the nano products with respect to risk assessment and its management.													Evaluate		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	3	1	2	1	1	2	1	2	3	2	3
CO2	3	2	3	2	3	2	2	2	2	2	2	3	3	2	3
CO3	3	3	2	3	3	2	2	2	1	2	2	3	3	3	3
CO4	2	2	3	2	3	1	2	1	1	2	1	2	3	2	2
CO5	3	3	2	3	2	3	3	2	1	2	2	3	2	3	3

23ECO010	ROBOTIC PROCESS AUTOMATION	Category: BE			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To understand the basic concepts of Robotic Process Automation. - To expose to the key RPA design and development strategies and methodologies.					

- To learn the fundamental RPA logic and structure. - To explore the Exception Handling, Debugging and Logging operations in RPA. - To learn to deploy and Maintain the software bot.		
Unit I	INTRODUCTION TO ROBOTIC PROCESS AUTOMATION	9
Emergence of Robotic Process Automation (RPA), Evolution of RPA, Differentiating RPA from Automation - Benefits of RPA - Application areas of RPA, Components of RPA, RPA Platforms. Robotic Process Automation Tools - Templates, User Interface, Domains in Activities, Workflow Files.		
Unit II	AUTOMATION PROCESS ACTIVITIES	9
Sequence, Flowchart & Control Flow: Sequencing the Workflow, Activities, Flowchart, Control Flow for Decision making. Data Manipulation: Variables, Collection, Arguments, Data Table, Clipboard management, File operations Controls: Finding the control, waiting for a control, Act on a control, UiExplorer, Handling Events		
Unit III	APP INTEGRATION, RECORDING AND SCRAPING	9
App Integration, Recording, Scraping, Selector, Workflow Activities. Recording mouse and keyboard actions to perform operation, Scraping data from website and writing to CSV. Process Mining.		
Unit IV	EXCEPTION HANDLING AND CODE MANAGEMENT	9
Exception handling, Common exceptions, Logging- Debugging techniques, Collecting crash dumps, Error reporting. Code management and maintenance: Project organization, Nesting workflows, Reusability, Templates, Commenting techniques, State Machine.		
Unit V	DEPLOYMENT AND MAINTENANCE	9
Publishing using publish utility, Orchestration Server, Control bots, Orchestration Server to deploy bots, License management, Publishing and managing updates. RPA Vendors - Open-Source RPA, Future of RPA		
Total periods: 45		
Text Books:		
1. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath by Alok Mani Tripathi, Packt Publishing, 2018.		
2. <u>Tom Taulli</u> , “The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems”, Apress publications, 2020.		
References:		
1. Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren Livingston (Author), Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation, Amazon Asia-Pacific Holdings Private Limited, 2018		
2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant, Amazon Asia-Pacific Holdings Private Limited, 2018		
3. A Gerardus Blokdyk, “Robotic Process Automation Rpa A Complete Guide “, 2020		
Course Outcomes:		Blooms Taxonomy
CO1:	Understand the fundamentals, evolution, components, tools, and applications of Robotic Process Automation.	Apply
CO2:	Apply workflow activities including sequences, flowcharts, control flows, and data manipulation techniques to automate business processes.	Apply
CO3:	Perform app integration, recording, scraping, and process mining using RPA tools.	Analyze
CO4:	Analyze and manage exceptions, debugging, project organization, and reusable components in RPA solutions.	Analyze

CO5: Apply deployment and bot orchestration techniques and evaluate RPA vendor platforms and future trends.													Evaluate		
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	2	1	2	2	1	3
CO2	3	2	3	1	3	1	1	1	2	2	2	3	3	2	3
CO3	3	3	3	2	3	1	1	1	2	2	2	3	3	2	3
CO4	2	3	2	2	3	1	1	1	2	2	2	3	2	2	2
CO5	2	2	3	1	3	1	1	1	2	2	2	3	2	3	2

OPEN ELECTIVE III

23HSO001	ENGLISH FOR COMPETITIVE EXAMINATIONS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
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	FOUNDATIONS OF VOCABULARY AND VERBAL ABILITY				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	FOUNDATIONS OF ENGLISH GRAMMAR AND SENTENCE CONSTRUCTION				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	COMPREHENSIVE READING STRATEGIES AND CRITICAL THINKING				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	ANALYTICAL AND RHETORICAL WRITING TECHNIQUES				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	FOUNDATIONS OF LISTENING AND SPEAKING												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																
															Total periods: 45	
Text Books:																
14. R.P.Bhatnagar - <i>General English for Competitive Examinations</i> . Macmillan India Limited, 2009.																
References:																
13. Educational Testing Service - The Official Guide to the GRE Revised General Test, Tata McGraw Hill, 2010.																
14. The Official Guide to the TOEFL Test, Tata McGraw Hill, 2010.																
15. R Rajagopalan- <i>General English for Competitive Examinations</i> , McGraw Hill Education (India) Private Limited, 2008.																
Course Outcomes:													Blooms Taxonomy			
CO1: Expand their vocabulary and gain practical techniques to read and comprehend a wide range of texts with the emphasis required.													Understand			
CO2: Identify errors with precision and write with clarity and coherence.													Apply			
CO3: Understand the importance of task fulfilment and the usage of task-appropriate vocabulary.													Analyze			
CO4: Communicate effectively in group discussions, presentations and interviews													Create			
CO5: Write topic based essays with precision and accuracy													Evaluate			
CO-PO 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	-	-	-	

23MGO001	NGOS AND SUSTAINABLE DEVELOPMENT	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - Tto 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 NGO's: Sustainability Stewardship, Lap Lambert Academic Publishing, India, ISBN-13: 978-6200442444.															
References:															
1. Dodds, F. (2007). NGO diplomacy: The influence of nongovernmental organizations in international environmental negotiations. Mit Press, Cambridge, ISBN-13: 978-0262524766.															
2. Ghosh, S. (Ed.). (2019). Indian environmental law: Key concepts and principles. Orient BlackSwan, India, ISBN-13: 978-9352875795.															
3. Alan Fowler and Chiku Malunga (2010) NGO Management: The Earthscan Companion, Routledge, ISBN-13 : 978-1849711197															
													Blooms Taxonomy		
CO1:	Have a thorough grounding on the issues and challenges being faced in attaining sustainable development.												Understand		
CO2:	Have a knowledge on the role of NGOs towards sustainable development												Remember		
CO3:	Sent strategies for NGOs in attaining sustainable development												Apply		
CO4:	Recognize the importance of providing energy, food security and health equity to all members of the society without damaging the environment												Evaluate		
CO5:	Understand the environmental legislations												Understand		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	2	3	3	-	-	-	2	3	2	-
CO2	2	1	-	-	-	2	3	3	2	-	-	1	2	1	-
CO3	3	2	2	2	-	3	3	3	2	1	1	2	3	2	-
CO4	3	2	1	-	-	3	3	3	2	-	-	2	3	2	-
CO5	2	1	-	-	-	3	3	3	-	-	-	2	2	1	-

23MGO002	DEMOCRACY AND GOOD GOVERNANCE	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - Explain the key features of the Indian democratic system and evaluate the functioning of its major institutions such as Parliament, federalism, and the judiciary, including judicial activism and local governance. - Describe the roles and regulatory mechanisms of SEBI, TRAI, and the Competition Commission of India and assess their contribution to economic governance. - Analyze the influence of lobbying groups such as chambers of commerce, trade unions, and farmers' associations on policymaking and governance. - Evaluate India's development models, examine recent trends of liberalization across sectors, and interpret the role of e-governance in modern administrative systems. - Discuss the role of civil society actors—including NGOs, new social movements, media, and popular culture—in shaping political participation and democratic processes.					
Unit I	GOVERNANCE STRUCTURES AND DEMOCRATIC PROCESSES IN INDIA				9
Structure and Process of Governance: Indian Model of Democracy, Parliament, Party Politics and Electoral Behavior, Federalism, the Supreme Court and Judicial Activism, Units of Local Governance					
Unit II	REGULATORY BODIES AND INSTITUTIONAL FRAMEWORK IN INDIA				9
Regulatory Institutions – SEBI, TRAI, Competition Commission of India					
Unit III	LOBBYING MECHANISMS AND INTEREST GROUPS				9
Lobbying Institutions: Chambers of Commerce and Industries, Trade Unions, Farmers Associations, etc.					
Unit IV	POLITICAL ECONOMY AND DEVELOPMENT TRENDS IN INDIA				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	CIVIL SOCIETY, SOCIAL MOVEMENTS, AND MEDIA DYNAMICS				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. Atul Kohli (ed.): The Success of India's Democracy, Cambridge University Press, 2001.					
References:					
1. Corbridge, Stuart and John Harris: Reinventing India: Liberalisation, Hindu Nationalism and Popular Democracy, Oxford University Press, 2000.					
2. J.Dreze and A.Sen, India: Economic Development and Social Opportunity, Clarendon, 1995.					
3. Saima Saeed: Screening the Public Sphere: Media and Democracy in India,2013					
4. Himat Singh: Green Revolution Reconsidered: The Rural World of Punjab, OUP, 2001.					
5. Jagdish Bhagwati: India in Transition: Freeing The Economy, 1993.					
6. Smitu Kothari: Social Movements and the Redefinition of Democracy, Boulder, Westview, 1993.					
Course Outcomes:					Blooms Taxonomy

CO1:	Explain the structure and functioning of the Indian governance system, including democracy, parliament, federalism, political parties, electoral behaviour, and judicial activism.	Understand
CO2:	Describe the role and functions of key regulatory institutions in India, such as SEBI, TRAI, and the Competition Commission of India.	Understand
CO3:	Analyse the influence of lobbying groups, including chambers of commerce, trade unions, and farmers' associations, on political and economic decision-making.	Apply
CO4:	Evaluate contemporary political-economic issues in India, including development models, sector-wise liberalisation, and the impact of e-governance initiatives.	Analyze
CO5:	Assess the dynamics of civil society, focusing on new social movements, NGOs, media, and popular culture, and their role in shaping socio-political change.	Understand
CO-PO Mapping		
Particular	PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12	PSO1 PSO2 PSO3
CO1	3 2 2 1 2 3 3 2 1 3 2 2	3 2 2
CO2	3 3 2 2 2 3 2 2 1 3 2 2	3 3 2
CO3	3 3 3 2 3 3 3 2 2 3 2 3	3 3 3
CO4	3 3 3 3 3 3 3 2 2 3 3 3	3 3 3
CO5	3 2 2 1 3 3 3 3 3 3 3 3	3 3 3

23EE001	RENEWABLE ENERGY TECHNOLOGIES	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To know the Indian and global energy scenario - To learn the various solar energy technologies and its applications. - To educate the various wind energy technologies. - To explore the various bio-energy technologies. - To study the ocean and geothermal technologies.					
Unit I	ENERGY SCENARIO				9
Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status-Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans					
Unit II	SOLAR ENERGY				9
Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications.					
Unit III	WIND ENERGY				9
Wind data and energy estimation – Betz limit - Site selection for windfarms – characteristics - Wind resource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.					

Unit IV	BIO-ENERGY												9		
Bio resources – Biomass direct combustion – thermochemical conversion - biochemical conversion-mechanical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration – Carbonisation – Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production - Applications.															
Unit V	OCEAN AND GEOTHERMAL ENERGY												9		
Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact.															
Total periods: 45															
Text Books:															
1. Fundamentals and Applications of Renewable Energy Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, cGraw Hill; First edition (10 December 2020), ISBN-10 : 9390385636															
2. Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India Learning Private Limited; 2nd edition (1 January 2011), ISBN-10 : 8120344707															
References:															
1. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K., 2012.															
2. Rai.G.D., “Non-Conventional Energy Sources”, Khanna Publishers, New Delhi, 2014.															
3. Sukhatme.S.P., “Solar Energy: Principles of Thermal Collection and Storage”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.															
4. Tiwari G.N., “Solar Energy – Fundamentals Design, Modelling and applications”, Alpha Science Intl Ltd, 2015.															
5. Twidell, J.W. & Weir A., “Renewable Energy Resources”, EFNSpon Ltd., UK, 2015.															
Course Outcomes:													Blooms Taxonomy		
CO1: Discuss the Indian and global energy scenario.													Understand		
CO2: Describe the various solar energy technologies and its applications.													Understand		
CO3: Explain the various wind energy technologies.													Understand		
CO4: Explore the various bio-energy technologies.													Apply		
CO5: Discuss the ocean and geothermal technologies.													Understand		
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	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

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

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-innovations-49f253ca8624		
3. https://blog.forgeforward.in/product-innovation-rubric-adf5ebdfd356		
4. https://blog.forgeforward.in/evaluating-product-innovations-e8178e58b86e		
5. https://blog.forgeforward.in/user-guide-for-product-innovation-rubric-857181b253dd		
6. https://blog.forgeforward.in/star-tup-failure-is-like-true-lie-7812cdf9b85		
Course Outcomes:		Blooms Taxonomy
CO1:	Define & test various hypotheses to mitigate the inherent risks in product innovations.	Apply/ Analyze

CO2:	Design the solution concept based on the proposed value by exploring alternate solutions to achieve value-price fit.												Create		
CO3:	Develop skills in empathizing, critical thinking, analyzing, storytelling & pitching												Apply		
CO4:	Apply system thinking in a real-world scenario												Apply		
CO5:	Define and explain the fundamental concepts of system thinking and system components.												Remember		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	2	1	2	1	3	2	2	3	3	2
CO2	3	2	3	3	3	2	1	2	2	3	2	2	3	3	3
CO3	2	2	3	2	3	2	1	3	3	3	3	2	2	3	3
CO4	3	3	3	3	2	3	2	3	2	2	3	3	3	3	3
CO5	3	2	2	2	1	2	1	2	1	2	2	3	3	2	2

23MEO002	REVERSE ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
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.					
UnitIII	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	
CO2:		Apply the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development												Apply	
CO3:		Apply the concept and principles of material identification and process verification in reverse engineering of product design and development.												Apply	
CO4:		Apply the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.												Apply	
CO5:		Analyze the various legal aspect												Analyze	
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	1	1	2	1	2	2	2	3	3	2
CO2	3	3	3	2	3	1	1	2	1	2	2	2	3	3	2
CO3	3	2	3	2	3	1	1	2	1	2	2	2	3	3	2
CO4	3	2	3	3	3	1	1	2	1	2	2	3	3	3	3
CO5	2	2	2	1	2	3	3	2	2	3	2	3	2	2	3

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

Prerequisites		
• Nil		
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	SUSTAINABILITY PRACTICES	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
CO1:	Discuss the importance of economic sustainability.	Understand
CO2:	Describe the importance of sustainable practices.	Understand

CO3: Identify drivers and barriers for the given conditions.													Remember		
CO4: Formulate strategy in sustainable manufacturing.													Create		
CO5: Plan for sustainable operation of industry with environmental, cost consciousness.													Apply		
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	3	3	2	1	2	2	2	2	2	1
CO2	2	2	1	1	2	3	3	2	1	2	2	2	2	2	1
CO3	2	2	2	1	2	2	2	2	1	2	2	2	2	2	2
CO4	3	3	3	2	3	2	2	3	2	3	3	3	3	3	3
CO5	3	3	3	2	3	3	3	3	2	3	3	3	3	3	3

23EE0002	ELECTRIC AND HYBRID VEHICLES	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: The objective of this course is to prepare the students to know about the general aspects of Electric and Hybrid Vehicles (EHV), including architectures, modelling, sizing, and sub system design and hybrid vehicle control.					
Unit I	DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES				9
Need for Electric vehicle- Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. - Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance- Transmission efficiency- Electric vehicle chassis and Body Design, Electric Vehicle Recharging and Refuelling Systems.					
Unit II	ENERGY SOURCES				9
Battery Parameters- - Different types of batteries – Lead Acid- Nickel Metal Hydride - Lithium ion- Sodium based- Metal Air. Battery Modelling - Equivalent circuits, Battery charging- Quick Charging devices. Fuel Cell- Fuel cell Characteristics- Fuel cell types-Half reactions of fuel cell. Ultra capacitors. Battery Management System.					
Unit III	MOTORS AND DRIVES				9
Types of Motors- DC motors- AC motors, PMSM motors, BLDC motors, Switched reluctance motors working principle, construction and characteristics.					
Unit IV	POWER CONVERTERS AND CONTROLLERS				9
Solid state Switching elements and characteristics – BJT, MOSFET, IGBT, SCR and TRIAC - Power Converters – rectifiers, inverters and converters - Motor Drives - DC, AC motor, PMSM motors, BLDC motors, Switched reluctance motors – four quadrant operations –operating modes.					
Unit V	HYBRID AND ELECTRIC VEHICLES				9
Main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Power Split devices for Hybrid Vehicles - Operation modes - Control Strategies for Hybrid Vehicle - Economy of hybrid Vehicles - Case study on specification of electric and hybrid vehicles.					
Total periods: 45					
Text Books:					

1. Iqbal Husain, “ Electric and Hybrid Vehicles-Design Fundamentals”, CRC Press,2003															
2. Mehrdad Ehsani, “ Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, CRC Press,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		
CO1: Understand the operation and architecture of electric and hybrid vehicles.													Understand		
CO2: Identify various energy source options like battery and fuel cell.													Remember		
CO3: Select suitable electric motor for applications in hybrid and electric vehicles.													Apply		
CO4: Explain the role of power electronics in hybrid and electric vehicles													Understand		
CO5: Analyze the energy and design requirement for hybrid and electric vehicles.													Analyze		
CO-PO Mapping															
Particular	PO1	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

23ECO002	SPACE ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
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		
CO1: Illustrate the history of aviation & developments over the years													Understand		
CO2: Ability to identify the types & classifications of components and control systems													Understand		
CO3: Explain the basic concepts of flight & Physical properties of Atmosphere													Understand		
CO4: Identify the types of fuselage and constructions.													Understand		
CO5: Distinguish the types of Engines and explain the principles of Rocket													Analyze		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	2	3	2	1	2	2	2	2	1	1
CO2	2	2	2	1	2	1	1	2	1	2	2	2	2	2	1
CO3	3	2	2	1	2	1	1	2	1	2	2	2	3	2	2
CO4	2	2	2	1	2	1	1	2	1	2	2	2	2	2	1
CO5	3	3	2	2	3	1	1	2	2	3	2	3	3	3	2

23MGO004	INDUSTRIAL MANAGEMENT	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
Course Objectives: • 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. • To study the planning; organizing and staffing functions of management in professional organization. • To study the leading; controlling and decision making functions of management in professional organization. • To learn the organizational theory in professional organization. • 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”, 8 th Edition, Tata McGrawhill, New Delhi, 2010.		
References:		
1. Joseph J, Massie, “Essentials of Management”, 4 th 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, 11 th Edition, 2012.		
5. S. Trevis Certo, “Modern Management Concepts and Skills”, Pearson Education, 2018.		
Course Outcomes:		Blooms Taxonomy
CO1:	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
CO2:	Discuss the planning; organizing and staffing functions of management in professional organization.	Understand
CO3:	Apply the leading; controlling and decision making functions of management in professional organization.	Apply
CO4:	Discuss the organizational theory in professional organization.	Understand
CO5:	Apply principles of productivity and modern concepts in management in professional organization.	Apply
CO-PO Mapping		

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

23MGO003	QUALITY ENGINEERING		Category: OEC			
			L	T	P	C
			3	0	0	3
Prerequisites • Nil						
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- $\bar{X}$, R and S charts, attribute control charts - p, np, c and u- Construction and application.						
Unit III	SPECIAL CONTROL PROCEDURES					9
Warning and modified control limits, control chart for individual measurements, multi-vari chart, $\bar{X}$ chart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts.						
Unit IV	STATISTICAL PROCESS CONTROL					9
Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits.						
Unit V	ACCEPTANCE SAMPLING					9
The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables, MIL-STD-105D and MIL-STD-414E & IS 2500 standards.						
Total periods: 45						
Text Books:						
3. “Introduction to Statistical Quality Control” – Douglas C. Montgomery						
References:						
7. “Quality Planning and Analysis” – J.M. Juran & Frank Gryn						
Course Outcomes:					Blooms Taxonomy	
CO1:	Control the quality of processes using control charts for variables in manufacturing industries					Apply

CO2:	Control the occurrence of defective product and the defects in manufacturing companies.												Apply		
CO3:	Control the occurrence of defects in services.												Analyse		
CO4:	Analysing and understanding the process capability study.												Apply		
CO5:	Developing the acceptance sampling procedures for incoming raw material.												Apply		
CO-PO 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

23CHO001	FIRE SAFETY ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
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 programmes.					
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.																
Referenes:																
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													Apply		
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.													Apply		
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.													Analyse		
CO4:	To decide the method of fire protection to RCC, steel, and wooden structural elements and their repair methods if damaged due to fire.													Apply		
CO5:	Describe the safety techniques and improve the analytical and intelligence to take the right decision at right time.													Apply		
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	2	-	1	-	-	1	-	-	-	-	-	-	-	-	-	
CO2	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	
CO3	1	-	2	-	-	-	3	-	-	1	-	-	-	-	-	
CO4	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	
CO5	2	-	1	-	-	1	1	1	-	1	-	1	-	-	-	

23CEO001	INTRODUCTION TO NON-DESTRUCTIVE TESTING	Category: OEC

		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
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, Penetrameters, safety in radiography					
Total periods: 45					
Text Books:					
1. Baldev Raj, T. Jayakumar and M. Thavasimuthu, Practical Non Destructive Testing, Alpha Science International Limited, 3rd edition, 2002.					

2. J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGraw-Hill Education, 2nd edition, 2011.															
3. Ravi Prakash, “Non-Destructive Testing Techniques”, 1st revised edition, New Age International Publishers, 2010.															
Referenes:															
1. ASM Metals Handbook, V-17, "Nondestructive Evaluation and Quality Control", American Society of Metals, USA, 2001.															
2. Barry Hull and Vernon John,"Nondestructive Testing", Macmillan, 1989.															
3. Chuck Hellier, “Handbook of Nondestructive Evaluation”, Mc Graw Hill, 2012.															
4. Louis Cartz, "Nondestructive Testing", ASM International, USA, 1995.															
Course Outcomes:													Blooms Taxonomy		
CO1: Realize the importance of NDT in various engineering fields.													Apply		
CO2: Have a basic knowledge of surface NDE techniques which enables to carry out various inspection in accordance with the established procedures.													Apply		
CO3: Calibrate the instrument and inspect for in-service damage in the components by means of Eddy current testing as well as Thermography testing.													Analyse		
CO4: Differentiate various techniques of UT and AET and select appropriate NDT methods for better evaluation.													Apply		
CO5: Interpret the results of Radiography testing and also have the ability to analyse the influence of various parameters on the testing.													Apply		
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				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 Nil					
Course Objectives: - Selecting sensors to develop mechatronics systems. - Explain 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		
CO2: Explain the architecture and timing diagram of microprocessor, and also interpret and develop programs.													Understand		
CO3: Design appropriate interfacing circuits to connect I/O devices with microprocessor.													Analyse		
CO4: Apply PLC as a controller in mechatronics system.													Apply		
CO5: Design and develop the apt mechatronics system for an application.													Apply		
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						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

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

			3	0	0	3
Prerequisites • Nil						
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 2ND edition 2012.						
References: 1. Fu K.S. Gonalz R.C. and ice C.S.G. "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill book 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.													Apply		
CO2: Apply the basic engineering knowledge and laws for the design of robotics.													Apply		
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.													Analyse		
CO4: Explain the concept of kinematics, degeneracy, dexterity and trajectory planning.													Apply		
CO5: Demonstrate the image processing and image analysis techniques by machine vision system.													Apply		
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			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

23MEO006	FUNDAMENTALS OF AERONAUTICAL ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
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				9
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				9
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:					
- Anderson, J.D., Introduction to Flight, McGraw-Hill; 8th edition , 2015 - E Rathakrishnan, “Introduction to Aerospace Engineering: Basic Principles of Flight”, John Wiley, NJ, 2021 - Stephen.A. Brandt, Introduction to aeronautics: A design perspective, 2nd edition, AIAA Education Series, 2004.					
References:					
- SADHU SINGH, “INTERNAL COMBUSTION ENGINES AND GAS TURBINE”-, SS Kataraiia & sons, 2015 - KERMODE , “FLIGHT WITHOUT FORMULAE”, -, Pitman; 4th Revised edition 1989					
Course Outcomes:					Blooms Taxonomy
CO1:	Illustrate the history of aircraft & developments over the years				Apply
CO2:	Ability to identify the types & classifications of components and control systems				Apply
CO3:	Explain the basic concepts of flight & Physical properties of Atmosphere				Analyse
CO4:	Identify the types of fuselage and constructions				Apply

CO5: Distinguish the types of Engines and explain the principles of Rocket													Apply		
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						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

23CEO002	REMOTE SENSING CONCEPTS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To introduce the concepts of remote sensing processes and its components. - To expose the various remote sensing platforms and sensors and to introduce the elements of data interpretation.					
Unit I	REMOTE SENSING AND ELECTROMAGNETIC RADIATION				9
Definition – components of RS – History of Remote Sensing – Merits and demerits of data collation between conventional and remote sensing methods - Electromagnetic Spectrum – Radiation principles - Wave theory, Planck’s law, Wien’s Displacement Law, Stefan’s Boltzmann law, Kirchoff’s law – Radiation sources: active & passive - Radiation Quantities.					
Unit II	EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL				9
Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows - Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance – Spectroradiometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water – solid surface scattering in microwave region.					
Unit III	ORBITS AND PLATFORMS				9
Motions of planets and satellites – Newton’s law of gravitation - Gravitational field and potential - Escape velocity - Kepler’s law of planetary motion - Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms - Ground based, Airborne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Lagrange Orbit.					
Unit IV	SENSING TECHNIQUES				9
Classification of remote sensors – Resolution concept : spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors - High Resolution Sensors - LIDAR , UAV – Orbital and sensor characteristics of live Indian earth observation satellites.					
Unit V	DATA PRODUCTS AND INTERPRETATION				9
Photographic and digital products – Types, levels and open source satellite data products -- selection and procurement of data– Visual interpretation: basic elements and interpretation keys - Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification					
					Total periods: 45
Text Books:					

1. Thomas M.Lillesand, Ralph W. Kiefer and Jonathan W. Chipman, Remote Sensing and Image interpretation, John Wiley and Sons, Inc, New York,2015.
2. George Joseph and C Jeganathan, Fundamentals of Remote Sensing,Third Edition Universities Press (India) Private limited, Hyderabad, 2018

References:

1. Janza, F.Z., Blue H.M. and Johnson,J.E. Manual of Remote Sensing. Vol.1, American Society 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.

Course Outcomes:													Blooms Taxonomy		
CO1: Understand the concepts and laws related to remote sensing													Apply		
CO2: Understand the interaction of electromagnetic radiation with atmosphere and earth material													Apply		
CO3: Acquire knowledge about satellite orbits and different types of satellites													Analyse		
CO4: Understand the different types of remote sensors													Apply		
CO5: Gain knowledge about the concepts of interpretation of satellite imagery													Apply		
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
CO2	3												3	3	3
CO3	3											3	3	3	3
CO4	3	3	3	3	3							3	3	3	3
CO5	3	3	3	3	3							3	3	3	3

23CEO003	URBAN AGRICULTURE	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
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 periods: 45															
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. 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		
CO1:		Demonstrate the principles behind crop production and various parameters that influences the crop growth on roof tops											Apply		
CO2:		Explain different methods of crop production on roof tops											Apply		
CO3:		Explain nutrient and pest management for crop production on roof tops											Analyse		
CO4:		Illustrate crop water requirement and irrigation water management on roof tops											Apply		
CO5:		Explain the concept of waste management on roof tops											Apply		
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	1	1	2	1	1	1	1	1	2	1
CO2	2	1	2	1	2	2	2	1	1	2	1	2	2	1	2
CO3	1	1	1	2	1	1	1	1	2	1	1	1	1	2	1
CO4	1	1	1	2	1	2	1	1	1	1	1	1	1	1	2
CO5	2	1	3	1	1	1	2	2	1	2	1	3	2	1	1

23CEO004	DRINKING WATER SUPPLY AND TREATMENT	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
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.															
Course Outcomes:												Blooms Taxonomy			
CO1:	An understanding of water quality criteria and standards, and their relation to public health												Apply		
CO2:	The ability to design the water conveyance system												Apply		
CO3:	The knowledge in various unit operations and processes in water treatment												Analyse		
CO4:	An ability to understand the various systems for advanced water treatment												Apply		
CO5:	An insight into the structure of drinking water distribution system												Apply		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			3								3	3	3

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

23EEO003	ELECTRIC VEHICLE TECHNOLOGY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To provide knowledge about electric machines and special machine - To understand the basics of power converters - To know the concepts of controlling DC and AC drive systems - To understand the architecture and power train components. - To impart knowledge on vehicle control for standard drive cycles of hybrid electrical vehicles (HEVs)					
Unit I	ROTATING POWER CONVERTERS				9
Magnetic circuits- DC machine and AC machine –Working principle of Generator and Motor- DC and AC - Voltage and torque equations – Characteristics and applications. Working principle of special machines like: Brushless DC motor, Switched reluctance motor and PMSM.					
Unit II	STATIC POWER CONVERTERS				9
Working and Characteristics of Power Diodes, MOSFET and IGBT. Working of uncontrolled rectifiers, controlled rectifiers (Single phase and Three phase), DC choppers, single and three phase inverters, Multilevel inverters and Matrix Converters.					
Unit III	CONTROL OF DC AND AC MOTOR DRIVES				9
Speed control for constant torque, constant HP operation of all electric motors - DC/DC chopper based four quadrant operation of DC motor drives, inverter based V/f Operation (motoring and braking) of induction motor drives, Transformation theory, vector control operation					
Unit IV	HYBRID ELECTRIC VEHICLE ARCHITECTURE AND POWER TRAIN COMPONENTS				9
History of evolution of Electric Vehicles - Comparison of Electric Vehicles with Internal Combustion Engines - Architecture of Electric Vehicles (EV) and Hybrid Electric Vehicles (HEV) – Plug-in Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes.					
Unit V	MECHANICS OF HYBRID ELECYTRIC VECHICLES AND CONTROL OF VECHICLE				9
Fundamentals of vehicle mechanics - tractive force, power and energy requirements for standard drive cycles of HEV's - motor torque and power rating and battery capacity. HEV supervisory control - Selection of modes - power spilt mode - parallel mode - engine brake mode - regeneration mode - series parallel mode.					
					Total periods: 45
Text Books:					
1. Electric Vehicles and Hybrid Electric Vehicles "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design" By Mehrdad Ehsani, Yimin Gao, Stefano Longo, Kambiz Ebrahimi Edition/Year: 3rd Edition, 2018					

References:																
- Stephen D. Umans, "Fitzgerald & Kingsley's Electric Machinery", Tata McGraw Hill, 7th Edition, 2020. - Bogdan M. Wilamowski, J. David Irwin, The Industrial Electronics Handbook, Second Edition, Power Electronics and Motor Drives, CRC Press, 2011 - Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven D. Pekarek "Analysis of Electric Machinery and Drive Systems", 3rd Edition, Wiley-IEEE Press, 2013. - Rashid M.H., "Power Electronics Circuits, Devices and Applications ", Pearson, fourth Edition, 10th Impression 2021. - Iqbal Husain, 'Electric and Hybrid Electric Vehicles', CRC Press, 2021. - Wei Liu, 'Hybrid Electric Vehicle System Modeling and Control', Second Edition, WILEY, 2017 - James Larminie and John Lowry, 'Electric Vehicle Technology Explained', Second Edition, Wiley, 2012																
Course Outcomes:													Blooms Taxonomy			
CO1: Able to understand the principles of conventional and special electrical machines.													Apply			
CO2: Acquired the concepts of power devices and power converters													Apply			
CO3: Able to understand the control for DC and AC drive systems.													Analyse			
CO4: Learned the electric vehicle architecture and power train components.													Apply			
CO5: Acquired the knowledge of mechanics of electric vehicles and control of electric vehicles.													Apply			
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				

23EEO004	INTRODUCTION TO PLC PROGRAMMING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
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 Communication architectures															
Unit V		CASE STUDIES												9	
Stepper Motor Control- Elevator Control-CNC Machine Control- conveyor control-Interlocking Problems															
Total periods: 45															
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:															
16. MadhuchanndMitra and SamerjitSengupta, Programmable Logic Controllers Industrial Automation an Introduction, Penram International Publishing Pvt. Ltd. 17. J. R. Hackworth and F. D. Hackworth, Programmable Logic Controllers Principles andApplications, Pearson publication															
Course Outcomes:													Blooms Taxonomy		
CO1:		Know the basic requirement of a PLC input/output devices and architecture. (L1)												Remember	
CO2:		Ability to apply Basics Instruction Sets used for ladder Logic and Function Block Programming.(L2)												Understand	
CO3:		Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function BLock.(L3)												Apply	
CO4:		Able to develop a PLC logic for a specific application on real world problem. (L5)												Evaluate	
CO5:		Ability to Understand the Concepts of Communication used for PLC/SCADA.(L1)												Remember	
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

23CHO002	NANO TECHNOLOGY												Category: OEC			
													L	T	P	C
													3	0	0	3

Prerequisites		
• Nil		
Course Objectives:		
• Understand foundational nanoscience principles • Describe synthesis and fabrication techniques • Apply characterization methods • Explore applications of nanomaterials		
Unit I	INTRODUCTION	9
General definition and size effects–important nano structured materials and nano particles- importance of nano materials- Size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nanomaterials-surface area - band gap energy and applications. Photochemistry and Electrochemistry of nanomaterials –Ionic properties of nanomaterials- Nano catalysis.		
Unit II	SYNTHESIS OF NANOMATERIALS	9
Bottom up and Top-down approach for obtaining nano materials - Precipitation methods – sol gel technique – high energy ball milling, CVD and PVD methods, gas phase condensation, magnetron sputtering and laser deposition methods – laser ablation, sputtering		
Unit III	NANO COMPOSITES	9
Definition- importance of nanocomposites- nano composite materials-classification of composites- metal/metal oxides, metal-polymer- thermoplastic based, thermoset based and elastomer based- influence of size, shape and role of interface in composites applications		
Unit IV	NANO STRUCTURES AND CHARACTERIZATION TECHNIQUES	9
Classifications of nanomaterials - Zero dimensional, one-dimensional and two-dimensional nanostructures- Kinetics in nanostructured materials- multilayer thin films and superlattice- clusters of metals, semiconductors and nanocomposites. Spectroscopic techniques, Diffraction methods, thermal analysis method, BET analysis method.		
Unit V	APPLICATIONS OF NANO MATERIALS	9
Overview of nanomaterials properties and their applications, nano painting, nano coating, nanomaterials for renewable energy, Molecular Electronics and Nanoelectronics – Nanobots- Biological Applications. Emerging technologies for environmental applications- Practice of nanoparticles for environmental remediation and water treatment.		
Total periods: 45		
Text Books:		
1.Mick Wilson, Kamali Kannangara,Geoff Smith, Michelle Simmom, Burkhard Raguse, “ Nano Technology: Basic Science & Engineering Technology”, 2005, Overseas Press 2.G. Cao, “Nanostructures & Nanomaterials: Synthesis, Properties &Applications” Imperial College Press, 2004 3.William A Goddard “Handbook of Nanoscience, Engineering and Technology”, 3 rd Edition, CRC Taylor and Francis group 2012.		
References:		
1.R.H.J.Hannink & A.J.Hill, Nanostructure Control, Wood Head Publishing Ltd.,Cambridge, 2006. 2.C.N.R.Rao, A.Muller, A.K.Cheetham, The Chemistry of Nanomaterials: Synthesis, Properties and Applications Vol. I & II, 2nd edition, 2005, Wiley VCH Verlag Gbtl & Co 3.Ivor Brodie and Julius J.Muray,’The physics of Micro/Nano –Fabrication’, Springer International Edition,2010		
Course Outcomes:		Blooms Taxonomy
CO1:	Understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications	Understand
CO2:	Able to acquire knowledge about the different types of nano material synthesis	Remember
CO3:	Describes about the shape, size, structure of composite nano materials and their interference	Understand

CO4: Understand the different characterization techniques for nanomaterials													Understand		
CO5: Develop a deeper knowledge in the application of nanomaterials in different fields.													Understand		
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 Nil						
Course Objectives: - Understand the fundamental concepts of functional materials - Understand the molecular self assembly - Explore the structural and functional features of natural materials - Identify different types of smart materials - Understand the materials used for polymer electronics						
Unit I	INTRODUCTION					9
Historical Perspectives, Lessons from the Nature, Engineering the Functions, Tuning the functions, Multiscale Modeling and Computation, Classification of Functional Materials, Functional Diversity of Materials, Hybrid Materials, Technological Relevance, Societal Impact.						
Unit II	MOLECULAR SELF ASSEMBLY					9
Molecular Organization, Self-Assembly in Biology, Energetics of Self-Organization, A Few Case Studies, Synthetic Protocols and Challenges, Solvent-assisted Self-Assembly, Directed Assembly- Langmuir-Blodgett and Langmuir-Schaefer techniques, Technological Applications of SAMs.						
Unit III	BIO-INSPIRED MATERIALS					9
Bio-inspired materials, Classification, Biomimicry, Spider Silk, Lotus Leaf, Gecko feet, Synovial fluid, ‘Bionics’- Bio-inspired Information Technologies, Artificial Sensory Organs, Biomineralization- En route to Nanotechnology.						
Unit IV	SMART OR INTELLIGENT MATERIALS					9
Criteria for Smartness, Significance of Smart Materials, Representative Examples like Smart Gels and Polymers, Electro/Magneto Rheological Fluids, Smart Electroceramics, Technical Limitations and Challenges, Functional Nanocomposites, Polymer-carbon nanotube composites.						
Unit V	MATERIALS FOR POLYMER ELECTRONICS					9
Polymers for Electronics, Organic Light Emitting Diodes, Working Principle of OLEDs, Illustrated Examples, Organic Field-Effect Transistors Operating Principle, Design Considerations, Polymer FETs vs Inorganic FETs, Liquid Crystal Displays, Engineering Aspects of Flat Panel Displays, Intelligent Polymers for Data Storage, Polymer-based Data Storage-Principle, Magnetic Vs. Polymer-based Data Storage.						
Total periods: 45						
Text Books:						
1.Vijayamohanan K. Pillai and MeeraParthasarathy, “Functional Materials: A chemist’s perspective”, Universities Press Hyderabad (2012).						
References:						

1.Stephen Manne “Biomimetic Materials Chemistry” Wiley-VCH Newyork, 1966.															
Course Outcomes:														Blooms Taxonomy	
CO1: Understand the classification, properties, and significance of functional materials.														Understand	
CO2: Understand the principles, mechanisms, and energetics of molecular self-assembly														Understand	
CO3: Understand principles of bio-inspired materials														Understand	
CO4: Understand the criteria and significance of smart materials														Understand	
CO5: Analyze device structures and performance														Analyze	
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	1	-	-	-	-	-	1	-	2	3	-	3
CO2	3	3	2	2	-	-	1	-	-	1	-	2	3	1	3
CO3	3	3	3	2	1	-	-	-	-	1	-	2	3	2	3
CO4	2	3	3	2	1	1	1	-	-	1	-	3	3	3	2
CO5	3	3	3	2	1	-	1	-	-	1	-	2	3	3	3

23BM0001	BIOMEDICAL INSTRUMENTATION (Department Of Biomedical Engineering)	Category: BSC			
		L	T	P	C
Prerequisites · Nil					
Course Objectives: · To understand the origin of various biological signals and electrode configurations specific tobio-potential measurements. · To understand the characteristics of Bio signals. · To understand the design of bioamplifiers					
Unit I	ELECTRODE CONFIGURATIONS				9
Bio signals characteristics – Origin of bio potential and its propagation. Frequency and amplitude ranges. Electrode configurations: Electrode-electrolyte interface, electrode– skin interface impedance, polarization effects of electrode – non-polarizable electrodes. Unipolar and bipolar configuration, classification of electrodes.					
Unit II	BIOSIGNAL CHARACTERISTICS				9
Bio signals characteristics – ECG-frequency and amplitude ranges – Einthoven’s triangle, standard 12lead system. EEG - EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. EMG - Electrode configuration -unipolar and bipolar mode.					
Unit III	BIOAMPLIFIERS				9
Need for bio-amplifier - Differential bio-amplifier – Single ended amplifier - Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference					
Unit IV	MEASUREMENT OF BIO SIGNALS				9

Temperature, respiration rate and pulse rate measurements. Blood Pressure - indirect methods: auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurements															
Unit V		BIOCHEMICAL MEASUREMENTS												9	
Biochemical sensors - pH, pO2 and pCO2, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors. Blood gas analyzers, colorimeter,flame photometer, spectrophotometer, blood cell counter, auto analyzer.															
Total periods:															
Text Books:															
1. Leslie Cromwell, “Biomedical Instrumentation and measurement”, 2nd edition, Prenticehall of India, New Delhi, 2015.															
2. John G. Webster, “Medical Instrumentation Application and Design”, 4th edition, WileyIndia Pvt Ltd, New Delhi, 2015.															
3. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, NewDelhi, 2003.															
References:															
1. John Enderle, Susan Blanchard, Joseph Bronzino, “Introduction to Biomedical Engineering”, second edition, Academic Press,2005.															
2. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”,Pearson Education, 2004.															
Course Outcomes:													Blooms Taxonomy		
CO1: Illustrate the origin of various biological signals and their characteristics.													Understanding		
CO2: Gain knowledge on characteristics of bio signals.													Remembering /		
CO3: Gain knowledge on various amplifiers involved in monitoring and transmission of bio signals.													Understanding / Applying		
CO4: Explain the different measurement techniques for non-electrical bio-signals.													Understanding / Applying		
CO5: Explain the biochemical measurement techniques as applicable for diagnosis and further treatment.													Understanding / Applying		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	1	-	-	-	-	-	-	1	3	2	-
CO2	3	2	-	1	2	-	-	-	-	-	-	1	2	3	-
CO3	3	2	2	1	3	-	-	-	-	-	-	1	3	3	-
CO4	2	3	2	3	2	-	-	-	-	-	-	1	3	3	-
CO5	2	2	2	2	1	-	-	-	-	-	-	2	2	3	-
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23BTO001	TRADITIONAL INDIAN FOODS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - Understand historical and cultural perspectives of Indian foods - Understand the traditional methods of food processing - Acquire knowledge on traditional food patterns - Discover the intricacies of commercial production of traditional foods - Explore the nutritional composition of 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: 45					
Text Books:					
1. Sen, Colleen Taylor “Food Culture in India” Greenwood Press, 2005. 2.Davidar, Ruth N. “Indian Food Science: A Health and Nutrition Guide to Traditional Recipes: East West Books, 2001.					
Course Outcomes:					Blooms Taxonomy
CO1: Explain the diversity and cultural aspects of Indian traditional foods					Understand

CO2:	Identify the ingredients and methods used in preparing various Indian traditional foods												Remember		
CO3:	Assess the traditional food patterns												Evaluate		
CO4:	<i>Explain the principles, techniques, and challenges involved in the commercial production of traditional foods.</i>												Evaluate		
CO5:	<i>Evaluate the health benefits associated with traditional food habits</i>												Evaluate		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	2	-	-	2	-	-	2	-	3	2	1	3
CO2	3	2	2	2	1	-	2	-	-	2	-	3	2	1	3
CO3	3	3	2	3	1	-	2	-	-	2	-	3	3	2	3
CO4	3	3	3	2	3	2	2	-	-	2	-	3	2	3	2
CO5	3	3	2	3	2	-	2	-	-	2	-	3	3	2	2

23BTO002	INTRODUCTION TO FOOD PROCESSING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - Understand the basic principles and concepts of food processing - Understand the principles and importance of proper food handling to ensure safety, quality, and hygiene. - Understand the principles and fundamentals of large-scale food processing and industrial operations. - Learn methods for quantifying, monitoring, and managing food waste effectively. - Identify sources of food contamination, including biological, chemical, and physical hazards.					
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				9
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				9
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/ References:															
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.															
Course Outcomes:														Blooms Taxonomy	
CO1: Be able to understand the significance of food processing														Understand	
CO2: Explain the principles and importance of proper food handling for safety, quality, and hygiene.														Understand	
CO3: Identify and apply various unit operations involved in industrial food processing,														Apply	
CO4: Identify and classify different types and sources of food waste generated at various stages of the food supply chain.														Understand	
CO5: Explain the principles and importance of food hygiene in ensuring safe and wholesome food.														Understand	
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	-	-	-	-	-	-	-	3	2	1
CO2	3	3	2	2	1	-	-	-	-	-	-	-	3	3	2
CO3	3	3	3	2	1	-	-	-	-	-	-	-	2	3	2
CO4	2	3	2	3	2	-	-	-	-	-	-	-	2	3	2
CO5	2	3	2	2	3	-	-	-	-	-	-	-	2	2	3

23BTO003	IPR FOR PHARMA INDUSTRY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
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:													Blooms Taxonomy		
CO1: Understand and differentiate the categories of intellectual property rights.													Understand		
CO2: Describe about patents and procedure for obtaining patents													Understand		
CO3: Distinguish plant variety, traditional knowledge and geographical indications under IPR.													Understand		
CO4: Provide different organizations role and responsibilities in the protection of in the international level.													Create		
CO5: Understand the interrelationships between different Intellectual Property Rights on International Society													Understand		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	1	1	-	-	-	-	-	-	-	3	2	1
CO2	3	2	2	2	1	-	-	-	-	-	-	-	3	2	1
CO3	3	3	3	2	1	-	-	-	-	-	-	-	3	3	2
CO4	2	3	3	1	1	-	-	-	-	-	-	-	2	3	1

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

23CHO003	BASICS OF TEXTILE FINISHING		Category: OEC			
			L	T	P	C
			3	0	0	3
Prerequisites Nil						
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: - V.A.Shennai, "Technology of Finishing", Vol X, Sevak Publications, Mumbai - Perkins, W.S., “Textile colouration and finishing”, Carolina Academic Press., U.K, ISBN: 0890898855.2004.						
References: - Microencapsulation in finishing, Review of progress of Colouration, SDC, 2001 62 - Chakraborty, J.N, Fundamentals and Practices in colouration of Textiles, Woodhead Publishing India, 2009, ISBN-13:978-81-908001-4-3 W. D. Schindler and P. J. Hauser "Chemical finishing of textiles", Woodhead Publishing Cambridge England,2004						
Course Outcomes:						Blooms Taxonomy
CO1:	Understand the Basics of Resin Finishing Process					Understand
CO2:	Explain the Concept of Flame proof & flame retardancy, waterproof and water repellent, Antimicrobial finishes.					Understand
CO3:	Explain theConcept of Soil Release, Anti Pilling, UV Protection and Antistatic finishes.					Understand
CO4:	Explain the Concept of Mechanical finishing.					Understand
CO5:	Understand the Basics of Micro encapsulation techniques, Nano finish, Plasma Treatment.					Understand
CO-PO Mapping						

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

23CHO004	INDUSTRIAL ENGINEERING FOR GARMENT INDUSTRY		Category: OEC			
			L	T	P	C
			3	0	0	3
Prerequisites Nil						
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 equipment, 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, equipment, techniques. Time study - Definition, basics of time study- equipment. 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: 789221071082
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 (P) Ltd., New Delhi, 1988, ISBN: 0882756311 | ISBN-13: 9780882756318
2. Chuter A. J., "Introduction to Clothing Production Management", Wiley-Black well Science, U.S. A., 1995, ISBN: 0632039396 | ISBN-13: 9780632039395
3. GordanaColovic., "Ergonomics in the garment industry", Wood publishing India Pvt. Ltd., India, 2014, ISBN: 0857098225 | ISBN-13: 9780857098221
4. Rajesh Bheda, "Managing Productivity in Apparel Industry "CBS Publishers & Distributors, 008

Course Outcomes:**Blooms Taxonomy****CO1:** Explain Fundamental concepts of industrial Engineering and productivity

Remember

CO2: Understand the work study

Understand

CO3: Understand the method study

Understand

CO4: Understand the Work measurement and SAM

Understand

CO5: Understand Ergonomics and its application to garment industry

Apply

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	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	-

23CHO005	BASICS OF TEXTILE MANUFACTURE	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
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”,																
2. Europa LehrmittelVerlag, 2008, ISBN: 3808562250 / ISBN: 978- 3808562253.																
3. Wynne A., “Motivate Series-Textiles”, Maxmillan Publications, London, 1997.																
4. Carr H. and Latham B., “The Technology of Clothing Manufacture” Backwell Science, U.K., 1994, ISBN: 0632037482 / ISBN:13: 9780632037483.																
Course Outcomes:													Blooms Taxonomy			
CO1: Understand the Classification of fibres and production of natural fibres													Understand			
CO2: Understand the Regenerated and synthetic fibres													Understand			
CO3: Understand the Yarn spinning													Understand			
CO4: Understand the Weaving													Understand			
CO5: Understand the Knitting and nonwoven													Understand			
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	-	-	-	-	-	-	-	3	2	1	
CO2	3	3	2	1	1	-	-	-	-	-	-	-	3	3	1	
CO3	3	3	2	2	1	-	-	-	-	-	-	-	3	3	2	
CO4	3	3	2	2	2	-	-	-	-	-	-	-	3	3	2	
CO5	3	3	2	2	2	-	-	-	-	-	-	-	3	3	2	

23CHO006	INTRODUCTION TO PETROLEUM REFINING AND PETROCHEMICALS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
Course Objectives: The course is aimed to • Gain knowledge about petroleum refining process and production of petrochemical products. • Understand the Fundamentals of Petroleum Geology. • Understand the basic differences between exploration, refining, and petrochemical production. • Understand the various conversion processes, such as catalytic cracking, catalytic reforming, and hydrocracking.					

- Examine the basics of different refinery types, their complexity, and their impact on profitability. - Develop an awareness of how to improve unit performance, product recovery, and energy utilization.																
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:																
15. Nelson, W. L., “Petroleum Refinery Engineering”, 4th Edition., McGraw Hill, New York,1985. 16. 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:													Blooms Taxonomy			
CO1:	Understand the classification, composition and testing methods of crude petroleum and its products. Learn the mechanism of refining process.												Understand			
CO2:	Understand the insights of primary treatment processes to produce the precursors.												Understand			
CO3:	Study the secondary treatment processes cracking, vis-breaking and coking to produce more petroleum products.												Understand			
CO4:	Appreciate the need of treatment techniques for the removal of sulphur and other impurities from petroleum products.												Analyze			
CO5:	Understand the societal impact of petrochemicals and learn their manufacturing processes.												Understand			
CO6:	Learn the importance of optimization of process parameters for the high yield of petroleum products.												Remember			
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	2	2	-	1	-	1	1	-	-	-	-	1	2	1	2	

CO2	3	3	2	2	1	1	2	-	-	1	-	1	3	2	3
CO3	2	1	-	1	-	1	1	1	-	1	1	1	2	1	1
CO4	2	2	2	-	-	1	1	-	-	-	-	1	2	2	-
CO5	3	3	3	2	1	2	2	1	1	1	1	2	3	3	1
CO6	2	2	-	1	-	1	1	-	-	-	-	1	2	1	2

23EEO005	ENERGY CONSERVATION AND MANAGEMENT		Category: OEC			
			L	T	P	C
			3	0	0	3
Prerequisites Nil						
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 &U sage: 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. L.C., P.S. Schmidt, D.R.Brown, “Industrial Energy Management and Utilisation” Hemisphere Publ, Washington, 1988.						
2. Witte. L.C., P.S. Schmidt, D.R.Brown, “Industrial Energy Management and Utilisation”						

Hemisphere Publ, Washington, 1988.															
3. Dryden. I.G.C., "The Efficient Use of Energy" Butterworths, London, 1982															
4. Dryden. I.G.C., "The Efficient Use of Energy" Butterworths, London, 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.													Remember		
CO2: Study the Importance of Stoichiometry relations, Theoretical air required for complete combustion													Evaluate		
CO3: Skills on combustion thermodynamics and kinetics.													Apply		
CO4: Apply calculation and design tube still heaters.													Apply		
CO5: Studied different heat treatment furnace.													Understand		
CO6: Practical and theoretical knowledge burner design.													Create		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	1	2	1	-	1	-	2	1	2	-
CO2	3	3	2	2	1	2	3	1	1	2	2	2	2	3	1
CO3	3	3	3	2	2	2	3	1	2	2	2	2	2	3	2
CO4	2	3	3	3	2	2	3	1	2	2	3	2	2	3	3
CO5	2	2	2	3	1	2	2	2	2	3	3	2	1	2	2
CO6	1	2	2	1	-	3	3	3	2	2	2	3	1	2	1

23CHO007	BASICS OF PLASTICS PROCESSING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
Course Objectives: At the end of the course, the student is expected to • Understand the fundamentals of plastics processing, such as the relationships between material structural properties and required processing parameters, and so on • 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) • Understand suitable additives for plastics compounding • Propose troubleshooting mechanisms for defects found in plastics products manufactured by various processing techniques					
Unit I	INTRODUCTION TO PLASTICS PROCESSING				9
Introduction to plastic processing – Principles of plastic processing: processing of plastics vs. metals and ceramics. Factors influencing the efficiency of plastics processing: molecular weight, viscosity and rheology. Difference in approach for thermoplastic and thermoset processing. Additives for plastics compounding and processing: antioxidants, light stabilizers, UV stabilizers, lubricants, impact modifiers, flame retardants, antistatic agents, stabilizers and plasticizers. Compounding: plastic compounding techniques, plasticization, pelletization.					
Unit II	EXTRUSION				9

Extrusion – Principles of extrusion. Features of extruder: barrel, screw, types of screws, drive mechanism, specifications, heating & cooling systems, types of extruders. Flow mechanism: process variables, die entry effects and exit instabilities. Die swell, Defects: melt fracture, shark skin, bambooning. Factors determining efficiency of an extruder. Extrusion of films: blown and cast films. Tube/pipe extrusion. Extrusion coating: wire & cable. Twin screw extruder and its applications. Applications of extrusion and new developments.		
Unit III	INJECTION MOLDING	9
Injection molding – Principles and processing outline, machinery, accessories and functions, specifications, process variables, mould cycle. Types of clamping: hydraulic and toggle mechanisms. Start-up and shut down procedures- Cylinder nozzles- Press capacity projected area-Shot weight Basic theoretical concepts and their relationship to processing - Interaction of moulding process aspect effects in quoted variables. Basic mould types. Reciprocating vs. plunger type injection moulding. Thermoplastic vs. thermosetting injection moulding. Injection moulding vs. other plastic processing techniques. State-of-the art injection moulding techniques - Introduction to trouble shooting		
Unit IV	COMPRESSION AND TRANSFER MOLDING	9
Compression moulding – Basic principles of compression and transfer moulding-Meaning of terms- Bulk factor and flow properties, moulding materials, process variables and process cycle, Inter relation between flow properties-Curing time-Mould temperature and Pressure requirements. Preforms and preheating- Techniques of preheating. Machines used-Types of compression mould- positive, semi-positive and flash. Common moulding faults and their correction- Finishing of mouldings. Transfer moulding: working principle, equipment, Press capacity-Integral moulds and auxiliary ram moulds, moulding cycle, moulding tolerances, pot transfer, plunger transfer and screw transfer moulding techniques, advantages over compression moulding		
Unit V	BLOW MOLDING, THERMOFORMING AND CASTING	9
Blow moulding: principles and terminologies. Injection blow moulding. Extrusion blow moulding. Design guidelines for optimum product performance and appearance. Thermoforming: principle, vacuum forming, pressure forming mechanical forming. Casting: working principle, types and applications.		
Total periods: 45		
References:		
1. S. S. Schwartz, 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, 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 Hanser Verlag GmbH & Co (2003).		
Course Outcomes:		Blooms Taxonomy
CO1:	Ability to find out the correlation between various processing techniques with product properties.	Analyze
CO2:	Understand the major plastics processing techniques used in moulding (injection, blow, compression, and transfer), extrusion, thermoforming, and casting.	Understand
CO3:	Acquire knowledge on additives for plastic compounding and methods employed for the same	Apply

CO4:	Familiarize with the machinery and ancillary equipment associated with various plastic processing techniques												Remember		
CO5:	Select an appropriate processing technique for the production of a plastic product												Evaluate		
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	-	-	-	-	-	3	3	1	3
CO2	3	3	2	2	1	1	-	-	-	-	-	2	3	2	3
CO3	3	3	3	3	2	1	-	-	-	-	-	2	3	3	3
CO4	2	3	2	3	2	1	-	-	-	2	-	2	2	3	2
CO5	1	1	1	1	-	3	3	3	1	1	1	3	1	1	1

23MEO008	FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Nil					
Course Objectives:					
At the end of the course, the student is expected					
- 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															
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.															
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.															
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		
CO1:	Define, formulate, and analyze a problem												Analyze		
CO2:	Solve specific problems independently or as part of a team												Apply		
CO3:	Gain knowledge of the Innovation & Product Development process in the Business Context												Understand		
CO4:	Work independently as well as in teams												Apply		
CO5:	Manage a project from start to finish												Apply		
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	1	1	1	1	1	3	1	1	3
CO2	3	3	2	2	3	1	1	1	1	1	1	2	2	2	3
CO3	2	2	3	2	3	1	1	1	3	2	2	2	3	3	2
CO4	1	1	1	1	1	3	3	3	1	2	1	2	1	1	1
CO5	1	1	1	1	1	1	1	2	2	3	1	3	1	1	1

23BMO002	ASSISTIVE TECHNOLOGY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					

Course Objectives: At the end of the course, the student is expected • 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 deliver.																
Total periods: 45																
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		
CO1:	Interpret the various mechanical techniques that will help in assisting the heart functions.												Understand			
CO2:	Interpret the various mechanical techniques that will help in assisting the heart functions.												Understand			
CO3:	Indicate the methodologies to assess the hearing loss.												Understand			
CO4:	Evaluate the types of assistive devices for mobilization.												Evaluate			
CO5:	Explain about TENS and biofeedback system.												Understand			
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	

CO1	3	2	1	1	-	2	1	2	1	1	-	2	3	2	3
CO2	3	3	2	2	-	3	2	3	2	2	-	2	3	3	3
CO3	3	3	3	3	2	2	2	1	3	2	1	2	3	3	3
CO4	2	2	2	2	-	3	3	3	2	2	-	3	2	2	2
CO5	1	1	1	-	-	2	1	2	3	3	2	3	1	2	1
CO6	3	2	1	1	-	2	1	2	1	1	-	2	3	2	3

23MAO001	OPERATIONS RESEARCH		Category: OEC			
			L	T	P	C
			3	0	0	3
Prerequisites Nil						
Course Objectives: At the end of the course, the student is expected to - 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						
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. Richar 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		
CO1: 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.													Create		
CO2: Analyze the concept of developing, formulating, modeling and solving transportation and assignment problems.													Analyze		
CO3: Solve the integer programming problems using various methods.													Apply		
CO4: Conceptualize the principle of optimality and sub-optimization, formulation and computational procedure of dynamic programming.													Understand		
CO5: Determine the optimum solution for nonlinear programming problems.													Analyze		
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	2	1	3	-	3
CO2	3	3	3	2	2	1	-	-	-	1	2	1	3	2	3
CO3	3	2	2	-	-	1	-	-	-	1	2	1	2	-	3
CO4	3	3	2	2	1	1	1	-	-	1	2	1	3	1	3
CO5	2	2	2	2	3	-	-	-	1	1	1	2	2	3	2

23MAO002	ALGEBRA AND NUMBER THEORY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
Course Objectives: At the end of the course, the student is expected • 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																
Text Books:																
1. Grimaldi, R.P and Ramana, B.V., "Discrete and Combinatorial Mathematics", Pearson Education, 5 th Edition, New Delhi, 2007.																
2. Thomas Koshy, “Elementary Number Theory with Applications”, Elsevier Publications , New Delhi , 2002.																
References:																
1. San Ling and Chaoping Xing, “Coding Theory – A first Course”, Cambridge Publications, Cambridge, 2004.																
2. Niven.I, Zuckerman.H.S., and Montgomery, H.L., “An Introduction to Theory of Numbers” , John Wiley and Sons , Singapore, 2004.																
3. Lidl.R., and Pitz. G, "Applied Abstract Algebra", Springer Verlag, New Delhi, 2 nd Edition , 2006.																
Course Outcomes:														Blooms Taxonomy		
CO1:		Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.												Remember		
CO2:		Demonstrate accurate and efficient use of advanced algebraic techniques.												Understand		
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		
CO4:		Gain knowledge of modular arithmetic, including properties of congruence, and perform calculations involving modular addition, subtraction, multiplication, and division.												Remember		
CO5:		Apply major "classical theorems"												Apply		
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	2	1	-	-	-	-	-	-	-	-	1	2	-	2	
CO2	3	3	1	2	-	-	-	-	-	-	-	1	3	3	3	
CO3	2	2	3	2	1	-	-	-	-	-	-	2	2	3	2	
CO4	1	3	-	3	-	-	-	-	-	-	-	3	3	1	3	
CO5	3	3	2	2	1	-	-	-	-	-	-	2	3	2	3	

23MAO003	LINEAR ALGEBRA	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					

Course Objectives:		
At the end of the course, the student is expected		
- To test the consistency and solve system of linear equations. - To find the basis and dimension of vector space. - To obtain the matrix of linear transformation and its eigenvalues and eigenvectors. - To find orthonormal basis of inner product space and find least square approximation. - To find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.		
Unit I	MATRICES AND SYSTEM OF LINEAR EQUATIONS	9
Matrices - Row echelon form - Rank - System of linear equations - Consistency - Gauss elimination method - Gauss Jordan method.		
Unit II	VECTOR SPACES	9
Vector spaces over Real and Complex fields - Subspace – Linear space - Linear independence and dependence - Basis and dimension.		
Unit III	LINEAR TRANSFORMATION	9
Linear transformation - Rank space and null space - Rank and nullity - Dimension theorem– Matrix representation of linear transformation - Eigenvalues and eigenvectors of linear transformation – Diagonalization.		
Unit IV	INNER PRODUCT SPACES	9
Inner product and norms - Properties - Orthogonal, Orthonormal vectors - Gram Schmidt orthonormalization process - Least square approximation.		
Unit V	EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION	9
Eigen value Problems: Power method, Jacobi rotation method - Singular value decomposition – QR decomposition.		
Total periods: 45		
Text Books:		
- Faires J.D. and Burden R., Numerical Methods, Brooks/Cole (Thomson Publications), New Delhi, 2002. - Friedberg A.H, Insel A.J. and Spence L, Linear Algebra, Pearson Education, 5th 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
CO1:	Test the consistency and solve system of linear equations.	Analyze
CO2:	Find the basis and dimension of vector space.	Apply
CO3:	Obtain the matrix of linear transformation and its eigenvalues and eigenvectors.	Apply
CO4:	Find orthonormal basis of inner product space and find least square approximation.	Apply
CO5:	Find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.	Apply
CO-PO Mapping		

3. Dave, B., Koskela, L., Kiviniemi, A., Owen, R., and Tzortzopoulos, 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		
CO1: Explains the contemporary management techniques and the issues in present scenario.													Remember		
CO2: Apply the basics of lean management principles and their evolution from manufacturing industry to construction industry.													Apply		
CO3: Develops a better understanding of core concepts of lean construction tools and techniques and their importance in achieving better productivity.													Create		
CO4: Apply lean techniques to achieve sustainability in construction projects.													Apply		
CO5: Apply lean construction techniques in design and modeling.													Apply		
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	-	1	1	-	2	2	1	2
CO2	3	3	2	2	3	2	2	1	2	1	2	2	3	3	3
CO3	2	3	3	3	2	1	2	1	2	2	2	2	2	3	3
CO4	2	2	3	2	2	1	2	1	2	1	3	2	2	3	3
CO5	1	-	-	-	-	2	1	3	3	3	2	3	1	1	2

OPEN ELECTIVE IV

23HSO002	PROJECT REPORT WRITING												Category: OEC			
													L	T	P	C
													3	0	0	3
Prerequisites Nil																
Course Objectives: - Understand the essentials of project writing. - Perceive the difference between general writing and technical writing - Assimilate the fundamental features of report writing. - Understand the essential differences that exist between general and technical writing. - Learn the structure of a technical and project report.																
Unit I														9		
Writing Skills – Essential Grammar and Vocabulary – Passive Voice, Reported Speech, Concord, Signpost words, Cohesive Devices – Paragraph writing - Technical Writing vs. General Writing.																
Unit II														9		
Project Report – Definition, Structure, Types of Reports, Purpose – Intended Audience – Plagiarism – Report Writing in STEM fields – Experiment – Statistical Analysis.																
Unit III														9		
Structure of the Project Report: (Part 1) Framing a Title – Content – Acknowledgement – Funding Details -Abstract – Introduction – Aim of the Study – Background - Writing the research question - Need of the Study/Project Significance, Relevance – Determining the feasibility – Theoretical Framework.																
Unit IV														9		
Structure of the Project Report: (Part 2) – Literature Review, Research Design, Methods of Data Collection - Tools and Procedures - Data Analysis - Interpretation - Findings –Limitations - Recommendations – Conclusion – Bibliography.																
Unit V														9		
Proof reading a report – Avoiding Typographical Errors – Bibliography in required Format – Font – Spacing – Checking Tables and Illustrations – Presenting a Report Orally – Techniques.																
Total periods: 45																
Text Books:																
17. Gerson and Gerson - Technical Communication: Process and Product, 7th Edition, Prentice Hall (2012).																
18. Virendra K. Pamecha - Guide to Project Reports, Project Appraisals and Project Finance (2012).																
References:																
18. Daniel Riordan - Technical Report Writing Today (1998).																
19. Darla-Jean Weatherford - Technical Writing for Engineering Professionals (2016) Penwell Publishers.																
Course Outcomes:													Blooms Taxonomy			
CO1: Write effective project reports.													Understand			
CO2: Use statistical tools with confidence.													Apply			
CO3: Explain the purpose and intension of the proposed project coherently and with clarity.													Understand			
CO4: Create writing texts to suit achieve the intended purpose.													Create			
CO5: Master the art of writing winning proposals and projects.													Understand			
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	2	1	1	1	1	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	-	-	-

23MAO004	ADVANCED NUMERICAL METHODS		Category: OEC			
			L	T	P	C
			3	0	0	3
Prerequisites Nil						
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”, 9 th Edition, Cengage Learning, New Delhi, 2016.						
3. Gupta S.K., “Numerical Methods for Engineers”, 4th Edition, New Age Publishers, 2019						
4. Sastry, S.S., “Introductory Methods of Numerical Analysis”, 5th Edition, PHI Learning, 2015.						
5. Morton, K.W. and Mayers D.F., “Numerical solution of Partial Differential equations”, Cambridge University press, Cambridge, 2002.						
Course Outcomes:						Blooms Taxonomy
CO1:	Demonstrate the understandings of common numerical methods for nonlinear equations, system of linear equations and eigenvalue problems.					Understand
CO2:	Understand the interpolation theory.					Understand
CO3:	Understand the concepts of numerical methods for ordinary differential equations.					Understand

CO4:	Demonstrate the understandings of common numerical methods for elliptic equations.												Understand		
CO5:	Understand the concepts of numerical methods for time dependent partial differential equations.												Understand		
CO-PO Mapping															
Particular	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	-	-	-

23MAO005	RANDOM PROCESSES		Category: OEC			
			L	T	P	C
			3	0	0	3
Prerequisites						
Nil						
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”, 1st Indian Reprint, Elsevier, 2007.						
2. Peebles, P.Z., “Probability, Random Variables and Random Signal Principles”, Tata McGraw Hill, 4th Edition, New Delhi, 2002.						
References:						
1. Cooper. G.R., McGillem. C.D., “Probabilistic Methods of Signal and System Analysis”, Oxford University Press, New Delhi, 3rd Indian Edition, 2012.						

2. Hwei Hsu, “Schaum’s Outline of Theory and Problems of Probability, Random Variables and Random Processes”, Tata McGraw Hill Edition, New Delhi, 2004.															
3. Miller. S.L. and Childers. D.G., “Probability and Random Processes with Applications to Signal Processing and Communications “, Academic Press, 2004.															
4. Stark. H. and Woods. J.W., “Probability and Random Processes with Applications to Signal Processing “, Pearson Education, Asia, 3rd Edition, 2002.															
5. Yates. R.D. and Goodman. D.J., “Probability and Stochastic Processes”, Wiley India Pvt. Ltd., Bangalore, 2nd Edition, 2012.															
Course Outcomes:														Blooms Taxonomy	
CO1: Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.														Understand	
CO2: Apply the concept random processes in engineering disciplines.														Apply	
CO3: Understand and apply the concept of correlation and spectral densities.														Understand	
CO4: Get an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable.														Understand	
CO5: Analyze the response of random inputs to linear time invariant systems.														Analyze	
CO-PO 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	-	-	-

23MAO006	QUEUEING AND RELIABILITY MODELLING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
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”, 9th Edition, Pearson India Education Services, Delhi, 2016.															
3. Trivedi, K.S., “Probability and Statistics with Reliability, Queueing and Computer Science Applications”, 2nd Edition, John Wiley and Sons, 2002.															
4. Stark. H. and Woods. J.W., “Probability and Random Processes with Applications to Signal Processing”, Pearson Education, Asia, 3rd Edition, 2002.															
5. Govil A.K., “Reliability Engineering”, Tata-McGraw Hill Publishing Company Ltd., New Delhi, 1983.															
Course Outcomes:													Blooms Taxonomy		
CO1:		Enable the students to apply the concept of random processes in engineering disciplines.												Apply	
CO2:		Students acquire skills in analyzing various queueing models.												Analyze	
CO3:		Students can understand and characterize phenomenon which evolve with respect to time in a probabilistic manner.												Understand	
CO4:		Students can analyze reliability of the systems for various probability distributions.												Analyze	
CO5:		Students can be able to formulate problems using the maintainability and availability analyses by using theoretical approach.												Analyze	
CO-PO 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	-	-	-

23MGO004	PRODUCTION AND OPERATIONS MANAGEMENT FOR ENTREPRENEURS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
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	
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.															
References:															
1. Adam Jr. Ebert, Production and Operations Management, PHI Publication, 1992.															
2. Muhlemann, Okland and Lockyer, Production and Operation Management, Macmillan India, 1992.															
3. Chary S.N, Production and Operations Management, TMH Publications, 2010.															
4. Terry Hill, Operation Management. Pal Grave McMillan (Case Study).2005.															
Course Outcomes:														Blooms Taxonomy	
CO1:	To understand the basics and functions of Production and Operation Management for business owners.													Understand	
CO2:	To learn about the Production & Operation Systems.													Understand	
CO3:	To acquaint on the Production & Operations Planning Techniques followed by entrepreneurs in Industries.													Understand	
CO4:	To known about the Production & Operations Management Processes in organisations.													Understand	
CO5:	To comprehend the techniques of controlling, Production and Operations in industries.													Understand	
CO-PO 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	-	-	-

23MGO005	MULTIVARIATE DATA ANALYSIS												Category: OEC			
													L	T	P	C
													3	0	0	3
Prerequisites Nil																
Course Objectives: To know various multivariate data analysis techniques for business research.																
Unit I	INTRODUCTION												9			
Uni-variate, Bi-variate and Multi-variate techniques – Classification of multivariate techniques – Guidelines for multivariate analysis and interpretation.																
Unit II	PREPARING FOR MULTIVARIATE ANALYSIS												9			
Conceptualization of research model with variables, collection of data –Approaches for dealing with missing data – Testing the assumptions of multivariate analysis.																
Unit III	MULTIPLE LINEAR REGRESSION ANALYSIS, FACTOR ANALYSIS												9			
Multiple Linear Regression Analysis – Inferences from the estimated regression function – Validation of the model. - Approaches to factor analysis – interpretation of results.																
Unit IV	LATENT VARIABLE TECHNIQUES												9			
Confirmatory Factor Analysis, Structural equation modelling, Mediation models, Moderation models, Longitudinal studies.																
Unit V	ADVANCED MULTIVARIATE TECHNIQUES												9			
Multiple Discriminant Analysis, Logistic Regression, Cluster Analysis, Conjoint Analysis, multidimensional scaling.																
Total periods: 45																
Text Books:																
3. Joseph F Hair, Rolph E Anderson, Ronald L. Tatham & William C. Black, Multivariate Data Analysis, Pearson Education, New Delhi, 2005.																
4. Barbara G. Tabachnick, Linda S.Fidell, Using Multivariate Statistics, 6th Edition, Pearson, 2012.																
References:																
5. Richard A Johnson and Dean W.Wichern, Applied Multivariate Statistical Analysis, Prentice Hall, New Delhi, 2005.																
6. David R Anderson, Dennis J Seveency, and Thomas A Williams, Statistics for Business and Economics, Thompson, Singapore, 2002																
Course Outcomes:													Blooms Taxonomy			
CO1:	Demonstrate a sophisticated understanding of the concepts and methods; know the exact scopes and possible limitations of each method; and show capability of using multivariate techniques to provide constructive guidance in decision making.												Understand			
CO2:	Use advanced techniques to conduct thorough and insightful analysis, and interpret the results correctly with detailed and useful information.												Analyze			
CO3:	Show substantial understanding of the real problems; conduct deep analysis using correct methods; and draw reasonable conclusions with sufficient explanation and elaboration.												Understand			
CO4:	Write an insightful and well-organized report for a real-world case study, including thoughtful and convincing details.												Understand			
CO5:	Make better business decisions by using advanced techniques in data analytics.												Evaluate			
CO-PO 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	-	-	-

23MEO009	ADDITIVE MANUFACTURING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To introduce the development, capabilities, applications, of Additive Manufacturing (AM), and its business opportunities. - To be acquainted with vat polymerization and material extrusion processes - To be familiar with powder bed fusion and binder jetting processes. - To gain knowledge on applications of direct energy deposition, and material jetting processes. - To impart knowledge on sheet lamination and direct write technologies.					
Unit I	INTRODUCTION				9
Overview - Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping- Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. AM Process Chain - ASTM/ISO 52900 Classification - Benefits - AM Unique Capabilities - AM File formats: STL, AMF Applications: Building Printing, Bio Printing, Food Printing, Electronics Printing, Automobile, Aerospace, Healthcare. Business Opportunities in AM.					
Unit II	VAT POLYMERIZATION AND MATERIAL EXTRUSION				9
Photo polymerization: Stereolithography Apparatus (SLA)- Materials -Process - top down and bottom up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) - Process - Advantages - Applications. Material Extrusion: Fused Deposition Modeling (FDM) - Process-Materials -Applications and Limitations.					
Unit III	POWDER BED FUSION AND BINDER JETTING				9
Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications. Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits - Limitations - Applications.					
Unit IV	MATERIAL JETTING AND DIRECTED ENERGY DEPOSITION				9
Material Jetting: Multijet Modeling- Materials - Process - Benefits - Applications. Directed Energy Deposition: Laser Engineered Net Shaping (LENS) - Process - Material Delivery - Materials -Benefits -Applications.					
Unit V	SHEET LAMINATION AND DIRECT WRITE TECHNOLOGY				9
Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding - Materials - Application and Limitation. Ink-Based Direct Writing (DW): Nozzle Dispensing Processes, Inkjet Printing Processes, Aerosol DW - Applications of DW.					
Total periods: 45					
Text Books:					
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. Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, Springer., United States, 2006, ISBN: 978-1-4614-9842-1.															
5. 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:													Blooms Taxonomy		
CO1:	Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.												Apply		
CO2:	Acquire knowledge on process vat polymerization and material extrusion processes and its applications.												Apply		
CO3:	Elaborate the process and applications of powder bed fusion and binder jetting.												Create		
CO4:	Evaluate the advantages, limitations, applications of material jetting and directed energy deposition processes.												Evaluate		
CO5:	Acquire knowledge on sheet lamination and direct write technology.												Understand		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	-	-	-	1	1	-	-	1	1	3	2
CO2	2	2	2	2	-	-	-	1	1	-	-	1	1	3	2
CO3	2	2	2	2	-	-	-	1	1	-	-	1	1	3	2
CO4	2	2	2	2	-	-	-	1	1	-	-	1	1	3	2
CO5	2	2	2	2	-	-	-	1	1	-	-	1	1	3	2

23MEO010	NEW PRODUCT DEVELOPMENT	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Nil					
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 programing. Tool assembly and shop floor trials. Initial sample submission with PPAP documents															
Unit IV		CRITERIONS OF NPD												9	
New product qualification for Dimensions, Mechanical & Physical Properties, Internal Soundness proving through X-Ray, Radiography, Ultrasonic Testing, MPT, etc. Agreement with customer for testing frequencies. Market Survey on similar products, Risk analysis, validating samples with simulation 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 periods: 45															
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:													Blooms Taxonomy		
CO1:	Discuss fundamental concepts and customer specific requirements of the New Product development												Understand		
CO2:	Discuss the Material specification standards, analysis and fabrication, manufacturing process.												Understand		
CO3:	Develop Feasibility Studies & reporting of New Product development												Apply		
CO4:	Analyzing the New product qualification and Market Survey on similar products of new product development												Analyze		
CO5:	Develop Reverse Engineering. Cloud points generation, converting cloud data to 3D model.												Apply		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	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

23MEO011		Category: OEC

		INDUSTRIAL DESIGN & RAPID PROTOTYPING TECHNIQUES										L	T	P	C
												3	0	0	3
Prerequisites															
• Nil															
Course Objectives:															
• Outline Fundamental concepts in UI & UX															
• Introduce the principles of Design and Building an mobile app															
• Illustrate the use of CAD in product design															
• Outline the choice and use of prototyping tools															
• Understanding design of electronic circuits and fabrication of electronic devices															
Unit I	UI/UX												9		
Fundamental concepts in UI & UX - Tools - Fundamentals of design principles - Psychology and Human Factors for User Interface Design - Layout and composition for Web, Mobile and Devices - Typography - Information architecture - Color theory - Design process flow, wireframes, best practices in the industry -User engagement ethics - Design alternatives															
Unit II	APP DEVELOPMENT												9		
SDLC -Introduction to App Development - Types of Apps – web Development - understanding Stack - Frontend - backend - Working with Databases - Introduction to API - Introduction to Cloud services - Cloud environment Setup - Reading and writing data to cloud - Embedding ML models to Apps - Deploying application.															
Unit III	INDUSTRIAL DESIGN												9		
Introduction to Industrial Design - Points, lines, and planes – Sketching and concept generation - Sketch to CAD - Introduction to CAD tools - Types of 3D modeling - Basic 3D Modeling Tools - Part creation – Assembly - Product design and rendering basics - Dimensioning & Tolerancing.															
Unit IV	MECHANICAL RAPID PROTOTYPING												9		
Need for prototyping - Domains in prototyping - Difference between actual manufacturing and prototyping - Rapid prototyping methods - Tools used in different domains - Mechanical Prototyping; 3D Printing and classification - Laser Cutting and engraving - RD Works - Additive manufacturing.															
Unit V	ELECTRONIC RAPID PROTOTYPING												9		
Basics of electronic circuit design - lumped circuits - Electronic Prototyping - Working with simulation tool - simple PCB design with EDA.															
Total periods: 45															
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:												Blooms Taxonomy			
CO1:	Create quick UI/UX prototypes for customer needs												Create		
CO2:	Develop web application to test product traction / product feature												Apply		
CO3:	Develop 3D models for prototyping various product ideas												Apply		
CO4:	Built prototypes using Tools and Techniques in a quick iterative methodology												Create		
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	-	2
CO2	1	1	3	1	-	-	-	1	1	-	-	1	1	-	2
CO3	1	1	3	1	-	-	-	1	1	-	-	1	1	-	2

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

23MEO012	MICRO AND PRECISION ENGINEERING												Category: OEC			
													L	T	P	C
													3	0	0	3
Prerequisites Nil																
Course Objectives: - Learn about the precision machine tools - Learn about the macro and micro components. - Understand handling and operating of the precision machine tools. - Learn to work with miniature models of existing machine tools/robots and other instruments. - Learn metrology for micro system																
Unit I		INTRODUCTION TO MICROSYSTEMS												9		
Design, and material selection, micro-actuators: hydraulic, pneumatic, electrostatic/ magnetic etc. for medical to general purpose applications. Micro-sensors based on Thermal, mechanical, electrical properties; micro-sensors for measurement of pressure, flow, temperature, inertia, force, acceleration, torque, vibration, and monitoring of manufacturing systems.																
Unit II		FABRICATION PROCESSES FOR MICRO-SYSTEMS												9		
Additive, subtractive, forming process, microsystems-Micro-pumps, micro- turbines, micro engines, micro-robot, and miniature biomedical devices																
Unit III		INTRODUCTION TO PRECISION ENGINEERING												9		
Machine tools, holding and handling devices, positioning fixtures for fabrication/ assembly of microsystems. Precision drives: inch worm motors, ultrasonic motors, stick- slip mechanism and other piezo-based devices.																
Unit IV		PRECISION MACHINING PROCESSES												9		
Precision machining processes for macro components - Diamond turning, fixed and free abrasive processes, finishing processes.																
Unit V		METROLOGY FOR MICRO SYSTEMS												9		
Metrology for micro systems - Surface integrity and its characterization.																
Total periods: 45																
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		
CO1:		Select suitable precision machine tools and operate												Understand		
CO2:		Apply the macro and micro components for fabrication of micro systems.												Apply		
CO3:		Apply suitable machining process												Apply		
CO4:		Able to work with miniature models of existing machine tools/robots and other instruments.												Understand		
CO5:		Apply metrology for micro system.												Apply		
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	

CO1	2	2	3	1	-	-	-	1	1	-	-	1	1	-	2
CO2	2	2	3	1	-	-	-	1	1	-	-	1	1	-	2
CO3	2	2	3	1	-	-	-	1	1	-	-	1	1	-	2
CO4	2	2	3	1	-	-	-	1	1	-	-	1	1	-	2
CO5	2	2	3	1	-	-	-	1	1	-	-	1	1	-	2

23MEO013	COST MANAGEMENT OF ENGINEERING PROJECTS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Engineering Economics and Financial Accounting • Industrial Management • Resource Management Techniques					
Course Objectives: • Summarize the costing concepts and their role in decision making • Infer the project management concepts and their various aspects in selection • Interpret costing concepts with project execution • Develop knowledge of costing techniques in service sector and various budgetary control techniques • Illustrate with quantitative techniques in cost management					
Unit I	INTRODUCTION TO COSTING CONCEPTS				9
Objectives of a Costing System - Cost concepts in decision-making - Relevant cost - Differential cost - Incremental cost and Opportunity cost - Creation of a Database for operational control					
Unit II	INTRODUCTION TO PROJECT MANAGEMENT				9
Project - meaning, Different types, why to manage, cost overruns centres - various stages of project execution: conception to commissioning - Project execution as conglomeration of technical and nontechnical activities - Detailed Engineering activities-Pre project execution main clearances and documents - Project team: Role of each member - Importance Project site: Data required with significance - Project 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:					
19. John M. Nicholas, Herman Steyn Project Management for Engineering, Business and Technology, Taylor & Francis, 2 August 2020, ISBN: 9781000092561..					
20. Albert Lester ,Project Management, Planning and Control, Elsevier/Butterworth-Heinemann, 2007, ISBN: 9780750669566, 075066956X.					
References:					
20. 1. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher, 1991.					
21. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988.					

22. Charles T. Horngren et al Cost Accounting a Managerial Emphasis, Prentice Hall of India, New Delhi, 2011.															
23. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003.															
24. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007.															
Course Outcomes:													Blooms Taxonomy		
CO1: Understand the costing concepts and their role in decision making.													Understand		
CO2: Understand the project management concepts and their various aspects in selection.													Understand		
CO3: To Interpret costing concepts with project execution.													Apply		
CO4: Gain knowledge of costing techniques in service sector and various budgetary control techniques													Understand		
CO5: Become familiar with quantitative techniques in cost management.													Understand		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1	1	–	–	–	–	2	2	–	2	1	2
CO2	2	1	2	–	1	–	–	–	–	2	2	–	2	1	2
CO3	2	2	3	2	2	–	–	–	–	2	2	1	3	2	2
CO4	2	1	2	1	2	–	–	–	–	2	2	1	2	1	2
CO5	2	2	3	2	3	–	–	–	–	2	2	1	3	2	2

23EE0011	BATTERIES AND MANAGEMENT SYSTEM	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic Electrical and Instrumentation Engineering • Control Systems					
Course Objectives: • The objective of this course is to make the 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 Modeling software and Model- Based Design					
Total periods: 45					
Text Books:					

1. Jiuchun Jiang and Caiping Zhang, “Fundamentals and applications of Lithium-Ion batteries in 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:													Blooms Taxonomy		
CO1: Acquire knowledge of different Li-ion Batteries performance.													Understand		
CO2: Design a Battery Pack and make related calculations.													Apply		
CO3: Demonstrate a Battery Model or Simulation.													Analyse		
CO4: Estimate State-of-Charges in a Battery Pack.													Analyse		
CO5: Approach different BMS architectures during real world usage.													Evaluate		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	–	–	–	1	–	–	2	–	1	3	2	1
CO2	2	3	3	2	2	–	1	–	2	2	1	2	3	3	2
CO3	2	3	3	3	2	–	–	–	–	2	–	2	3	2	2
CO4	2	3	2	3	2	–	–	–	–	2	–	2	3	3	2
CO5	2	2	3	2	3	–	1	–	1	2	1	2	3	3	3

23EE0006	SENSORS AND ACTUATORS		Category: OEC			
			L	T	P	C
			3	0	0	3
Prerequisites Control Systems						
Course Objectives: The objective of this course is to make the students to list common types of sensor and actuators used in automotive vehicles.						
Unit I	INTRODUCTION TO MEASUREMENTS AND SENSORS					9
Sensors: Functions- Classifications- Main technical requirement and trends Units and standards- Calibration methods- Classification of errors- Error analysis- Limiting error- Probable error- Propagation of error- Odds and uncertainty-principle of transduction-Classification. Static characteristics- mathematical model of transducers- Zero, First and Second order transducers- Dynamic characteristics of first and second order transducers for standard test inputs.						
Unit II	VARIABLE RESISTANCE AND INDUTANCE SENSORS					9
Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezoresistive sensors Inductive potentiometer- Variable reluctance transducers:- EI pick up and LVDT.						
Unit III	VARIABLE AND OTHER SPECIAL SENSORS					9
Variable air gap type, variable area type and variable permittivity type- capacitor microphone Piezoelectric, Magnetostrictive, Hall Effect, semiconductor sensor- digital transducers-Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.						
Unit IV	AUTOMOTIVE ACTUATORS					9

Electromechanical actuators- Fluid-mechanical actuators- Electrical machines- Direct-current machines- Three-phase machines- Single-phase alternating-current Machines - Duty-type ratings for electrical machines. Working principles, construction and location of actuators viz. Solenoid, relay, stepper motor etc.															
Unit V		AUTOMATIC TEMPERATURE CONTROL ACTUATORS												9	
Different types of actuators used in automatic temperature control- Fixed and variable displacement temperature control- Semi Automatic- Controller design for Fixed and variable displacement type air conditioning system.															
Total periods: 45															
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 AutomotiveElectronics Systems and Components, Networking and Hybrid Drive, 5th Edition, 2007, ISBN No: 978-3-658-01783-5.															
References:															
1. James D Halderman, “ Automotive Electrical and Electronics” , Prentice Hall, USA, 2013															
2. Tom Denton, “Automotive Electrical and Electronics Systems,” Third Edition, 2004, SAE International.															
3. Patranabis.D, “ Sensors and Transducers”, 2nd Edition, Prentice Hall India Ltd,2003															
4. William Ribbens, "Understanding Automotive Electronics -An Engineering Perspective," 7th Edition, Elsevier Butterworth-Heinemann Publishers, 2012.															
Course Outcomes:													Blooms Taxonomy		
CO1: List common types of sensor and actuators used in vehicles.													Understand		
CO2: Design measuring equipment’s for the measurement of pressure force, temperature and flow.													Apply		
CO3: Generate new ideas in designing the sensors and actuators for automotive application													Apply		
CO4: Understand the operation of the sensors, actuators and electronic control.													Understand		
CO5: Design temperature control actuators for vehicles													Apply		
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	1
CO2	3	3	3	2	2	–	–	–	–	1	2	2	3	3	2
CO3	2	2	3	1	2	–	–	–	–	2	2	2	3	3	3
CO4	3	2	1	1	–	–	–	–	–	1	–	–	2	2	1
CO5	3	3	3	2	2	–	–	–	–	1	2	2	3	3	3

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

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 subsystem – types of staging – Interfaces – selection and criteria for stages and their role in launch vehicle configuration design.																
Unit III		ENGINE SYSTEMS, CONTROLS, AND INTEGRATION												9		
Propellant Budget – Performance of Complete or Multiple Rocket Propulsion Systems – Engine Design – Engine Controls – Engine System Calibration – System Integration and Engine Optimization.																
Unit IV		THRUST VECTOR CONTROL												9		
TVC Mechanisms with a Single Nozzle – TVC with Multiple Thrust Chambers or Nozzles – Testing – Integration with Vehicle – SITVC method – other jet control methods - exhaust plume problems in space environment																
Unit V		NOSE CONE CONFIGURATION												9		
Aerodynamic aspects on the selection of nose shape of a launch vehicle - design factors in the finalization of nose configuration with respect to payload - nose cone thermal protection system - separation of fairings - payload injection mechanism																
Total periods: 4																
Text Books:																
1. G. P. Sutton and O. Biblarz, Rocket Propulsion Elements, 9th ed. Hoboken, NJ, USA: Wiley, 2017.																
2. M. D. Griffin and J. R. French, Space Vehicle Design, 2nd ed. Reston, VA, USA: AIAA, 2004.																
References:																
1. D. A. Vallado, Fundamentals of Astrodynamics and Applications, 4th ed. Hawthorne, CA, USA: Microcosm Press, 2013.																
2. D. K. Huzel and D. H. Huang, Modern Engineering for Design of Liquid-Propellant Rocket Engines, Washington, DC, USA: AIAA, 1992.																
3. P. G. Hill and C. R. Peterson, Mechanics and Thermodynamics of Propulsion, 2nd ed. Boston, MA, USA: Addison-Wesley, 1992.																
4. J. D. Anderson, Introduction to Flight, 8th ed. New York, NY, USA: McGraw-Hill, 2015.																
5. ISRO, Launch Vehicle Design Handbook, Bengaluru, India: ISRO Press, 2010 (Reference Manual).																
Course Outcomes:														Blooms Taxonomy		
CO1:		Explain exotic space propulsion concepts, such as nuclear, solar sail, and antimatter.												Understand		
CO2:		Apply knowledge in selecting the appropriate rocket propulsion systems.												Apply		
CO3:		Interpret the air-breathing propulsion suitable for initial stages and fly-back boosters.												Analyse		
CO4:		Analyze aerodynamics aspect, including boost-phase lift and drag, hypersonic, and re-entry.												Analyse		
CO5:		Adapt from aircraft engineers moving into launch vehicle, spacecraft, and hypersonic vehicle design.												Evaluate		
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	3	2	1

CO2	3	2	3	2	–	–	–	–	–	–	–	1	3	3	2
CO3	2	3	2	2	–	–	–	–	–	–	–	1	2	3	2
CO4	2	3	2	3	–	–	–	–	–	–	–	1	2	3	3
CO5	3	2	3	2	–	–	–	–	–	–	–	3	3	2	3

23MGO006	MANAGEMENT SCIENCE	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Principles of Management					
Course Objectives: - To introduce fundamental concepts of management and organization to students. - To impart knowledge to students on various aspects of marketing, quality control and marketing strategies. - To make students familiarize with the concepts of human resources management. - To acquaint students with the concepts of project management and cost analysis. - To make students familiarize with the concepts of planning process and business strategies.					
Unit I	INTRODUCTION TO MANAGEMENT AND ORGANISATION				9
Concepts of Management and organization- nature, importance and Functions of Management, Systems Approach to Management - Taylor's Scientific Management Theory- Fayal's Principles of Management- Maslow's theory of Hierarchy of Human Needs- Douglas McGregor's TheoryX and TheoryY- Hertzberg Two Factor Theory of Motivation Leadership Styles, Social responsibilities of Management, Designing Organizational Structures: Basic concepts related to Organization -Departmentation and Decentralization.					
Unit II	OPERATIONS AND MARKETING MANAGEMENT				9
Principles and Types of Plant Layout-Methods of Production(Job, batch and Mass Production),Work Study - Basic procedure involved in Method Study and Work Measurement – Business Process Reengineering (BPR) StatisticalQualityControl:controlchartsforVariablesandAttributes (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 Product Life Cycle.					
Unit III	HUMAN RESOURCES MANAGEMENT				9
Concepts of HRM, HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR, Basic functions Wage and of HR Manager: Manpower planning, Recruitment, Selection, Training and Development, Salary Administration, Promotion, Transfer, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating –Capability Maturity Model (CMM)Levels.					
Unit IV	PROJECT MANAGEMENT				9
Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method(CPM), identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing (simple problems).					
Unit V	STRATEGIC MANAGEMENT AND CONTEMPORARY STRATEGIC ISSUES				9
Mission, Goals, Objectives, Policy, Strategy, Programmes, Elements of Corporate Planning Process, Environmental Scanning, Value Chain Analysis, SWOT Analysis, Steps in Strategy Formulation and Implementation, Generic Strategy alternatives. Bench Marking and Balanced Score Cards Contemporary Business Strategies.					
Total periods: 45					
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 R Jauch, R. Gupta and William F. Glueck: Business Policy and Strategic Management Science, McGrawHill, 2012.															
4. Samuel C. Certo: Modern Management,2012.															
Course Outcomes:													Blooms Taxonomy		
CO1: Plan and organizational structure for a given context in the organization to carry out production operation through Work-study.													Apply		
CO2: Survey the markets, customers and competition better and price the given products appropriately													Analyse		
CO3: Ensure quality for a given product or service.													Apply		
CO4: Plan, schedule and control projects through PERT and CPM.													Apply		
CO5: Evaluate strategy for a business or service organization													Evaluate		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	1	–	–	–	2	1	–	–	3	2	1
CO2	2	3	2	2	3	1	–	–	2	2	–	1	2	3	2
CO3	3	2	3	2	1	1	2	–	2	1	–	–	3	2	3
CO4	3	3	3	2	2	–	–	–	3	2	–	2	3	3	2
CO5	2	3	2	3	3	1	–	–	2	3	–	2	2	3	3

23MEO014	PRODUCTION PLANNING AND CONTROL	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Introduction to Industrial Engineering					
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	MINTRODUCTION				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:														Blooms Taxonomy	
CO1:	The students can able to prepare production planning and control act work study													Apply	
CO2:	The students can able to prepare product planning,													Apply	
CO3:	The students can able to prepare production scheduling													Analyse	
CO4:	The students can able to prepare Inventory Control.													Apply	
CO5:	They can plan manufacturing requirements manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).													Analyse	
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	–	–	–	–	–	–	–	3	2	1
CO2	3	2	3	2	1	–	–	–	–	–	–	–	3	2	1
CO3	2	3	2	2	1	–	–	–	–	–	–	–	3	2	2
CO4	2	3	2	3	1	–	–	–	–	–	–	–	3	3	2
CO5	3	2	3	2	2	–	–	–	–	–	–	–	3	3	3

23MGO007	OPERATIONS MANAGEMENT		Category: OEC			
			L	T	P	C
			3	0	0	3
Prerequisites Principles of Management						
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. Stores Management – Nature, Layout, Classification and Coding. Inventory – COURSE OBJECTIVES, Costs and control techniques. Overview of JIT.						
Unit V		SCHEDULING AND PROJECT MANAGEMENT				9
Project Management – Scheduling Techniques, PERT, CPM; Scheduling - work centers – nature, importance; Priority rules and techniques, shopfloor control; Flow shop scheduling – Johnson Algorithm – Gantt charts; personnel scheduling in services.						
						Total periods: 45
Text Books:						
1. Richard B. Chase, Ravi Shankar, F. Robert Jacobs, Nicholas J. Aquilano, Operations and Supply Management, Tata McGraw Hill, 12th Edition, 2010.						
2. Norman Gaither and Gregory Frazier, Operations Management, South Western Cengage Learning, 2002.						
References:						
1. William J Stevenson, Operations Management, Tata McGraw Hill, 9th 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		
CO1:	The students will appreciate the role of Production and Operations management in enabling and enhancing a firm’s competitive advantages in the dynamic business environment.												Understand		
CO2:	The students will obtain sufficient knowledge and skills to forecast demand for Production and Service Systems.												Apply		
CO3:	The students will able to Formulate and Assess Aggregate Planning strategies and Material Requirement Plan.												Analyse		
CO4:	The students will be able to develop analytical skills to calculate capacity requirements and developing capacity alternatives.												Apply		
CO5:	The students will be able to apply scheduling and Lean Concepts for improving System Performance.												Apply		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	–	–	–	–	–	–	–	2	–	1	2	1	1
CO2	2	2	2	2	–	–	–	–	–	2	–	1	3	2	1
CO3	2	2	3	3	–	–	–	–	1	2	–	1	3	3	2
CO4	2	3	3	3	–	–	–	–	1	2	–	1	3	3	2
CO5	2	2	3	2	2	–	–	1	1	2	–	1	3	3	3

23BMO003	INDUSTRIAL HYGIENE	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Environmental Science and engineering • Engineering Chemistry					
Course Objectives: • To 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: Occupation 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
i. 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: 4		

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 Mager Stellman, 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. Butterworth Heinemann 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**

CO1:	Explain and apply human factors engineering concepts in both evaluation of existing systems and design of new systems	Apply
CO2:	Specify designs that avoid occupation related injuries	Apply
CO3:	Define and apply the principles of work design, motion economy, and work environment design.	Analyse
CO4:	Identify the basic human sensory, cognitive, and physical capabilities and limitations with respect to human-machine system performance.	Understand
CO5:	Acknowledge the impact of workplace design and environment on productivity	Analyse

CO-PO Mapping

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

23CHO008	CHEMICAL PROCESS SAFETY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					

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, 3rd Edition,2014.		
2. Maurice Jones .A,"Fire Protection Systems,2nd edition, Jones & Bartlett Publishers,2015		
References:		
1. Ralph King and Ron Hirst,"King's safety in the process industries", Arnold, London, 1998.		
2. Industrial Environment and its Evolution and Control, NIOSH Publication, 1973.		
3. National Safety Council," Accident prevention manual for industrial operations". Chicago, 1982.		
4. Lewis, Richard. J., Sr,"Sax's dangerous properties of materials". (Ninth edition). Van Nostrand Reinhold, New York, 1996.		
5. Roy E Sanders, "Chemical Process Safety",3rd Edition, Gulf professional publishing, 2006		
Course Outcomes:		Blooms Taxonomy
CO1:	Differentiate between inherent safety and engineered safety and recognize the importance of safety in the design of chemical process plants.	Analyse

CO2:	Develop thorough knowledge about safety in the operation of chemical plants.	Understand
CO3:	Apply the principles of safety in the storage and handling of gases.	Apply
CO4:	Identify the conditions that lead to reaction hazards and adopt measures to prevent them.	Analyse
CO5:	Students gain skills to assess risks, quantify failures, analyze human errors, investigate accidents, and apply OSHAS/OSHMS standards for improving workplace safety and reliability.	Evaluate
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 – – – 2	3 2 –
CO2	2 2 3 – – – 3 3 – – – 2	3 2 2
CO3	2 2 3 – – – 3 2 – – – 2	2 3 2
CO4	3 3 3 – – – 3 3 – – – 3	3 2 3
CO5	3 3 3 2 2 2 3 3 – – – 3	3 3 3

23EEO007	ELECTRICAL, ELECTRONIC AND MAGNETIC MATERIALS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
Engineering Physics					
Course Objectives:					
- Understanding the importance of various materials used in electrical, electronics and magnetic applications - Acquiring knowledge on the properties of electrical, electronics and magnetic materials. - Gaining knowledge on the selection of suitable materials for the given application - Knowing the fundamental concepts in Semiconducting materials - Getting equipped with the materials used in optical and optoelectronic applications.					
Unit I	DIELECTRIC MATERIALS				9
Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials					
Unit II	MAGNETIC MATERIALS				9
Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, 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, bimetallic 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, 2 nd 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		
CO2: Evaluate magnetic materials and their behaviour.													Evaluate		
CO3: Evaluate semiconductor materials and technologies.													Evaluate		
CO4: Select suitable materials for electrical engineering applications.													Apply		
CO5: Identify right material for optical and optoelectronic applications.													Apply		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	–	–	–	–	–	–	–	1	–	2	3	2	1
CO2	3	2	–	–	–	–	–	–	–	1	–	2	3	2	2
CO3	3	2	2	–	–	–	–	–	–	1	–	2	3	3	2
CO4	3	2	3	2	–	–	–	–	–	2	–	2	3	3	3
CO5	2	–	2	2	–	–	–	–	–	2	–	2	2	3	3

23CHO009	NANOMATERIALS AND APPLICATIONS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
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 characterization techniques employed to characterize 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:																	
25. Poole C.P, and Owens F.J., Introduction to Nanotechnology, John Wiley 2003																	
26. Nalwa H.S., Encyclopedia of Nanoscience and Nanotechnology, American Scientific Publishers 2004																	
27. Zehetbauer M.J. and Zhu Y.T., Bulk Nanostructured Materials, Wiley 2008																	
28. Wang Z.L., Characterization of Nanophase Materials, Wiley 2000																	
29. 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													Evaluate			
CO2:	Recognise the effects of dimensionality of materials on the properties													Understand			
CO3:	Process different nanomaterials and use them in engineering applications													Analyze			
CO4:	Use appropriate techniques for characterising nanomaterials													Apply			
CO5:	Identify and use different nanomaterials for applications in different engineering fields.													Apply			
CO-PO Mapping																	
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3		
CO1	2	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

23CE0012	HYDRAULICS AND PNEUMATICS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
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 PRINCIPLES 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		
CO1: Analyze the methods in fluid power principles and working of hydraulic pumps													Analyze		
CO2: Recognize the concepts in hydraulic actuators and control components													Understand		
CO3: Obtain the knowledge in basics of hydraulic circuits and systems													Understand		
CO4: Know about the basics concept in pneumatic and electro pneumatic systems													Understand		
CO5: Apply the concepts to solve the trouble shooting hydraulic and pneumatics													Apply		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1		2	2						1	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

23EE0008	SENSORS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
COURSE OBJECTIVES: - To learn the various types of sensors, transducers, sensor output signal types, calibration techniques, formulation of system equation and its characteristics. - To understand basic working principle, construction, Application and characteristics of displacement, speed and ranging sensors. - To understand and analyze the working principle, construction, application and characteristics of force, magnetic and heading sensors. - To learn and analyze the working principle, construction, application and characteristics of optical, pressure, temperature and other sensors. - To familiarize students with different signal conditioning circuits design and data acquisition system.					
Unit I	SENSOR CLASSIFICATION, CHARACTERISTICS AND SIGNAL TYPES				9

Basics of Measurement – Classification of Errors – Error Analysis – Static and Dynamic Characteristics of Transducers – Performance Measures of Sensors – Classification of Sensors – Sensor Calibration Techniques – Sensor Outputs - Signal Types - Analog and Digital Signals, PWM and PPM		
Unit II	DISPLACEMENT, PROXIMITY AND RANGING SENSORS	9
Displacement Sensors – Brush Encoders - Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – Range Sensors - Ultrasonic Ranging - Reflective Beacons - Laser Range Sensor (LIDAR) – GPS - RF Beacons.		
Unit III	FORCE, MAGNETIC AND HEADING SENSORS	9
Strain Gage – Types, Working, Advantage, Limitation, and Applications: Load Measurement – Force and Torque Measurement - Magnetic Sensors – Types, Principle, Advantage, Limitation, and Applications - Magneto Resistive – Hall Effect, Eddy Current Sensor - Heading Sensors – Compass, Gyroscope and Inclinometers.		
Unit IV	OPTICAL, PRESSURE, TEMPERATURE AND OTHER SENSORS	9
Photo Conductive Cell, Photo Voltaic, Photo Resistive, LDR – Fiber Optic Sensors – Pressure – Diaphragm – Bellows - Piezoelectric - Piezo-resistive - Acoustic, Temperature – IC, Thermistor, RTD, Thermocouple – Non Contact Sensor - Chemical Sensors - MEMS Sensors - Smart Sensors.		
Unit V	SIGNAL CONDITIONING	9
Need for Signal Conditioning – Resistive, Inductive and Capacitive Bridges for Measurement - DC and AC Signal Conditioning - Voltage, Current, Power and Instrumentation Amplifiers – Filter and Isolation Circuits – Fundamentals of Data Acquisition System		
Total periods: 45		
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: Understand various sensor effects, sensor characteristics, signal types, calibration methods and obtain transfer function and empirical relation of sensors. They can also analyze the sensor response.		Understand
CO2: Analyze and select suitable sensor for displacement, proximity and range measurement.		Analyze
CO3: Analyze and select suitable sensor for force, magnetic field, speed, position and direction measurement.		Analyze
CO4: Analyze and Select suitable sensor for light detection, pressure and temperature measurement and also familiar with other miniaturized smart sensors.		Analyze

CO5: Select and design suitable signal conditioning circuit with proper compensation and linearizing element based on sensor output signal.													Create		
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	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

23ECO006	CONCEPTS IN MOBILE ROBOTS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
• Nil					
COURSE OBJECTIVES					
- To introduce mobile robotic technology and its types in detail. - To learn the kinematics of wheeled and legged robot. - To familiarize the intelligence into the mobile robots using various sensors. - To acquaint the localization strategies and mapping technique for mobile robot. - To aware the collaborative mobile robotics in task planning, navigation and intelligence					
Unit I	INTRODUCTION TO MOBILE ROBOTICS				9
Introduction – Locomotion of the Robots – Key Issues on Locomotion – Legged Mobile Robots – Configurations and Stability – Wheeled Mobile Robots – Design Space and Mobility Issues – Unmanned Aerial and Underwater Vehicles					
Unit II	KINEMATICS				9
Kinematic Models – Representation of Robot – Forward Kinematics – Wheel and Robot Constraints – Degree of Mobility and Steerability – Manoeuvrability – Workspace – Degrees of Freedom – Path and Trajectory Considerations – Motion Controls - Holonomic Robots					
Unit III	PERCEPTION				9
Sensor for Mobile Robots – Classification and Performance Characterization – Wheel/Motor Sensors – Heading Sensors - Ground-Based Beacons - Active Ranging - Motion/Speed Sensors – Camera - Visual Appearance based Feature Extraction					
Unit IV	LOCALIZATION				9
Localization Based Navigation Versus Programmed Solutions - Map Representation – Continuous Representations - Decomposition Strategies - Probabilistic Map-Based Localization- Landmark-Based Navigation - Globally Unique Localization - Positioning Beacon Systems - Route-Based Localization - Autonomous Map Building - Simultaneous Localization and Mapping (SLAM)					
Unit V	PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS				9
Introduction - Competences for Navigation: Planning and Reacting - Path Planning – Obstacle Avoidance - Navigation Architectures - Control Localization - Techniques for Decomposition - Case Studies – Collaborative Robots – Swarm Robots.					
Total periods: 45					
Text Books:					
1. Roland Siegwart and IllahR.Nourbakish, “Introduction to Autonomous Mobile Robots” MIT Press, Cambridge, 2004.					
References:					

1. Dragomir N. Nenchev, Atsushi Konno, TeppeiTsujita, “Humanoid Robots: Modelling and Control”, Butterworth-Heinemann, 2018															
2. MohantaJagadish Chandra, “Introduction to Mobile Robots Navigation”, LAP Lambert Academic Publishing, 2015.															
3. Peter Corke, “Robotics, Vision and Control”, Springer, 2017.															
4. Ulrich Nehmzow, “Mobile Robotics: A Practical Introduction”, Springer, 2003.															
5. Xiao Qi Chen, Y.Q. Chen and J.G. Chase, “Mobile Robots - State of the Art in Land, Sea, Air, and Collaborative Missions”, Intec Press, 2009.															
6. Alonzo Kelly, Mobile Robotics: Mathematics, Models, and Methods, Cambridge University Press, 2013, ISBN: 978-1107031159.															
Course Outcomes:													Blooms Taxonomy		
CO1: Evaluate the appropriate mobile robots for the desired application													Evaluate		
CO2: Create the kinematics for given wheeled and legged robot.													Create		
CO3: Analyze the sensors for the intelligence of mobile robotics.													Analyze		
CO4: Create the localization strategies and mapping technique for mobile robot.													Create		
CO5: Create the collaborative mobile robotics for planning, navigation and intelligence for desired applications													Create		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1				1	1		2	3	2	2
CO2	3	3	3	2	1				1	1		2	3	3	2
CO3	3	3	2	3	2				1			2	3	3	2
CO4	3	2	3	3	3				2			2	2	3	2
CO5	3	2	3	3	3				2			2	3	3	3

23MEO015	MARINE PROPULSION	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
COOURSE 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,																
Course Outcomes:														Blooms Taxonomy		
CO1: Explain the basics of propulsion system and ship dynamic movements														Understand		
CO2: Familiarize with various components assisting ship stabilization.														Understand		
CO3: Demonstrate the performance of the ship.														Apply		
CO4: Classify the Propeller and its types, Materials etc.														Analyze		
CO5: Categories the Rudder and its types, design criteria of rudder.														Analyze		
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
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

23MEO016	MARINE MERCHANT VESSELS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					

COURSE OBJECTIVES:																
At the end of the course, students are expected to acquire																
• Knowledge on basics of Hydrostatics • Familiarization on types of merchant ships • Knowledge on Shipbuilding Materials • Knowledge on marine propeller and rudder • Awareness on governing bodies in shipping industry																
Unit I		INTRODUCTION TO HYDROSTATICS												9		
Archimedes Principle- Laws of floatation– Meta centre – stability of floating and submerged bodies- Density, relative density - Displacement –Pressure –centre of pressure																
Unit II		TYPES OF SHIP												9		
General cargo ship - Refrigerated cargo ships - Container ships - Roll-on Roll-off ships – Oil tankers- Bulk carriers - Liquefied Natural Gas carriers - Liquefied Petroleum Gas carriers - Chemical tankers - Passenger ships																
Unit III		SHIPBUILDING MATERIALS												9		
Types of Steels used in Shipbuilding - High tensile steels, Corrosion resistant steels, Steel sandwich panels, Steel castings, Steel forgings - Other shipbuilding materials, Aluminium alloys, Aluminium alloy sandwich panels, Fire protection especially for Aluminium Alloys, Fiber Reinforced Composites																
Unit IV		MARINE PROPELLER AND RUDDER												9		
Types of rudder, construction of Rudder-Types of Propeller, Propeller material-Cavitations and its effects on propeller																
Unit V		GOVERNING BODIES FOR SHIPPING INDUSTRY												9		
Role of IMO (International Maritime Organization), SOLAS (International Convention for the Safety of Life at Sea), MARPOL (International Convention for the Prevention of Pollution from Ships) , MLC (Maritime Labour Convention), STCW 2010 (International Convention on Standards of Training, Certification and Watch keeping for Seafarers), Classification societies Administration authorities																
															Total periods: 45	
Text Books:																
1. D.J.Eyres, “Ship Constructions”, Seventh Edition, Butter Worth Heinemann Publishing, USA,2015																
2. Dr.DA Taylor, “Merchant Ship Naval Architecture” I. Mar EST publications, 2006																
3. EA Stokoe, E.A, “Naval Architecture for Marine Engineers”, Vol.4, Reeds Publications,2000																
References:																
1. Kemp & Young “Ship Construction Sketches & Notes”, Butter Worth Heinemann Publishing,USA, 2011																
2. MARPOL Consolidated Edition , Bhandakar Publications, 2018																
3. SOLAS Consolidated Edition , Bhandakar Publications, 2016																
Course Outcomes:														Blooms Taxonomy		
CO1: Acquire Knowledge on floatation of ships														Understand		
CO2: Acquire Knowledge on features of various ships														Understand		
CO3: Acquire Knowledge of Shipbuilding Materials														Remember		
CO4: Acquire Knowledge to identify the different types of marine propeller and rudder														Apply		
CO5: Understand the Roles and responsibilities of governing bodies														Understand		
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	2	1		1						1		1	2	1	1	
CO2	2	1		1						1		1	2	1	1	

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

23MEO017	ELEMENTS OF MARINE ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
COURSE OBJECTIVES: At the end of the course, students are expected to - 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					

Course Outcomes:													Blooms Taxonomy		
CO1: Distinguish the role of various marine machinery systems													Understand		
CO2: Relate the components of marine propulsion machinery system													Apply		
CO3: Explain the importance of marine auxiliary machinery system													Understand		
CO4: Acquire knowledge of marine boiler system													Remember		
CO5: Understand the importance of ship propellers and steering system													Understand		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1						1				3	2	1
CO2	3	2	2	1					1				3	3	1
CO3	2	2	1										3	2	1
CO4	2	1	1	1									3	2	2
CO5	3	2	1						2				3	3	1

23ECO007	DRONE TECHNOLOGIES	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
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, 2001															
References:															
1. John Baichtal, “Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs”, Que Publishing, 2016															
2. Završnik, “Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance”, Springer, 2018.															
Course Outcomes:													Blooms Taxonomy		
CO1:		Know about a various type of drone technology, drone fabrication and programming.											Understand		
CO2:		Execute the suitable operating procedures for functioning a drone											Apply		
CO3:		Select appropriate sensors and actuators for Drones											Analyze		
CO4:		Develop a drone mechanism for specific applications											Create		
CO5:		Create the programs for various drones											Create		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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					
• Nil					
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:															
1. Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition, 2011.															
2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, “An Introduction Geographical Information Systems, Pearson Education, 2nd Edition,2007.															
References:															
1. Lo. C. P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers, 2006															
Course Outcomes:													Blooms Taxonomy		
CO1:	Have basic idea about the fundamentals of GIS.													Remember	
CO2:	Understand the types of data models.													Understand	
CO3:	Get knowledge about data input and topology													Apply	
CO4:	Gain knowledge on data quality and standards													Understand	
CO5:	Understand data management functions and data output													Apply	
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												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

23CEO006	AGRICULTURE ENTREPRENEURSHIP DEVELOPMENT	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
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.					
Unit V	ENTREPRENEURIAL PROMOTION MEASURES AND GOVERNMENT SUPPORT				9
Social responsibility of business. Morals and ethics in enterprise management- SWOT analysis- Government schemes and incentives for promotions of entrepreneurship. Government policy on small and medium enterprises (SMEs)/SSIs/MSME sectors- Venture capital (VC), contract framing (CF) and Joint Venture (JV), public-private partnerships (PPP) - overview of agricultural engineering industry, characteristics of Indian farm machinery industry.					
Total periods: 45					
Text Books:					
4. Joseph L. Massie, 1995, “Essentials of Management”, prentice Hall of India Pvt limited, New Delhi					
5. Khanka S, 1999, Entrepreneurial Development, S, Chand and Co, New Delhi					
6. Mohanty S K, 2007, Fundamentals of Entrepreneurship, Prentice Hall India, New Delhi					
References:					
8. Harih S B, Conner U J and Schwab G D, 1981, Management of the Farm Business, Prentice Hall Inc, New					

Jersey															
9. Omri Ralins, N.1980, Introduction to Agricultural: Prentice Hall Inc, New Jersey															
10. Gittenger Price, 1989, Economic Analysis of Agricultural project, John Hopkins University, Press, London.															
11. Thomas W Zimmer and Norman M Scarborough, 1996, Entrepreneurship, Prentice Hall, New Jersey.															
12. Mar J Dollinger, 1999, Entrepreneurship strategies and resources, Prentice –Hall, Upper Saddal Rover, New Jersey.															
Course Outcomes:													Blooms Taxonomy		
CO1: Judge about agricultural finance, banking and cooperation													Analyse		
CO2: Evaluate basic concepts, principles and functions of financial management													Evaluate		
CO3: Improve the skills on basic banking and insurance schemes available to customers													Apply		
CO4: Analyse various financial data for efficient farm management													Analyse		
CO5: Identify the financial institutions													Remember		
CO-PO 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	2	1	1	1	1	1	1	1	2	1	1	1	1	2

23CEO010	BIODIVERSITY CONSERVATION	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
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. S. Chand, Limited, Pandey, B. P. January 2001															
2. Principles of Systematic Zoology, Mcgraw-Hill College, Ashlock, P.D., Latest Edition.															
3. Microbiology, MacGraw Hill Companies Inc, Prescott, L.M., Harley, J.P., and Klein D.A. (2022).															
4. Microbiology, Pearson Publisher, Gerard J. Tortora, Berdell R. Funke, Christine L.Case, 13 th Edition 2019															
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.													Understand		
CO2: Understand the concept of animal diversity and taxonomy													Understand		
CO3: Understand socio-economic issues pertaining to biodiversity													Understand		
CO4: An understanding of biodiversity in community resource management.													Understand		
CO5: Student can apply fundamental knowledge of biodiversity conservation to solve problems associated with infrastructure development.													Apply		
CO-PO 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	-

23EEO009	INTRODUCTION TO CONTROL SYSTEMS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To impart knowledge on various representations of systems. - To familiarize time response analysis of LTI systems and steady state error. - To analyze the frequency responses and stability of the systems. - To analyze the stability of linear systems in frequency domain and time domain. - To develop linear models mainly state variable model and transfer function model.					
Unit I	MATHEMATICAL MODELS OF PHYSICAL SYSTEMS				9
Definition & classification of system – terminology & structure of feedback control theory – Analogous systems - Physical system representation by Differential equations – Block diagram reduction–Signal flow graphs.					
Unit II	TIME RESPONSE ANALYSIS & ROOT LOCUS TECHNIQUE				9
Standard test signals – Steady state error & error constants – Time Response of I and II order system–Root locus– Rules for sketching root loci.					

Unit III	FREQUENCY RESPONSE ANALYSIS												9		
Correlation between Time & Frequency response – Polar plots – Bode Plots – Determination of Transfer Function from Bode plot.															
Unit IV	STABILITY CONCEPTS & ANALYSIS												9		
Concept of stability – Necessary condition – RH criterion – Relative stability – Nyquist stability criterion – Stability from Bode plot – Relative stability from Nyquist & Bode – Closed loop frequency response.															
Unit V	STATE VARIABLE ANALYSIS												9		
Concept of state – State Variable & State Model – State models for linear & continuous time systems–Solution of state & output equation–controllability & observability.															
Total periods: 45															
Text Books:															
1. Farid Golnarghi , Benjamin C. Kuo, Automatic Control Systems Paper back McGraw Hill Education, 2018															
2. Katsuhiko Ogata, ‘Modern Control Engineering’, Pearson, 5 th Edition2015.															
3. J. Nagrath and M. Gopal, Control Systems Engineering (Multi Colour Edition), New Age International, 2018.															
References:															
1. Richard C. Dorf and Robert H. Bishop, Modern Control Systems, Pearson Education, 2010.															
2. Control System Dynamics" by Robert Clark, Cambridge University Press, 1996 USA.															
3. John J. D’Azzo, Constantine H. Houpis and Stuart N. Sheldon, Linear Control System Analysis and Design, 5 th Edition, CRC PRESS, 2003.															
4. S. Palani, Control System Engineering, McGraw-Hill Education Private Limited, 2009.															
5. Yaduvir Singh and S.Janardhanan, Modern Control, Cengage Learning, First Impression2010.															
Course Outcomes:													Blooms Taxonomy		
CO1: Design the basic mathematical model of physical System.													Create		
CO2: Analyze the time response analysis and techniques.													Analyse		
CO3: Analyze the transfer function from different plots													Analyse		
CO4: Apply the stability concept in various criterion.													Apply		
CO5: Assess the state models for linear and continuous Systems.													Evaluate		
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	3	3	3
CO2	3	3	2	3	1								3	3	3
CO3	3	3	3	2	2								3	3	3
CO4	3	3	3	2	2							2	3	3	3
CO5	3	3	3	1	1							1	3	3	3

23MEO021	INTRODUCTION TO INDUSTRIAL AUTOMATION SYSTEMS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
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																	
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,3rd Edition,2005.																	
Course Outcomes:													Blooms Taxonomy				
CO1:	Design a signal conditioning circuits for various application .													Apply			
CO2:	Acquire a detail knowledge on data acquisition system interface and DCS system .													Understand			
CO3:	Understand the basics and Importance of communication buses in applied automation Engineering .													Understand			
CO4:	Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block.													Apply			
CO5:	Able to develop a PLC logic for a specific application on real world problem.													Evaluate			
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	-	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		

23EE0010	ENERGY TECHNOLOGY		Category: OEC			
			L	T	P	C
			3	0	0	3
Prerequisites Nil						
Course Objectives: - Understanding energy resource assessment and conversion principles. - Gaining skills in energy system design, analysis and optimization. - Learning about energy conservation , storage technologies and grid integration. - Developing capabilities to perform energy audits and management in various sectors. - Preparing students for addressing global issues like climate change, pollution and sustainable environment.						
Unit I	INTRODUCTION					9
Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources.						
Unit II	CONVENTIONAL ENERGY					9
Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.						
Unit III	NON-CONVENTIONAL ENERGY					9
Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.						
Unit IV	BIOMASS ENERGY					9
Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.						
Unit V	ENERGY CONSERVATION					9
Energy conservation in chemical process plants, energy audit, energy saving in heat exchangers, distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation.						
Total periods: 45						
Text Books:						
1. Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005.						
2. Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi, 1984.						
3. Bansal, N.K., Kleeman, M. and Meliss, M., Renewable Energy Sources and Conversion Technology, Tata McGraw Hill, 1990.						
4. Nagpal, G.R., Power Plant Engineering, Khanna Publishers, 2008.						
References:						
1. Nejat Vezirog, Alternate Energy Sources, IT, McGraw Hill, New York.						
2. El. Wakil, Power Plant Technology, Tata McGraw Hill, New York, 2002.						
3. Sukhatme. S.P., Solar Enery - Thermal Collection and Storage, Tata McGraw hill, New Delhi, 1981.						
Course Outcomes:						Blooms Taxonomy
CO1:	Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels					Understand

CO2:	Students will excel as professionals in the various fields of energy engineering												Analyse		
CO3:	Compare different renewable energy technologies and choose the most appropriate based on local conditions.												Analyse		
CO4:	Explain the technological basis for harnessing renewable energy sources.												Understand		
CO5:	Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level.												Evaluate		
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

23OCH354	SURFACE SCIENCE	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: To enable the students to analyze properties of a surfaces and correlate them to structure, chemistry, and physics and surface modification technique.					
Unit I	SURFACE STRUCTURE AND EXPERIMENTAL PROBES				9
Relevance of surface science to Chemical and Electrochemical Engineering, Heterogeneous Catalysis and Nanoscience; Surface structure and reconstructions, absorbate structure, Band and Vibrational structure, Importance of UHV techniques, Electronic probes and molecular beams, Scanning probes and diffraction, Qualitative introduction to electronic and vibrational spectroscopy					
Unit II	ADSORPTION, DYNAMICS, THERMODYNAMICS AND KINETICS AT SURFACES				9
Interactions at the surface, Physisorption, Chemisorption, Diffusion, dynamics and reactions of atoms/molecules on surfaces, Generic reaction mechanism on surfaces, Adsorption isotherms, Kinetics of adsorption, Use of temperature desorption methods.					
Unit III	LIQUID INTERFACES				9
Structure and Thermodynamics of liquid-solid interface, Self-assembled monolayers, Electrified interfaces, Charge transfer at the liquid-solid interfaces, Photoelectrochemical processes, Gratzel cells.					
Unit IV	HETEROGENEOUS CATALYSIS				9
Characterization of heterogeneous catalytic processes, Microscopic kinetics to catalysis, Overview of important heterogeneous catalytic processes: Haber-Bosch, Fishcher-Tropsch and Automotive catalysis, Role of promoters and poisons, Bimetallic surfaces, surface functionalization and clusters in catalysis, Role of Sabatier principle in catalyst design, Rate oscillations and spatiotemporal pattern formation.					
Unit V	EPITAXIAL GROWTH AND NANO SURFACE-STRUCTURES				9
Origin of surface forces, Role of stress and strain in epitaxial growth, Energetic and growth modes, Nucleation theory, Nonequilibrium growth modes, MBE, CVD and ablation techniques, Catalytic growth of nanotubes, Etching of surfaces, Formation of nanopillars and nanorods and its application in photoelectrochemical processes, Polymer surfaces and bio interfaces.					
Total periods: 45					

Text Books:															
1. K. W. Kolasinski, “Surface Science: Foundations of catalysis and nanoscience” II Edition, John Wiley & Sons, New York, 2008.															
References:															
1. Gabor A. Somorjai and Yimin Li “Introduction to Surface Chemistry and catalysis”, II Edition John Wiley & Sons, New York, 2010.															
Course Outcomes:													Blooms Taxonomy		
CO1: The students can understand surface properties based on surface structure.													UNDERSTAND		
CO2: Students would understand the physics and chemistry behind surface phenomena													UNDERSTAND		
CO3: Students gain the ability to predict and design surface properties													CREATE		
CO4: Students can apply State-of-art methods to surface modification.													APPLY		
CO5: Students can able to prepare comprehend scientific literature related to surface science.													CREATE		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	1	2						3	1	2
CO2	2	3	2	3	1	1	2						3	2	1
CO3	2	3	3	3	2	1	3						2	1	1
CO4	1	2	3	3	2	2	3						2	1	1
CO5	1	1	1	1	1	1	1						1	2	1

23BTO004	FUNDAMENTALS OF FOOD ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
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, 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 lo.w- 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 Intitute 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.															
References															
1. George D. Saravacos and Athanasios E. Kostaropoulos. 2002. Handbook of Food Processing Equipment. Springer Science+Business Media, New York, USA.															
2. 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.															
Course Outcomes:													Blooms Taxonomy		
CO1: Understand the importance of food polymers													Understand		
CO2: Understand the effect of various methods of processing on the structure and texture of food materials													Understand		
CO3: Understand the interaction of food constituents with respect to thermal, electrical properties to develop new technologies for processing and preservation.													Understand		
CO4: Evaluate the effects of processing on food quality and safety.													Evaluate		
CO5: Design and optimize food processing techniques and equipment for industrial applications.													Design		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	1	2						3	2	3
CO2	2	3	2	3	1	1	2						3	3	3
CO3	1	2	3	2	2	2	3						3	1	3
CO4	2	3	2	3	2	2	2						2	2	3

CO5	1	1	2	1	3	1	2						1	2	1

23BTO005	FOOD SAFETY AND QUALITY REGULATION	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - To characterize different type of food hazards, physical, chemical and biological in the industry and food service establishments - To help become skilled in systems for food safety surveillance - To be aware of the regulatory and statutory bodies in India and the world - To ensure processed food meets global standards					
Unit I					9
Introduction to food safety and security: Hygienic design of food plants and 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					9
Food quality: Various Quality attributes of food, Instrumental, chemical and microbial Quality control. Sensory evaluation of food and statistical analysis. Water quality and other utilities.					
Unit III					9
Size reduction: Benefits, classification, determination and designation of the fineness of ground material, sieve/screen analysis, principle and mechanisms of comminution of food, Rittinger’s, Kick’s and Bond’s equations, work index, energy utilization; Size reduction equipment: Principal types, crushers (jaw crushers, gyratory, smooth roll), hammer mills and impactors, attrition mills, buhr mill, tumbling mills, tumbling mills, ultra fine grinders, fluid jet pulverizer, colloid mill, cutting machines (slicing, dicing, shredding, pulping)					
Unit IV					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					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					
Textbooks:					
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					
References:					
1. Microbiological safety of Food by Hobbs BC, 1973					
2. Food Safety Handbook by Ronald H. Schmidt, Gary E. Rodrick, A John Wiley & Sons Publication, 2003					

Course Outcomes:													Blooms Taxonomy		
CO1: Thorough Knowledge of food hazards, physical, chemical and biological in the industry and food service establishments													Understand		
CO2: Awareness on regulatory and statutory bodies in India and the world													Understand		
CO3: Understand regulatory frameworks and food laws related to food safety and quality													Understand		
CO4: Gain knowledge of food quality standards													Remember		
CO5: Develop skills to assess the quality of various food products													Apply		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	1	2						3	3	2
CO2	2	3	2	3	2	2	2						3	2	2
CO3	2	3	3	3	2	2	3						3	1	2
CO4	1	2	3	3	2	3	3						3	3	2
CO5	1	1	2	1	3	1	2						3	1	1

23BTO006	NUTRACEUTICALS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
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					
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**

CO1:	Acquire knowledge about the Nutraceuticals and functional foods, their classification and benefits.	Understand
CO2:	Acquire knowledge of phytochemicals, zoochemicals and microbes in food, plants, animals and microbes	Understand
CO3:	Attain the knowledge of the manufacturing practices of selected nutraceutical components and formulation considerations of functional foods.	Understand
CO4:	Distinguish the various In vitro and In vivo assessment of Antioxidant activity of compounds from plant sources.	Understand
CO5:	Gain information about the health benefits of various functional foods and nutraceuticals in the prevention and treatment of various lifestyle diseases.	Understand

CO-PO Mapping

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

23CHO010	BASICS OF DYEING AND PRINTING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites -Nil-					
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
CO1: 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													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	-
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															

23CHO010	FIBRE SCIENCE	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
-Nil-					
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	SYNTHEITC FIBRES				9
Production Sequence of Synthetic Fibers: polymer-Polyester, Nylon, Acrylic and polypropylene. Mineral fibres: fibre glass ,carbon .Introduction to spin finishes and texturization					
Unit IV	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, 2nd Edition, 1998, ISBN: 1855733196.															
3. Raheel M. (ed.), “Modern Textile Characterization Methods”, Marcel Dekker, 1995, ISBN:0824794737															
4. Mukhopadhyay. S. K., “The Structure and Properties of Typical Melt Spun Fibres”, Textile Progress, Vol. 18, No. 4, Textile Institute, 1989, ISBN: 1870812115															
5. Hearle J.W.S., “Polymers and Their Properties: Fundamentals of Structures and Mechanics Vol 1”, Ellis Horwood, England, 1982, ISBN: 047027302X ISBN-13: 9780470273029 36															
Course Outcomes:													Blooms Taxonomy		
CO1: Understand the process sequence of various fibres													Understand (k2)		
CO2: Understand the properties of various fibres													Understand (k2)		
CO3: Explain the production principles of regenerated fibres such as viscose, acetate, modal, lyocell, and Tencel.													Understand(k2)		
CO4: Apply knowledge of fibre-forming polymers to compare synthetic fibres (polyester, nylon, acrylic, polypropylene) and specialty fibres like carbon and fiberglass.													Apply (k3)		
CO5: Describe the functional characteristics and end-use applications of advanced fibres, including medical fibres, biodegradable PLA fibres, elastomeric fibres, superabsorbent fibres, ultrafine fibres, nanofibres, and metallic-coated fibres.													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	1	1	2	1	2	2	2	1
CO2	3	3	1	2	1	1	2	1	1	2	1	2	2	2	1

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

23CHO012	GARMENT MANUFACTURING TECHNOLOGY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
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 346abelling of apparels.					
Total periods: 45					
Text Books:					
1.Carr H., and Latham B., “The Technology of Clothing Manufacture”, Blackwell Science Ltd., Oxford, 1994					
2. Gerry Cooklin, “Introduction to Clothing Manufacture” Blackwell Science Ltd., 1995. 64					
3. Harrison.P.W Garment Dyeing, The Textile Institute Publication, Textile Progress, Vol .19 No.2,1988					
References:					
1. Winifred Aldrich., “Metric Pattern Cutting”, Blackwell Science Ltd., Oxford, 1994					
2. 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
CO1: Pattern making, marker planning, cutting					Understand
CO2: Types of seams, stitches and functions of needles					Understand
CO3: Components and trims used in garment					Remember
CO4: Garment inspection and dimensional changes					Understand
CO5: Garment pressing, packing and careabelling					Understand
CO-PO 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
23CEO009	INDUSTRIAL SAFETY											Category: OEC			
												L	T	P	C
												3	0	0	3
Prerequisites															
• Nil															
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. <i>Industrial Safety, Health and Environment Management Systems</i> — R. K. Jain & Sunil S. Rao . Very comprehensive, covering safety systems, legislation, health, ergonomics, risk, and environmental aspects.															
2. <i>Industrial Safety Management: Hazard Identification & Risk Control</i> — L. M. Deshmukh , McGraw-Hill.															
References:															
1. Encyclopaedia of Occupational Health and Safety (4th Edition) — Very comprehensive coverage of hazards, health, policies, chemicals, safety systems.															

2. Occupational and Environmental Safety and Health — Edited by Pedro M. Arezes, João Baptista, Paula Carneiro, et al. A modern Springer text covering a broad spectrum: risk assessment, occupational health, ergonomics, safety culture.															
3. Industrial Safety Management: 21st Century Perspectives (Asia) — by J. Maiti & P. K. Ray (Springer). Very good for safety analytics, safety-by-design, and current industrial safety trends in Asia.															
4. Industrial Accident Prevention – A Scientific Approach — by H.W. Heinrich. A classic in safety, foundational for understanding accident theory, root causes, and behavior-based safety.															
5. Bretherick's Handbook of Reactive Chemical Hazards — by Leslie Bretherick. Excellent reference for chemical safety, handling reactive substances, risk of explosions, and understanding chemical hazards.															
Course Outcomes:													Blooms Taxonomy		
CO1: Describe, with example, the common work-related diseases and accidents in occupational setting													Understand		
CO2: Describe the essential members of the Occupational Health team													Understand		
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		
CO4: Explain hazard identification, risk assessment, and emergency planning.													Understand		
CO5: Describe the key elements of Environmental Health and Safety (EHS) management.													Understand		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	3	2	2	1	1	-	2	3	2	1
CO2	1	1	-	-	-	2	1	2	2	2	-	1	2	3	1
CO3	1	1	1	-	-	3	2	2	3	3	1	2	2	3	2
CO4	2	3	3	3	2	3	2	2	1	1	2	2	3	3	3
CO5	1	1	2	1	1	3	3	3	2	2	3	3	2	3	3

23CHO013	UNIT OPERATIONS IN PETRO CHEMICAL INDUSTRIES	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: To impart to the student basic knowledge on fluid mechanics, mechanical operations, heat transfer operations and mass transfer operations.					
Unit I	FLUID MECHANICS CONCEPTS				9
Fluid definition and classification of fluids, types of fluids, Rheological behaviour of fluids & Newton’s Law of viscosity. Fluid statics-Pascal's law, Hydrostatic equilibrium, Barometric equation and pressure measurement(problems),Basic equations of fluid flow - Continuity equation, Euler’s equation and Bernoulli equation; Types of flow - laminar and turbulent; Reynolds experiment; Flow through circular and non-circular conduits - Hagen Poiseuille equation (no derivation). Flow through stagnant fluids – theory of Settling and Sedimentation – Equipment (cyclones, thickeners) Conceptual numericals.					
Unit II	FLOW MEASUREMENTS & MECHANICAL OPERATIONS				9
Different types of flow measuring devices (Orifice meter, Venturimeter, Rotameter) with derivations, flow measurements –. Pumps – types of pumps (Centrifugal & Reciprocating pumps), Energy calculations and characteristics of pumps. Size reduction–characteristics of comminute products, sieve analysis, Properties and handling of particulate solids – characterization of solid particles, average particle size, screen analysis- Conceptual numerical of differential and cumulative analysis. Size reduction, crushing laws, working principle of ball mill. Filtration & types, filtration equipments (plate and frame, rotary drum). Conceptual numericals.					
Unit III	CONDUCTIVE & CONVECTIVE HEAT TRANSFER				9

Modes of heat transfer; Conduction – steady state heat conduction through unilayer and multilayer walls, cylinders; Insulation, critical thickness of insulation. Convection- Forced and Natural convection, principles of heat transfer co-efficient, log mean temperature difference, individual and overall heat transfer co-efficient, fouling factor; Condensation – film wise and drop wise (no derivation). Heat transfer equipments – double pipe heat exchanger, shell and tube heat exchanger (with working principle and construction with applications).															
Unit IV		BASICS OF MASS TRANSFER												9	
Diffusion-Fick’s law of diffusion. Types of diffusion. Steady state molecular diffusion in fluids at rest and laminar flow (stagnant / unidirection and bi direction). Measurement of diffusivity, Mass transfer coefficients and their correlations. Conceptual numerical.															
Unit V		MASS TRANSFER OPERATIONS												9	
Basic concepts of Liquid-liquid extraction – equilibrium, stage type extractors (belt extraction and basket extraction).Distillation – Methods of distillation, distillation of binary mixtures using McCabe Thiele method.Drying-drying operations, batch and continuous drying. Conceptual numerical.															
Total periods: 45															
Text Books:															
1. Unit operations in Chemical Engineering Warren L. McCabe, Julian C. Smith & Peter Harriot McGraw-Hill Education (India) Edition 2014															
2.Fluid Mechanics K L Kumar S Chand & Company Ltd 2008															
3.Introduction to Chemical Engineering Badger W.I. and Banchero, J.T., Tata McGraw Hill New York 1997															
References:															
1. Principles of Unit Operations Alan S Foust, L.A. Wenzel, C.W. Clump, L. Maus, and L.B. Anderson John Wiley & Sons 2nd edition 2008															
2. Unit Operations of Chemical Engineering, Vol I &II Chattopadhyaya Khanna Publishers, Delhi-6 1996															
3. Heat Transfer J P Holman McGraw Hill International Ed															
Course Outcomes:													Blooms Taxonomy		
CO1: State and describe the nature and properties of the fluids.													Understan		
CO2: Study the different flow measuring instruments, the principles of various size reductions, conveying equipment’s, sedimentation and mixing tanks.													Understand		
CO3: Comprehend the laws governing the heat and mass transfer operations to solve the problems.													Understand		
CO4: Design the heat transfer equipment suitable for specific requirement.													Create		
CO5: Understand and apply mass-transfer operations (extraction, distillation, drying).													Apply		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	-	-	-	-	-	-	2	3	3	3
CO2	3	3	2	2	2	-	-	-	1	1	-	2	3	3	3
CO3	3	3	2	2	2	-	-	-	-	-	-	3	3	3	3
CO4	3	3	3	2	3	-	-	-	1	1	2	3	3	3	3
CO5	3	3	2	2	2	-	-	-	1	1	-	3	3	3	3

23MEO018	PLASTIC MATERIALS FOR ENGINEERS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					
• Nil					

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																
Text Books:																
1. Marianne Gilbert (Ed.), Brydson’s Plastics Materials, 8th Edn., Elsevier (2017)																
2. J.A.Brydson, Plastics Materials, 7th Edn., Butterworth Heinemann (1999)																
References:																
1. Manas Chanda, Salil K. Roy, Plastics Technology Handbook, 4th Edn., CRC press (2006)																
2. A. Brent Strong, Plastics: Materials and Processing, 3rd Edn., Pearson Prentice Hall (2006)																
3. Olagoke Olabisi, Kolapo Adewale (Eds.), Handbook of Thermoplastics 2nd Edn., CRC press (2016)																
4. Charles A. Harper, Modern Plastics Handbook, McGraw-Hill, New York, 1999																
5. H. Dominighaus, Plastics for Engineers, Hanser Publishers, Munich, 1988																
Course Outcomes:														Blooms Taxonomy		
CO1:	To study the importance, advantages and classification of plastic materials													Understand		
CO2:	Summarize the raw materials, sources, production, properties and applications of various engineering thermoplastics													Understand		
CO3:	To understand the application of polyamides, polyesters and other engineering thermoplastics, thermosetting resins													Understand		
CO4:	Know the manufacture, properties and uses of thermosetting resins based on polyester, epoxy, silicone and PU													Understand		
CO5:	To understand the engineering applications of various polymers in miscellaneous areas and applications of different biopolymers													Apply		
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	1	1	1	1	1	1	3	3	3	

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

23MEO019	PROPERTIES AND TESTING OF PLASTICS		Category: OEC			
			L	T	P	C
			3	0	0	3
Prerequisites • Nil						
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 co-efficient, dielectric polarization), dissipation factor and its importance. Optical properties: transparency, refractive index, haze, gloss, clarity, birefringence.						
Unit V		ENVIRONMENTAL AND CHEMICAL RESISTANCE				9
Environmental stress crack resistance (ESCR), water absorption, weathering, aging, ozone resistance, permeability and adhesion. Tests for chemical resistance. Acids, alkalies, Flammability tests- oxygen index test.						
Total periods: 45						
Text Books:						
1. 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						
References:						
1. R.P.Brown, Plastic test methods, 2nd Edn., Harlond, Longman Scientific, 1981						

2. A. B. Mathur, I. S. Bharadwaj, Testing and Evaluation of Plasticis, Allied Publishers Pvt. Ltd., New Delhi, 2003															
3. Vishu Shah, Handbook of Plastic Testing Technology, 3rd Edn., John Wiley & Sons 2007															
4. 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		
CO2:	Summarize the various test methods for evaluating the mechanical properties of the polymers.												Analyze		
CO3:	To know the thermal, electrical & optical properties of polymers.												Understand		
CO4:	Identify various techniques used for characterizing polymers.												Understand		
CO5:	Distinguish the processability tests used for thermoplastics, thermosets and elastomers.												Analyze		
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	1	1	1	1	1	1	3	2	1
CO2	3	3	2	2	2	1	1	1	2	1	1	1	3	3	2
CO3	3	3	2	2	2	1	1	1	2	1	1	1	3	3	2
CO4	2	3	3	2	2	1	1	1	2	1	1	1	3	3	2
CO5	2	2	2	2	3	1	1	1	2	1	1	1	3	1	3

23BMO004	MEDICAL INFORMATICS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
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 inclinical 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”, 3rd Edition, Springer, 2006															
Course Outcomes:														Blooms Taxonomy	
CO1:	Explain the structure and functional capabilities of Hospital Information System.													Understand	
CO2:	Describe the need of computers in medical imaging and automated clinical laboratory.													Understand	
CO3:	Articulate the functioning of information storage and retrieval in computerized patient record system.													Understand	
CO4:	Apply the suitable decision support system for automated clinical diagnosis.													Apply	
CO5:	Discuss the application of virtual reality and telehealth technology in medical industry.													Understand	
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	-	-	-	-	-	-	-	1	1	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

23CEO008	BASICS OF INTEGRATED WATER RESOURCES MANAGEMENT	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Nil					
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. 2002															
2. IWRM Guidelines at River Basin Level (UNESCO, 2008)															
3. Tutorial on Basic Principles of Integrated Water Resources Management ,CAP-NET. http://www.pacificwater.org/userfiles/file/IWRM/Toolboxes/introduction%20to%20iwrn/Tutorial_text.pdf															
4. Pramod R. 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.												Analyze		
CO2:	Discuss on the different water uses; how it is impacted and ways to tackle these impacts.												Apply		
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.												Apply		
CO4:	Illustrate the recent trends in water management.												Understand		
CO5:	Understand the implementation hitches and the institutional frameworks.												Understand		
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	1	–	1	–	2	2	1	1
CO2	3	2	2	2	1	2	3	1	–	1	–	2	2	1	1
CO3	3	2	2	3	2	1	2	1	–	1	–	2	2	2	1
CO4	3	2	2	2	3	1	3	1	–	1	–	2	2	2	1
CO5	3	1	1	2	1	2	3	1	–	1	–	3	2	3	2

23BTO008	BIOTECHNOLOGY FOR WASTE MANAGEMENT	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Nil					
Course Objectives: - Provide fundamental knowledge on biological treatment processes involved in waste management, including aerobic, anaerobic, and anoxic systems. - Develop understanding of waste biomass, its characteristics, and techniques used for value addition and biotransformation. - Introduce various bioconversion technologies used to convert waste into biofuels and renewable energy sources. - Enable learners to understand the production of chemicals and industrially important enzymes from different waste materials.					

Familiarize students with composting processes and the role of microorganisms in organic waste decomposition and quality improvement.																	
Unit I	BIOLOGICAL TREATMENT PROCESS													9			
Fundamentals of biological process - Anaerobic process – Pretreatment methods in anaerobic process – Aerobic process, Anoxic process, Aerobic and anaerobic digestion of organic wastes - Factors affecting process efficiency - Solid state fermentation – Submerged fermentation – Batch and continuous fermentation																	
Unit II	WASTE BIOMASS AND ITS VALUE ADDITION													9			
Types of waste biomass – Solid waste management - Nature of biomass feedstock – Biobased economy/process – Value addition of waste biomass – Biotransformation of biomass – Biotransformation of marine processing wastes – Direct extraction of biochemicals from biomass – Plant biomass for industrial application																	
Unit III	BIOCONVERSION OF WASTES TO ENERGY													9			
Perspective of biofuels from wastes - Bioethanol production – Biohydrogen Production – dark and photofermentative process - Biobutanol production – Biogas and Biomethane production - Single stage anaerobic digestion, Two stage anaerobic digestion - Biodiesel production - Enzymatic hydrolysis technologies																	
Unit IV	CHEMICALS AND ENZYME PRODUCTION FROM WASTES													9			
Production of lactic acid, succinic acid, citric acid – Biopolymer synthesis – Production of Amylases - Lignocellulolytic enzymes - Pectinolytic enzymes - Proteases – Lipases																	
Unit V	BIOCOMPOSTING OF ORGANIC WASTES													9			
Overview of composting process - Benefits of composting, Role of microorganisms in composting - Factors affecting the composting process - Waste Materials for Composting, Fundamentals of composting process - Composting technologies, Composting systems – Nonreactor Composting, Reactor composting - Compost Quality																	
Total periods: 45																	
Text Books:																	
1.Antoine P. T., (2017) “Biofuels from Food Waste Applications of Saccharification Using Fungal Solid State Fermentation”, CRC press																	
2.Joseph C A., (2019)“Anaerobic Waste-Wastewater Treatment and Biogas Plants-A Practical Handbook”, CRC Press																	
References:																	
1. Palmiro P. and Oscar F.D’Urso, (2016) ‘Biotransformation of Agricultural Waste and By-Products’,The Food, Feed, Fibre, Fuel (4F) Economy, Elsevier																	
2. Kaur Brar S., Gurpreet Singh D. and Carlos R.S., (Eds), (2014)‘Biotransformation of Waste Biomass into High Value Biochemicals’, Springer																	
3. Keikhosro K, Editor, (2015) ‘Lignocellulose-Based Bioproducts’, Springer																	
4. John P, (2014) ‘Waste Management Practices-Municipal, Hazardous, and Industrial’, Second Edition, CRC Press, 2014																	
Course Outcomes:													Blooms Taxonomy				
CO1:	Explain the various methods used in biological treatment of wastes.													Understand			
CO2:	Describe the characteristics of waste biomass and its potential for value addition.													Understand			
CO3:	Develop bioconversion processes for converting wastes into energy.													Create			
CO4:	Synthesize useful chemicals and enzymes from waste materials.													Create			
CO5:	Produce biocompost from organic wastes through suitable composting methods.													Create			
CO-PO Mapping																	
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3		
CO1	2	1	1	2	1	1	–	–	–	–	1	2	1	1	2		
CO2	2	1	1	2	1	1	–	–	–	–	1	2	1	1	2		
CO3	2	2	2	2	1	1	–	–	–	1	1	2	2	2	2		
CO4	2	2	2	2	1	1	–	–	–	1	1	2	2	2	2		
CO5	2	2	2	2	1	1	–	–	–	1	1	2	1	2	2		

23BTO009	LIFESTYLE DISEASES												Category: OEC			
													L	T	P	C
													3	0	0	3
Prerequisites																
• Nil																
Course Objectives:																
• Understand the causes, risk factors, and preventive measures of major lifestyle diseases.																
• Analyze the mechanisms, diagnosis, and treatment strategies for cancer, cardiovascular diseases, diabetes, obesity, and respiratory diseases.																
• Evaluate lifestyle modifications and interventions for the prevention and management of lifestyle-related diseases.																
Unit I		INTRODUCTION												9		
Lifestyle diseases – Definition ; Risk factors – Eating, smoking, drinking, stress, physical activity, illicit drug use ; Obesity, diabetes, cardiovascular diseases, respiratory diseases, cancer; Prevention – Diet and exercise.																
Unit II		CANCER												9		
Types - Lung cancer, Mouth cancer, Skin cancer, Cervical cancer, Carcinoma oesophagus; Causes Tobacco usage, Diagnosis – Biomarkers, Treatment.																
Unit III		CARDIOVASCULAR DISEASES												9		
Coronary atherosclerosis – Coronary artery disease; Causes -Fat and lipids, Alcohol abuse – Diagnosis - Electrocardiograph, echocardiograph, Treatment, Exercise and Cardiac rehabilitation.																
Unit IV		DIABETES AND OBESITY												9		
Types of Diabetes mellitus; Blood glucose regulation; Complications of diabetes – Paediatric and adolescent obesity – Weight control and BMI.																
Unit V		RESPIRATORY DISEASES												9		
Chronic lung disease, Asthma, COPD; Causes - Breathing pattern (Nasal vs mouth), Smoking – Diagnosis - Pulmonary function testing.																
Total periods: 45																
Text Books:																
1. R.Kumar&Meenal Kumar, “Guide to Prevention of Lifestyle Diseases”, Deep & Deep Publications, 2003																
2. Gary Eggar et al, “Lifestyle Medicine”, 3rd Edition, Academic Press, 2017																
References:																
1. James M.R, “Lifestyle Medicine”, 2nd Edition, CRC Press, 2013																
2. Akira Miyazaki et al, “New Frontiers in Lifestyle-Related Disease”, Springer, 2008																
Course Outcomes:													Blooms Taxonomy			
CO1:	Explain the causes, risk factors, and prevention strategies of major lifestyle diseases.												Understand			
CO2:	Describe the types, causes, diagnosis, and treatment approaches of various cancers.												Understand			
CO3:	Analyze the causes, diagnosis methods, and rehabilitation strategies related to cardiovascular diseases.												Analyze			
CO4:	Discuss the mechanisms, complications, and management strategies of diabetes and obesity.												Understand			
CO5:	Explain the causes, symptoms, and preventive measures of major respiratory diseases.												Understand			
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	3	2	2	1	2	1	3	3	2	3
CO2	3	3	2	2	1	3	2	2	1	2	1	3	3	3	2
CO3	3	3	2	3	3	2	2	2	1	2	1	3	3	3	2
CO4	3	2	2	2	1	3	2	2	1	2	1	3	3	2	3
CO5	3	2	2	3	3	2	2	2	1	2	1	3	3	3	2

23BTO010	BIOTECHNOLOGY IN HEALTH CARE		Category: OEC			
			L	T	P	C
			3	0	0	3
Prerequisites Nil						
Course Objectives: - Create higher standard of knowledge on healthcare system and services - Prioritize advanced technologies for the diagnosis and treatment of various diseases						
Unit I	PUBLIC HEALTH					9
Definition and Concept of Public Health, Historical aspects of Public Health, Changing Concepts of Public Health, Public Health versus Medical Care, Unique Features of Public Health, Determinants of Health (Social, Economic, Cultural, Environmental, Education, Genetics, Food and Nutrition).Indicators of health, Burden of disease, Role of different disciplines in Public Health.						
Unit II	CLINICAL DISEASES					9
Communicable diseases: Chickenpox / Shingles, COVID-19, Tuberculosis, Hepatitis B, Hepatitis C, HIV / AIDS, Influenza, Swine flu. Non Communicable diseases: Diabetes mellitus, atherosclerosis, fatty liver, Obesity, Cancer						
Unit III	VACCINOLOGY					9
History of Vaccinology, conventional approaches to vaccine development, live attenuated and killed vaccines, adjuvants, quality control, preservation and monitoring of microorganisms in seed lot systems. Instruments related to monitoring of temperature, sterilization, environment.						
Unit IV	OUTPATIENT & IN PATIENT SERVICES					9
Radiotherapy, Nuclear medicine, surgical units, OT Medical units, G & Obs. units Pediatric, neonatal units, Critical care units, Physical medicine & Rehabilitation, Neurology, Gastroenterology, Endoscopy, Pulmonology, Cardiology.						
Unit V	BASICS OF IMAGING MODALITIES					9
Diagnostic X-rays - Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography – Different types of biotelemetry systems.						
Total periods: 45						
Text Books:						
1. Joseph J.carr and John M. Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th Edition, 2012.						
2. Thomas M. Devlin.Textbook of Biochemistry with clinical correlations. Wiley Liss Publishers						
3. The Vaccine Book (2nd Ed.), Rafi Ahmed, Roy M. Anderson et. al.Editor(s): Barry R. Bloom, PaulHenri Lambert, Academic Press, 2016, Pages xxi-xxiv.						
References:						
1. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011						
2. Burtis & Ashwood W.B. Tietz Textbook of Clinical chemistry. Saunders Company						
3. Levine, M. M. (2004). New Generation Vaccines. New York: M. Dekker						
Course Outcomes:						Blooms Taxonomy
CO1:	Explain the concepts, determinants, and indicators of public health.					Understand
CO2:	Describe communicable and non-communicable clinical diseases and their impact on health.					Understand

CO3: Illustrate conventional and modern approaches in vaccinology, including vaccine development and quality control.													Apply		
CO4: Analyze the functioning of outpatient and inpatient healthcare services and their roles in patient care.													Analyze		
CO5: Explain the principles and applications of basic imaging modalities in diagnosis and monitoring.													Understand		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	1	2	2	2	-	1	-	1	3	2	3
CO2	3	2	-	-	1	2	2	2	-	1	-	1	3	3	2
CO3	3	2	-	-	1	2	3	2	-	1	-	1	3	3	2
CO4	3	2	2	1	1	2	3	2	-	1	-	1	3	2	3
CO5	3	2	-	-	1	2	2	2	-	1	-	1	3	3	2

MINOR DEGREE

VERTICAL I : FINT ECH 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 FinancialAssets, the Indian securities market, the market participants and trading of securities, securitymarket indices, sources of financial information, Concept of return and risk, Impact of Taxes andInflationonreturn.					
Unit II	FIXED INCOME SECURITIES				9
Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, defaultrisk andcreditrating.					
Unit III	APPROACHES TOEQUITYANALYSIS				9
Introduction to Fundamental Analysis, Technical Analysis and Efficient Market Hypothesis, dividend capitalisation models, and price-earnings multiple approach to equity valuation.					

Unit IV	PORTFOLIO ANALYSIS AND FINANCIAL DERIVATIVES												9		
Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India															
Unit V	INVESTOR PROTECTION												9		
Role of SEBI and stock exchanges in investor protection; Investor grievances and their redressal system, insider trading, investors’ awareness 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 Madisetti, <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 Madisetti, “Blockchain Applications: A Hands On Approach”, VPT, 2017.					
Course Outcomes:					Blooms Taxonomy

CO 1: Explain the fundamentals and architecture of blockchain systems													Understand (K2)		
CO2: Analyze cryptocurrencies, Bitcoin mechanics, and alternative coins													Analyze (K4)		
CO3: Develop and deploy smart contracts on Ethereum													Apply (K3)		
CO4: Utilize Web3 and Hyperledger tools for decentralized applications													Apply (K3)		
CO5: Evaluate emerging blockchain technologies, scalability, and privacy challenges													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1					2			3	2	1
CO2	3	3	2	2	1					2		1	3	2	1
CO3	2	2	3	3	2	1				3	1		3	3	2
CO4	2	2	3	3	3	1				3	1	1	3	3	2
CO5	3	3	2	3	3	1				3	1	2	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CMG005	FINTECH PERSONAL FINANCE AND PAYMENTS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of finance concepts • Familiarity with digital payments • Knowledge of basic computer and internet usage					
Course Objectives: • Understand cryptocurrencies, digital wallets, and modern payment systems • Learn the evolution and impact of digital and alternative finance • Understand InsureTech innovations using AI/ML and IoT • Explore peer-to-peer lending, crowdfunding, and marketplace lending • Study regulatory frameworks, RegTech, and fraud detection technologies					
Unit I	CURRENCY EXCHANGE AND PAYMENT				9
Understand the concept of Crypto currency- Bitcoin and Applications -Cryptocurrencies and Digital Crypto Wallets - Types of Cryptocurrencies - Cryptocurrencies and Applications, block chain, Artificial Intelligence, machine learning. Fintech users, Individual Payments, RTGS Systems, Immediate Page 54 of 90 Payment Service (IMPS), Unified Payments Interface (UPI).Legal and Regulatory Implications of Crypto currencies, Payment systems and their regulations.Digital Payments Smart Cards, Stored-Value Cards, EC Micropayments, Payment Gateways, Mobile Payments, Digital and Virtual Currencies, Security, Ethical, Legal, Privacy, and Technology Issues					
Unit II	DIGITAL FINANCE AND ALTERNATIVE FINANCE				9
A Brief History of Financial Innovation, Digitization of Financial Services, Crowd funding, Charity and Equity,. Introduction to the concept of Initial Coin Offering					
Unit III	INSURETECH				9
InsurTech Introduction , Business model disruption AI/ML in InsurTech IoT and InsurTech ,Risk Modeling ,Fraud Detection Processing claims and Underwriting Innovations in Insurance Services					
Unit IV	PEER TO PEER LENDING				9
P2P and Marketplace Lending, New Models and New Products in market place lending P2P Infrastructure and technologies, Concept of Crowdfunding Crowdfunding Architecture and Technology ,P2P and Crowdfunding unicorns and business models , SME/MSME Lending: Unique opportunities and Challenges, Solutions and Innovations					
Unit V	REGULATORY ISSUES				9
FinTech Regulations: Global Regulations and Domestic Regulations, Evolution of RegTech, RegTech Ecosystem: Financial Institutions, RegTech Ecosystem: StartupsRegTech, Startups: Challenges, RegTech Ecosystem: Regulators, Use of AI in regulation and Fraud detection					

Total periods:45															
Text Books:															
1. Swanson Seth, <i>Fintech for Beginners: Understanding and Utilizing the Power of Technology</i> , 2016															
2. Tanda & Models, <i>Fintech BigTech and Banks</i> , Springer, 2019															
3. Henning Diedrich, <i>Ethereum: Blockchains, Digital Assets, Smart Contracts</i> , 2016															
4. Jacob William, <i>FinTech: The Beginner's Guide to Financial Technology</i> , 2016															
References:															
1. Swanson Seth, <i>Fintech for Beginners: Understanding and Utilizing the power of technology</i> , Createspace Independent Publishing Platform, 2016.															
2. Models AuTanda, <i>Fintech Bigtech And Banks Digitalization and Its Impact On Banking Business</i> , Springer, 2019															
3. Henning Diedrich, <i>Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations</i> , Wildfire Publishing, 2016															
4. Jacob William, <i>FinTech: The Beginner's Guide to Financial Technology</i> , Createspace Independent Publishing Platform, 2016															
5. IIBF, <i>Digital Banking</i> , Taxmann Publication, 2016															
6. Jacob William, <i>Financial Technology</i> , Create space Independent Pub, 2016															
7. Luke Sutton, <i>Financial Technology: Bitcoin & Blockchain</i> , Createspace Independent Pub, 2016															
Course Outcomes:													Blooms Taxonomy		
CO 1: Explain cryptocurrencies, digital wallets, and modern payment systems													Understand (K2)		
CO2: Analyze digital finance, alternative finance, and ICO mechanisms													Analyze (K4)		
CO3: Apply InsureTech tools such as AI, ML, and IoT in insurance operations													Apply (K3)		
CO4: Evaluate P2P lending, crowdfunding models, and SME lending innovations													Evaluate (K5)		
CO5: Examine regulatory frameworks, RegTech applications, and fraud detection systems													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	2					2			3	2	1
CO2	3	3	2	3	2					2	1	1	3	2	1
CO3	2	2	3	3	3	1				3	1		3	3	2
CO4	3	3	3	3	3	1				3	1	2	3	3	3
CO5	3	3	2	3	3	1				3	1	3	3	3	3
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23CMG006	INTRODUCTION TO FINTECH	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of financial systems • Basic understanding of digital technology and internet usage					

Course Objectives:		
- To learn about history, importance and evolution of Fintech - To acquire the knowledge of Fintech in payment industry - To acquire the knowledge of Fintech in insurance industry - 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 ENTREPRENEURSHIP	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. Ed: 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 Technopreneurship Fable, Dennis Posadas, (Singapore: Pearson Prentice Hall, 2009		
7. Basics of Technopreneurship: 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 environment		Understand (K2)
CO3: Understand the Job opportunities in Industries relating to Technopreneurship		Understand (K2), Apply (K3)
CO4: Learn about applications of technopreneurship and successful technopreneurs		Apply (K3), Analyze (K4)
CO5: Acquaint with the recent and emerging trends in entrepreneurship		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, 5th ed, 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 Inovation in Entrepreneurship, Kankha, Sultan Chand															
2. Pradip N Khandwalla, Lifelong Creativity, An Unending Quest, Tata Mc Graw Hill, 2004.															
3. Paul Trott, Innovation Management and New Product Development, 4e, Pearson, 2018.															
4. Vinnie Jauhari, Sudanshu Bhushan, Innovation Management, Oxford Higher Education, 2014.															
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 inteligence 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 Kotler 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 scenarios 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 Dent 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.															
5. Muttalis M.A: Union Public Service Commission.															
6. Bhakara Rao .V: Employer Employee Relations in India.															
7. Davar R.S. Personnel Management & Industrial Relations															
Course Outcomes:													Blooms Taxonomy		
CO1: Analyze the meaning, scope, importance, and types of personnel administration systems.													Analyze (K4)		
CO2: Analyze the functions of generalists and specialists, political–administrative relationships, and integrity mechanisms.													Analyze(K4)		
CO3: Evaluate recruitment, training, and promotion processes in public personnel administration.													Evaluate(K5)		
CO4:Create effective personnel management strategies relating to Governor, State Legislature, and High Court functions in the administrative system.													Create(K6)		
CO5: Apply concepts of employer–employee relations, wage systems, allowances, and benefits in public organizational settings.													Applying(K3)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2			1				2	3				1		
CO2	2	1		2				2	3				1		
CO3	2	2	2	3				2	3				2	1	

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

23CMG016	ADMINISTRATIVE THEORIES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites - No formal prerequisites. - Basic understanding of public administration and management concepts (recommended).					
Course Objectives: - To understand the meaning, scope, and significance of Public Administration. - To study the evolution of Public Administration as a discipline and its identity. - To learn classical, scientific, and human relations theories of organization. - To analyze organizational behavior, design, and group dynamics. - To examine motivation and leadership theories and the contributions of eminent administrative thinkers.					
Unit I					9
Meaning, Scope and significance of Public Administration, Evolution of Public Administration as a discipline and Identity of Public Administration					
Unit II					9
Theories of Organization: Scientific Management Theory, Classical Model, Human Relations Theory					
Unit III					9
Organization goals and Behaviour, Groups in organization and group dynamics, Organizational Design.					
Unit IV					9
Motivation Theories, content, process and contemporary; Theories of Leadership: Traditional and Modern: Process and techniques of decision-making					
Unit V					9
Administrative thinkers: Kautilya, Woodrow Willson, C.I. Barnard . Peter Drucker					
Total periods: 45					
Text Books:					
1.Shum Sun Nisa Alvi – <i>Eminent Administrative Thinkers</i>					
2.Keith Davis – <i>Organization Theory</i>					
References:					
1. Crozier M : The Bureaucratic phenomenon (Chand)					
2. Blau. P.M and Scott. W : Formal Organizations (RKP)					
3. Presthus. R : The Organizational Society (MAC)					
4. Alvi, Shum Sun Nisa : Eminent Administrative Thinkers.					
5. Keith Davis : Organization Theory (MAC)					
Course Outcomes:					Blooms Taxonomy
CO1: Explain the meaning, scope, significance, and evolution of Public Administration.					Understand(K2)
CO2: Analyze organizational theories: Scientific Management, Classical, and Human Relations approaches.					Analyze(K4)
CO3: Examine organizational behavior, group dynamics, and organizational design.					Analyze(K4)
CO4: Evaluate motivation and leadership theories and apply decision-making techniques.					Evaluate(K5)
CO5: Assess contributions of eminent administrative thinkers and their relevance to contemporary administration.					Evaluate(K5)
CO - PO & PSO Mapping					

Page 339 of 361

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 interval 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. GalitShmueli, 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 <i>Vs.</i> 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	
Meatllicnanobiomaterials–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, Sodiated 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 – Cadmium Telluride solar cells – dye sensitized solar cells – Perovskite solar cells – Measurement and characterization of solar cells - Materials used in solar cells (metallic oxides, CNT films, graphene, OD fullerenes, single-multi walled carbon nanotubes, two-dimensional Graphene, organic or Small molecule-based solar cells materials - copper-phthalocyanine and perylenetetracarboxylicbis - benzene – fullerenes - boron subphthalocyanine- tin (II) phthalocyanine)					
Unit V	SUPERCAPACITORS				9
Supercapacitor –types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) - design of supercapacitor-three and two electrode cell-parameters of supercapacitor- Faradaic and non -					

Faradaic capacitance – electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbon fibres (ACF)- Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite- conductive polypyrrole hydrogels – Different types of nanocomposites for the SC electrodes (carbon–carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.															
Total periods:45															
Text Books:															
1. David S. Ginley and David Cahen, Fundamentals of Materials for Energy and Environmental Sustainability, Cambridge University Press, 2012.															
2. John A. Turner, Sustainable Hydrogen Production Processes, Wiley, 2014.															
3. Mark Z. Jacobson, Renewable Energy and the Environment, Academic Press, 2018.															
4. Vikas Mittal, Advanced Materials for Energy Conversion and Storage, Wiley, 2019.															
References:															
1. Functional materials for sustainable energy applications; John A. Kilner, Stephen J. Skinner, Stuart J. C. Irvine and Peter P. Edwards.															
2. Hand Book of Fuel Cells: Fuel Cell Technology and Applications, Wolf Vielstich, Arnold Lamm, Hubert Andreas Gasteiger, Harumi Yokokawa, Wiley, London 2003.															
3. B.E. Conway, Electrochemical supercapacitors: scientific fundamentals and technological applications, Kluwer Academic / Plenum publishers, New York, 1999.															
4. T.R. Crompton, Batteries reference book, Newners, 3rd Edition, 2002.															
5. Materials for Supercapacitor applications; B.Viswanathan. M.Aulice Scibioh															
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															