

SRM VALLIAMMAI ENGINEERING COLLEGE

(AN AUTONOMOUS INSTITUTION)

SRM Nagar, Kattankulathur - 603 203.

ELECTRONICS AND INSTRUMENTATION ENGINEERING



UG-Curricula and Syllabi

B.E. – Electronics and Instrumentation Engineering

Regulation 2023

VISION OF THE INSTITUTE

“Educate to excel in Social Transformation”

To accomplish and maintain international eminence and become a model institution for higher learning through dedicated development of minds, advancement of knowledge and professional application of skills to meet the global demands.

MISSION OF THE INSTITUTE

- To contribute to the development of human resources in the form of professional engineers and managers of international excellence and competence with high motivation and dynamism, who besides serving as ideal citizen of our country will contribute substantially to the economic development and advancement in their chosen areas of specialization.
- To build the institution with international repute in education in several areas at several levels with specific emphasis to promote higher education and research through strong institute industry interaction and consultancy.

VISION OF THE DEPARTMENT

To be a global leader in Electronics and Instrumentation Engineering, driving innovation, excellence, and societal impact through interdisciplinary collaboration and cutting-edge research.

MISSION OF THE DEPARTMENT

M1: To lead in academic excellence by providing top-tier technical education in the field of electronics and instrumentation engineering.

M2: To inspire students to cultivate innovation, competence, efficiency, and a strong sense of values.

M3: To provide students with enhanced exposure to the latest developments in the field.

M4: To enable students to engage with technological progress and play an active role in fostering a more prosperous society.

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

I. PROFESSIONAL KNOWLEDGE:

Graduates will have the knowledge of mathematics, science, computing and engineering fundamentals, laboratory and project based experiences breadth and in- depth studies to formulate and solve engineering problems in Electronics, Instrumentation, Control and Automation Engineering and shall have proficiency in computer based engineering and use of modern computational tools.

II. PROFESSIONAL EMPLOYMENT:

Graduates will succeed in entry-level engineering positions with Electronics, Instrumentation, Automation and Computational or Manufacturing firms in regional, national, or international industries and with government agencies.

III. PROFESSIONAL STUDIES:

Graduates will succeed in the pursuit of advanced degrees in engineering or other fields and will have skills for, continued independent, life-long learning to become experts in their profession and to broaden their professional knowledge.

IV. PROFESSIONAL CITIZENSHIP:

Graduates will have the ability to organize and present information, to write and speak effective English, to work effectively on team-based engineering projects and will practice Ethics and have a sense of social responsibility.

V. PROFESSIONAL PRACTICE

Graduates will have the ability to develop their engineering design, problem- solving skills and aptitude for innovation as they work on multi-disciplinary teams, to develop the basic skills needed to perform and design experimental projects.

2. PROGRAM OUTCOMES (POs)

- 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.

3. PROGRAM SPECIFIC OUTCOMES (PSOs)

By the completion Bachelor of Engineering in Electronics and Instrumentation Engineering program the student will have following Program specific outcomes

PSO1: Be able to Select, install, calibrate and maintain instruments used for measurement and analysis and interpret the data obtained to arrive at a significant conclusion.

PSO2: Be able to analyze, design and develop signal conditioning circuits for sensors, actuators and select a suitable Embedded System for realizing various control schemes and smart instruments.

PSO3: Be able to design, develop and implement control schemes for various industrial processes and gain hands on experience in configuring Industrial Automation System such as PLC and DCS.

4. PEO – PO- PSO Mapping

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I	1	1	1	1	1	-	-	-	2	2	2	-	-	3	-
II	2	2	2	2	2	2	-	-	-	-	-	-	-	3	2
III	1	1	1	2	2	2	1	1	2	2	-	-	-	-	1
IV	2	-	-	-	-	-	1	1	1	1	-	-	-	1	-
V	1	1	1	1	1	-	-	-	2	2	2	-	2	-	-

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

MAPPING:

SEMESTER	COURSE CODE	PROGRAMME OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
		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	PSO 2	PSO 3	PSO 4
I	Professional English - I	2.2	2.0	2.0	2.0	2.0	-	2.0	-	-	2.8	1.0	1.0	-	-	-	-
	Matrices and Calculus	3.0	2.0	2.0	1.0	-	-	-	-	-	-	-	1.0	-	-	-	-
	Engineering Physics	2.8	1.4	1.4	1.0	1.3	1.0	1.0	-	-	-	-	1.0	-	-	-	-
	Engineering Chemistry	2.8	1.8	2.2	1.5	1.0	1.0	2.0	-	-	-	-	2.0	-	1.0	-	-
	Basic Civil and Mechanical Engineering	3.0	1.8	2.0	1.0	-	1.5	1.5	1.0	-	-	-	1.0	1.6	1.0	1.0	1.8
	தமிழர் மரபு/Heritage of Tamils	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Physics and Chemistry Laboratory	2.5	1.7	1.7	1.0	1.1	-	0.2	-	-	-	-	0.2	-	0.4	-	-
	Engineering Practices Laboratory	3.0	2.0	2.3	2.0	2.3	1.0	-	-	1.0	-	1.0	1.0	-	-	-	-
	English Language Learning Laboratory	1.7	1.3	1.0	1.3	2.0	-	2.0	-	-	2.8	-	1.0	-	-	-	-
II	Professional English - II	2.0	2.0	1.4	2.0	2.0	-	2.0	-	-	2.8	1.0	1.0	-	-	-	-
	Statistics and Numerical Methods	3.0	3.0	-	-	-	-	-	-	-	-	-	-	1.0	-	-	-
	Physics for Electronics Engineering	3.0	1.7	1.5	1.0	2.0	1.5	3.0	-	-	-	-	1.0	-	-	-	-
	Chemistry of Electronic Materials	2.6	2.4	2.2	1.8	1.8	1.0	1.0	-	-	-	-	2.0	1.5	-	-	-
	Problem Solving and Python Programming	2.3	2.5	3.0	2.8	1.8	-	-	-	-	-	1.5	2.0	2.0	-	2.0	1.0

	தமிழரும் தொழில்நுட்பமும் /Tamils and Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Engineering Graphics and Design	2.0	-	3.0	-	1.0	-	-	-	1.0	3.0	-	2.0	2.0	1.0	1.0	1.0
	Engineering Sciences Laboratory	2.5	1.9	1.8	1.0	1.1	2.0	1.5	2.0	-	-	-	-	-	2.0	-	-
	Problem Solving and Python Programming Laboratory	2.5	2.6	3.0	2.8	2.2	-	-	-	-	-	1.8	2.0	1.0	3.0	1.5	2.0
III	Transforms and Partial Differential Equations	3.0	3.0	-	-	1.0	-	-	-	-	-	-	1.0	-	-	-	-
	Electric Circuit Analysis	1.0	1.0	1.0	2.0	2.0	-	-	3.0	-	-	3.0	2.0	1.0	1.0	2.0	3.0
	Electron Devices and Circuits	2.6	2.6	2.2	2.0	-	-	-	1.0		1.0	-	-	2.0	2.6	2.0	-
	Electrical and Electronic Instruments	2.6	2.2	2.2	2.4	2.2	2.0	2.0	1.0	-	-	1.0	1.0	2.2	2.0	-	-
	Transducers Engineering	3.0	3.0	1.0	1.0	1.7	2.0	-	-	-	-	-	1.0	1.7	2.2	1.5	-
	Applied Fluid Dynamics and Thermodynamics	2.0	2.0	1.0	-	-	-	-	-	-	-	-	1.0	1.0	1.0	-	-
	Measurements and Transducers Laboratory	3.0	-	2.0	-	1.6	2.0	-	-	-	-	-	-	2.0	1.8	1.5	-
	Electric Circuits Laboratory	1.0	1.0	1.0	1.0	1.0		2.5	2.0	3.0		2.0	3.0	1.0	2.3	2.0	3.0
	Electron Devices and Circuits Laboratory	3.0	2.0	1.0	-	-	2.0	-	2.0	2.0	1.0	-	-	1.3	2.6	1.7	-
IV	Applied Mathematics for Electrical and Instrumentation Engineering	3.0	1.6	1.4	1.0	-	-	-	-	-	-	-	1.0	-	-	-	-
	Electrical Machines	3.0	3.0	1.3	2.0	-	-	-	-	-	-	-	1.0	1.3	1.4	2.0	-
	Digital Logic Circuits	3.0	3.0	3.0	1.0	3.0	-	-	-	-	-	-	1.0	3.0	-	1.0	-
	Electronics for Analog Signal Processing	2.3	2.0	3.0	1.0	2.0	-	-	-	1.0	-	1.0	1.0	1.7	2.8	1.3	-

	Control Systems	3.0	3.0	2.6	2.8	2.4	-	-	-	2.0	-	-	1.0	-	2.0	2.8	-
	Microprocessors and Microcontrollers	2.2	2.2	1.8	1.8	2.4	-	2.0	-	2.0	-	2.0	1.7	-	2.4	1.8	-
	Electrical Machines and Control Systems Laboratory	3.0	3.0	2.4	1.6	2.2	1.5	-	-	-	-	-	1.0	1.8	1.6	3.0	-
	Linear and Digital Integrated Circuits Laboratory	1.0	1.3	2.8	3.0	3.0	-	-	1.0	1.0	1.0	-	1.0	-	2.7	1.7	-
	Microprocessors and Microcontrollers Laboratory	2.0	1.5	3.0	2.0	3.0	2.0	-	-	2.0	3.0	-	2.0	-	2.3	2.2	-
V	Industrial Instrumentation	2.8	2.0	2.0	1.8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0	3.0	3.0	3.0	-
	Discrete Time and Signal Processing	3	3	3	2	3	-	-	-	1	-	-	-	2	2	-	3
	Process Control	2.2	1.8	1.8	1.8	2.0	2.5	2.0	1.0	1.5	1.0	2.0	1.5	1.5	1.8	1.4	-
	Environmental Studies	2.8	1.8	1.0	1.0	-	2.2	2.4	-	-	-	-	1.8	-	-	-	-
	Industrial Automation Systems	2.8	2.6	2.8	2.2	-	-	-	2.8	-	2.8	-	1.0	1.4	-	1.8	-
	Industrial Instrumentation Laboratory	3.0	1.4	1.4	1.4	1.4	-	-	-	-	-	-	-	3.0	1.0	1.0	-
	Process Control Laboratory	2.2	1.8	1.8	1.8	2.0	2.5	2.0	1.0	1.5	1.0	2.0	1.5	1.5	1.8	1.4	-
VI	IOT Concepts and Applications	2	3	3	2	-	-	-	-	-	-	-	2	2	2	2	3
	Data Structures	2	1.4	2.2	2	2	-	-	-	2.4	1.8	1.2	2.4	3	1.8	2.2	1.6
	Embedded Systems	2.8	2.7	2.5	2.2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0	2.0	1.0	
	Data Structures Laboratory	1.8	1.8	2.0	1.6	2.0	-	-	-	1.6	1.8	1.6	1.8	1.6	2	2	1.6
	Professional Communication Laboratory	3	2.4	2.3	2.7	2.5		3			2.8		1	1.8	1.8	1	1.5
	Mini Project	2.7	3.0	2.0	2.0	3.0	-	2.0	-	3.0	3.0	2.0	2.4	3.0	3.0	1.8	

VII	Applied Machine Learning	2.0	1.8	2.3	1.5	2.3	2.0	-	-	3.0	-	-	3.0	2.0	2.0	1.0	
	Industrial Data Networks	3.0	1.8	2.0	1.0	-	1.5	1.5	1.0	-	-	-	1.0	1.6	1.0	1.0	
	Human Values and Ethics	-	-	1	1.5	-	-	1	-	-	-	-	-	-	-	-	-
	Instrumentation System Design Laboratory	2.4	2.0	1.8	1.6	2.0	-	-	-	-	-	-	-	1.8	2.0	2.5	
	Internship	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
	System Identification, Modeling and Simulation Laboratory	2.2	1.8	1.8	1.8	2.0	2.5	2.0	1.0	1.5	1.0	2.0	1.5	1.5	1.8	1.4	
VIII	Project Work	3.0	3.0	2.5	2.3	3.0	3.0	1.7	2.7	3.0	3.0	1.5	2.5	3.0	3.0	1.8	

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

SRM VALLIAMMAI ENGINEERING COLLEGE
(An Autonomous Institution Affiliated to Anna University, Chennai)
B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING
REGULATIONS – 2023
CHOICE BASED CREDIT SYSTEM
CURRICULUM AND SYLLABUS

SEMESTER I

S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	EN3111	Professional English - I	HSMC	3	0	0	3	3
2.	MA3122	Matrices and Calculus	BSC	3	1	0	4	4
3.	PH3123	Engineering Physics	BSC	3	0	0	3	3
4.	CH3124	Engineering Chemistry	BSC	3	0	0	3	3
5.	GE3133	Basic Civil and Mechanical Engineering	ESC	3	0	0	3	3
6.	GE3111	தமிழர் மரபு / Heritage of Tamils	HSMC	1	0	0	1	1
PRACTICALS								
7.	GE3121	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
8.	GE3134	Engineering Practices Laboratory	ESC	0	0	4	4	2
9.	EN3119	English Language Learning Laboratory	HSMC	0	0	2	2	1
TOTAL				16	1	10	27	22

SEMESTER II

SEMESTER II								
S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	EN3211	Professional English - II	HSMC	3	0	0	3	3
2.	MA3222	Statistics and Numerical Methods	BSC	3	1	0	4	4
3.	PH3223	Physics for Electronics Engineering	BSC	3	0	0	3	3
4.	CH3223	Chemistry of Electronic Materials	BSC	3	0	0	3	3
5.	GE3231	Problem Solving and Python Programming	ESC	3	0	0	3	3
6.	GE3211	தமிழரும் தொழில்நுட்பமும் /Tamils and Technology	HSMC	1	0	0	1	1
THEORY CUM PRACTICALS								
7.	GE3233	Engineering Graphics and Design	ESC	1	0	4	5	3
PRACTICALS								
8.	GE3221	Engineering Sciences Laboratory	BSC	0	0	4	4	2
9.	GE3232	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
10.	GE3251	NSS/YRC/NSO/ Club Activities#	PCD	0	0	0	0#	0#
TOTAL				17	1	12	30	24

[#]Conducted after college hours.

SEMESTER III

S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	MA3321	Transforms and Partial Differential Equations	BSC	3	0	0	3	3
2.	EE3363	Electric Circuit Analysis	PCC	3	0	0	3	3
3.	EI3361	Electron Devices and Circuits	PCC	3	0	0	3	3
4.	EI3362	Electrical and Electronic Instruments	PCC	3	0	0	3	3
5.	EI3363	Transducers Engineering	PCC	3	0	0	3	3
6.	ME3366	Applied Fluid Dynamics and Thermodynamics	PCC	3	0	0	3	3
PRACTICALS								
7.	EI3364	Measurements and Transducers Laboratory	PCC	0	0	3	3	1.5
8.	EE3365	Electric Circuits Laboratory	PCC	0	0	3	3	1.5
9.	EI3365	Electron Devices and Circuits Laboratory	PCC	0	0	3	3	1.5
TOTAL				18	0	9	27	22.5

SEMESTER IV

SEMESTER IV								
S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	MA3423	Applied Mathematics for Electrical and Instrumentation Engineering	BSC	2	0	0	2	2
2.	EI3461	Electrical Machines	PCC	3	0	0	3	3
3.	EE3361	Digital Logic Circuits	PCC	3	0	0	3	3
4.	EI3463	Electronics for Analog Signal Processing	PCC	3	0	0	3	3
5.	EI3464	Control Systems	PCC	3	0	0	3	3
6.	EI3465	Microprocessors and Microcontrollers	PCC	3	0	0	3	3
7.	GE3451	NCC Credit Course Level -I*	PCD	3*	0	0	3*	3*
PRACTICALS								
8.	EI3466	Electrical Machines and Control Systems Laboratory	PCC	0	0	4	4	2
9.	EI3467	Linear and Digital Integrated Circuits Laboratory	PCC	0	0	3	3	1.5
10.	EI3468	Microprocessors and Microcontrollers Laboratory	PCC	0	0	3	3	1.5
TOTAL				17	0	10	27	22

NCC Credit Course Level -I is offered for NCC Students only. The grades earned by the students will be recorded in the Mark Sheet, However the same shall not be considered for the computation of CGPA.

SEMESTER V

S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	EI3561	Industrial Instrumentation	PCC	3	0	0	3	3
2.	EC3568	Discrete Time Systems and Signal Processing	PCC	3	0	0	3	3
3.	EI3562	Process Control	PCC	3	1	0	4	4
4.	CE3531	Environmental Studies	ESC	2	0	0	2	2
5.	PEIXXX	Professional Elective -I	PEC	3	0	0	3	3
6.	PEIXXX	Professional Elective - II	PEC	3	0	0	3	3
7.	GE3551	NCC Credit Course Level -II*	PCD	3*	0	0	3*	3*
THEORY CUM PRACTICALS								
8.	EI3563	Industrial Automation Systems	PCC	3	0	2	5	4
PRACTICALS								
9.	EI3564	Industrial Instrumentation Laboratory	PCC	0	0	3	3	1.5
10.	EI3565	Process Control Laboratory	PCC	0	0	3	3	1.5
TOTAL				20	1	8	29	25

SEMESTER VI

S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	EC3666	IoT Concepts and Applications	PCC	3	0	0	3	3
2.	CS3665	Data Structures	PCC	3	0	0	3	3
3.	PEIXXX	Professional Elective - III	PEC	3	0	0	3	3
4.	PEIXXX	Professional Elective –IV	PEC	3	0	0	3	3
5.	MAN1XX	Elective -Management	HSMC	2	0	0	2	2
6.	MXXXXX	Mandatory Course-I&	MC	3&	0	0	3&	0
THEORY CUM PRACTICALS								
7.	EI3665	Embedded Systems	PCC	3	0	2	5	4
PRACTICALS								
8.	CS3666	Data Structures Laboratory	PCC	0	0	3	3	1.5
9.	EN3649	Professional Communication Laboratory	EEC	0	0	2	2	1
10.	EI3641	Mini Project	EEC	0	0	4	4	2
TOTAL				17	0	11	28	22.5

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

*Offered only for NCC Students. The grades earned by the students will be recorded in the Mark Sheet, However the same shall not be considered for the computation of CGPA.

SEMESTER VII

S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	EI3761	Applied Machine Learning	PCC	3	0	0	3	3
2.	EI3762	Industrial Data Networks	PCC	3	0	0	3	3
3.	PEIXXX	Professional Elective –V	PEC	3	0	0	3	3
4.	PEIXXX	Professional Elective –VI	PEC	3	0	0	3	3
5.	BA3711	Human Values and Ethics	HSMC	2	0	0	2	2
6.	OXXXXX	Open Elective	OEC	3	0	0	3	3
7.	MXXXXX	Mandatory Course-II ^{&}	MC	3 ^{&}	0	0	3 ^{&}	0
PRACTICALS								
8.	EI3763	Instrumentation System Design Laboratory	PCC	0	0	3	3	1.5
9.	EI3741	Internship	EEC	0	0	0	0	1
10.	EI3764	System Identification, Modeling and Simulation Laboratory	PCC	0	0	3	3	1.5
TOTAL				17	0	6	23	21

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

SEMESTER VIII

S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
PRACTICALS								
1.	EI3841	Project Work	EEC	0	0	20	20	10
TOTAL				0	0	20	20	10

TOTAL NO. OF CREDITS: 169

ELECTIVE – MANAGEMENT COURSES

S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1.	MAN101	Principles of Management	HSMC	2	0	0	2	2
2.	MAN102	Total Quality Management	HSMC	2	0	0	2	2
3.	MAN103	Human Resource Management	HSMC	2	0	0	2	2
4.	MAN104	Entrepreneurship Development	HSMC	2	0	0	2	2

MANDATORY COURSES- I&

S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1.	MBA101	Introduction to Gender Studies	MC	3	0	0	3	0
2.	MBA102	Patent drafting for Beginners	MC	3	0	0	3	0
3.	MBA103	Industrial Psychology	MC	3	0	0	3	0
4.	MBA104	Indian Constitution	MC	3	0	0	3	0
5.	MEN101	Elements of Literature	MC	3	0	0	3	0

MANDATORY COURSES- II&

S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1.	MGE201	Well-Being With Traditional Practices-Yoga, Ayurveda and Siddha	MC	3	0	0	3	0
2.	MGE202	History of Science and Technology in India	MC	3	0	0	3	0
3.	MCY201	Awareness of Cyber Security and Cyber Law	MC	3	0	0	3	0
4.	MME201	Industrial Safety	MC	3	0	0	3	0

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Professional Elective	Vertical I	Vertical II	Vertical III	Vertical IV	Vertical V	Vertical VI
	IOT and Automation	Advanced Control	Applied Instrumentation	Health Care Instrumentation	Semiconductor / Communication	Computing Techniques
1.	PLC and SCADA	Process Modelling and Simulation	Analytical Instrumentation	Biomedical Instrumentation	Power Electronics and Drives	Soft Computing Techniques for Process Control
2.	Robotics and Automation	Advanced Process Control	Thermal power plant Instrumentation	Digital Image Processing	MEMS and Nano Technology	Computer Control of Processes
3.	Industry 4.0 for Process Industries	Model Based Control	Instrumentation and Control in Petrochemical Industries	Bio Signal Processing	VLSI Design	Artificial Intelligence
4.	Sensor for IOT Application	System Identification and Adaptive control	Automotive Instrumentation and Control	Medical Imaging Systems	Wireless Sensor Network Design	Cloud and Edge computing
5.	IOT for Industry Automation	Non Linear Control	Safety Instrumented System	Medical Robotics	Automotive Electronics	Deep and Reinforcement Learning
6.	Security in IOT	Optimal Control	Fiber Optics and Laser Instrumentation	Physiological Control Systems	Solar PV Fundamentals and Applications	Augmented Reality and Virtual Reality Technologies

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V, VI and VII. These courses are listed in groups called verticals that represent a particular area of specialisation. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI or VII. The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E./B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to the Regulations 2023, Clause 19. Total number of courses per vertical may change in each programme of study as 6 or 7 or 8. If there is shortage of courses in a vertical the same may be chosen from another vertical of the same programme.

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL I: IOT and AUTOMATION

S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1.	PEI101	PLC and SCADA	PEC	3	0	0	3	3
2.	PEI102	Robotics and Automation	PEC	3	0	0	3	3
3.	PEI103	Industry 4.0 for Process Industries	PEC	3	0	0	3	3
4.	PEI104	Sensor for IoT Application	PEC	3	0	0	3	3
5.	PEI105	IoT for Industry Automation	PEC	3	0	0	3	3
6.	PEC507	Security in IoT	PEC	3	0	0	3	3

VERTICAL II: ADVANCED CONTROL

S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1.	PEI201	Process Modelling and Simulation	PEC	3	0	0	3	3
2.	PEI202	Advanced Process Control	PEC	3	0	0	3	3
3.	PEI203	Model Based Control	PEC	3	0	0	3	3
4.	PEI204	System Identification and Adaptive control	PEC	3	0	0	3	3
5.	PEI205	Non Linear Control	PEC	3	0	0	3	3
6.	PEI206	Optimal Control	PEC	3	0	0	3	3

VERTICAL III: APPLIED INSTRUMENTATION

S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1.	PEI301	Analytical Instrumentation	PEC	3	0	0	3	3
2.	PEI302	Thermal power plant Instrumentation	PEC	3	0	0	3	3
3.	PEI303	Instrumentation and Control in Petrochemical Industries	PEC	3	0	0	3	3
4.	PEI304	Automotive Instrumentation and Control	PEC	3	0	0	3	3
5.	PEI305	Safety Instrumented System	PEC	3	0	0	3	3
6.	PEI306	Fiber Optics and Laser Instrumentation	PEC	3	0	0	3	3

VERTICAL IV: HEALTH CARE INSTRUMENTATION

S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1.	PEI401	Biomedical Instrumentation	PEC	3	0	0	3	3
2.	PEC204	Digital Image Processing	PEC	3	0	0	3	3
3.	PMD401	Bio Signal Processing	PEC	3	0	0	3	3
4.	PEC403	Medical Imaging Systems	PEC	3	0	0	3	3
5.	PEI402	Medical Robotics	PEC	3	0	0	3	3
6.	PEI403	Physiological Control Systems	PEC	3	0	0	3	3

VERTICAL V: SEMI CONDUCTOR /COMMUNICATION

S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1.	PEI501	Power Electronics and Drives	PEC	3	0	0	3	3
2.	PEI502	MEMS and Nano Technology	PEC	3	0	0	3	3
3.	PEC107	VLSI Design	PEC	3	0	0	3	3
4.	PEC504	Wireless Sensor Network Design	PEC	3	0	0	3	3
5.	PEI503	Automotive Electronics	PEC	3	0	0	3	3
6.	PEI504	Solar PV Fundamentals and Applications	PEC	3	0	0	3	3

VERTICAL VI: COMPUTING TECHNIQUES

S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1.	PEI601	Soft Computing Techniques for Process Control	PEC	3	0	0	3	3
2.	PEI602	Computer Control of Processes	PEC	3	0	0	3	3
3.	PCS701	Artificial Intelligence	PEC	3	0	0	3	3
4.	PIT601	Cloud and Edge computing	PEC	3	0	0	3	3
5.	PIT602	Deep and Reinforcement Learning	PEC	3	0	0	3	3
6.	PIT603	Augmented Reality and Virtual Reality Technologies	PEC	3	0	0	3	3

**OPEN ELECTIVE COURSES
(VII SEMESTER)**

S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	OAG101	Environment and Agricultural Engineering	AGRI	3	0	0	3	3
2.	OAG102	Organic Farming for Sustainable Agricultural Production	AGRI	3	0	0	3	3
3.	OAG103	Sustainable Development through Indian Knowledge System	AGRI	3	0	0	3	3
4.	OCE101	Air and Noise Pollution Control Engineering	CIVIL	3	0	0	3	3
5.	OCE102	Environmental Impact Assessment	CIVIL	3	0	0	3	3
6.	OCE103	Green Building Design	CIVIL	3	0	0	3	3
7.	OAD101	Foundation of Data Science	AIDS	3	0	0	3	3
8.	OAD102	Open Source Software Tools	AIDS	3	0	0	3	3
9.	OCS101	IoT and its Applications	CSE	3	0	0	3	3
10.	OCS102	Machine Learning with R	CSE	3	0	0	3	3
11.	OCS103	Tamil Computing	CSE	3	0	0	3	3
12.	OCY101	Cyber Forensic and Investigation	CYB	3	0	0	3	3
13.	OCY102	Social Media Security	CYB	3	0	0	3	3
14.	OEC101	Introduction to 5G Communication Networks	ECE	3	0	0	3	3
15.	OEC102	Introduction to Industrial IoT	ECE	3	0	0	3	3
16.	OEC103	Arduino Programming and its Applications	ECE	3	0	0	3	3
17.	OMD101	Introduction to Food Processing	MDE	3	0	0	3	3
18.	OMD102	Introduction to Biomedical Instrumentation	MDE	3	0	0	3	3
19.	OEE101	Renewable Energy Sources	EEE	3	0	0	3	3
20.	OEE102	Energy Conservation and Management	EEE	3	0	0	3	3
21.	OEE103	Electric and Hybrid Vehicles	EEE	3	0	0	3	3
22.	OIT101	Multimedia Technologies	IT	3	0	0	3	3
23.	OIT102	3D Printing and its Applications	IT	3	0	0	3	3
24.	OIT103	Web Frameworks	IT	3	0	0	3	3
25.	OME101	Refrigeration and Air Conditioning	MECH	3	0	0	3	3
26.	OME102	Advanced Manufacturing Processes	MECH	3	0	0	3	3
27.	OME103	Material Testing and Characterization	MECH	3	0	0	3	3

28.	OME104	Hazardous Waste Management	MECH	3	0	0	3	3
29.	OME105	Automotive Engineering	MECH	3	0	0	3	3
30.	OCH101	Nanomaterials and Applications	CHEM	3	0	0	3	3
31.	OPH101	Advanced Functional Materials	PHY	3	0	0	3	3

(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)

SUMMARY

S.No	SUBJECT AREA	CREDIT AS PER SEMESTER								CREDITS TOTAL	PERCENTAGE
		I	II	III	IV	V	VI	VII	VIII		
1.	HSMC	5	4	-	-	-	2	2	-	13	7.69
2.	BSC	12	12	3	2	-	-	-	-	29	17.16
3.	ESC	5	8	-	-	2	-	-	-	15	8.88
4.	PCC	-	-	19.5	20	17	11.5	9	-	77	45.56
5.	PEC	-	-	-	-	6	6	6	-	18	10.65
6.	OEC	-	-	-	-		-	3	-	3	1.78
7.	EEC	-	-	-	-	-	3	1	10	14	8.28
8.	PCD	-	-	-	-	3*	3*	-	-	-	-
	TOTAL	22	24	22.5	22	25	22.5	21	10	169	100
	Non credit /Mandatory	-	✓	-	-	-	✓	✓	-	-	-

COURSES IN MINOR DEGREE
OFFERED BY DEPARTMENT OF MANAGEMENT STUDIES
DEPARTMENT OF AGRICULTURAL ENGINEERING
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
FOR B.E / B.TECH (HONOURS) / OPTIONAL COURSES (R2023)

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

Enrolment for B.E. / B. Tech. (Honours) / Minor degree (Optional) A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E./B.Tech. (Honours) Minor degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes, Moreover, for minor degree the student can register for courses from any one of the following verticals also. Complete details are available in clause 19 of Regulations 2023.

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

VERTICAL I	VERTICAL II	VERTICAL III	VERTICAL IV	VERTICAL V
Fintech and Blockchain	Entrepreneurship	Public Administration	Business Data Analytics	Environment and Sustainability
Financial Management	Foundations of Entrepreneurship	Principles of Public Administration	Statistics for Management	Sustainable infrastructure Development
Fundamentals of Investment	Team Building and Leadership Management for Business	Constitution of India	Data mining for Business Intelligence	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity and Innovation in Entrepreneurship	Public Personnel Administration	Human Resource Analytics	Sustainable Bio Materials
Introduction to Block chain and its Applications	Principles of Marketing Management for Business	Administrative Theories	Marketing and Social Media Web Analytics	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Human Resource Management for 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

VERTICAL I: FINTECH AND BLOCKCHAIN								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1	BAM101	Financial Management	PEC	3	0	0	3	3
2	BAM102	Fundamentals of Investment	PEC	3	0	0	3	3
3	BAM103	Banking, Financial Services and Insurance	PEC	3	0	0	3	3
4	CSM101	Introduction to Blockchain and its Applications	PEC	3	0	0	3	3
5	BAM104	Fintech Personal Finance and Payments	PEC	3	0	0	3	3
6	BAM105	Introduction to Fintech	PEC	3	0	0	3	3

VERTICAL II: ENTREPRENEURSHIP								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1	BAM201	Foundations of Entrepreneurship	PEC	3	0	0	3	3
2	BAM202	Team Building and Leadership Management for Business	PEC	3	0	0	3	3
3	BAM203	Creativity and Innovation in Entrepreneurship	PEC	3	0	0	3	3
4	BAM204	Principles of Marketing Management for Business	PEC	3	0	0	3	3
5	BAM205	Human Resource Management for Entrepreneurs	PEC	3	0	0	3	3
6	BAM206	Financing New Business Ventures	PEC	3	0	0	3	3

VERTICAL III: PUBLIC ADMINISTRATION								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1	BAM301	Principles of Public Administration	PEC	3	0	0	3	3
2	BAM302	Constitution of India	PEC	3	0	0	3	3
3	BAM303	Public Personnel Administration	PEC	3	0	0	3	3
4	BAM304	Administrative Theories	PEC	3	0	0	3	3
5	BAM305	Indian Administrative System	PEC	3	0	0	3	3
6	BAM306	Public Policy Administration	PEC	3	0	0	3	3

VERTICAL IV: BUSINESS DATA ANALYTICS								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1	BAM401	Statistics for Management	PEC	3	0	0	3	3
2	BAM402	Data Mining for Business Intelligence	PEC	3	0	0	3	3
3	BAM403	Human Resource Analytics	PEC	3	0	0	3	3
4	BAM404	Marketing and Social Media Web Analytics	PEC	3	0	0	3	3
5	BAM405	Operation and Supply Chain Analytics	PEC	3	0	0	3	3
6	BAM406	Financial Analytics	PEC	3	0	0	3	3

VERTICAL V: ENVIRONMENT AND SUSTAINABILITY								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1	AGM501	Sustainable infrastructure Development	PEC	3	0	0	3	3
2	AGM502	Sustainable Agriculture and Environmental Management	PEC	3	0	0	3	3
3	AGM503	Sustainable Bio Materials	PEC	3	0	0	3	3
4	AGM504	Materials for Energy Sustainability	PEC	3	0	0	3	3
5	AGM505	Green Technology	PEC	3	0	0	3	3
6	AGM506	Environmental Quality Monitoring and Analysis	PEC	3	0	0	3	3

SEMESTER I

EN3111	PROFESSIONAL ENGLISH – I	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To upgrade the English language skills of students by introducing communication techniques, speaking and grammar learning activities which are relevant to authentic contexts.
2. To improve the basic reading and writing skills of the learners.
3. To enhance the communicative competence of the first-year engineering students.
4. To enable learners to use language effectively in academic/work contexts.
5. To help learners understand content- context in relevant situations.

UNIT I INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 9

Listening: Podcast watching –Listening for new words and pronunciation.

Speaking: Note of appreciation for classmates /family member – formal appreciation of someone, expression of feelings.

Reading: Books, shorts stories to be read. Filling forms (i.e.) post office or bank.

Writing: Film and series Review / Book Review, Email and Informal letters.

Language and Vocabulary development: WH questions, Yes/No questions, Single Word Substitutes, Pronouns, Parts of Speech, Question tags, Prefixes and Suffixes.

UNIT II NARRATION AND SUMMATION 9

Listening: Books – Short Stories to be read aloud in class for listening purpose.

Speaking: Short stories to be read and narrated in the class.

Reading: Reading favourite blogs on Travel, Sports and Food and expressing opinions regarding the same.

Writing: Paragraph writing, Report – field trip / I.V., Autobiography and Comprehension.

Language and Vocabulary development: Tenses – Past, Antonyms, Synonyms, Subject Verb agreement and Prepositions.

UNIT III DESCRIPTION OF A PROCESS/PRODUCT

9

Listening: Listening to snippets from celebrities/ National leaders' lives.

Speaking: Narrating personal experiences/ events – Expression of emotions and feelings.

Reading: Reading short biographies – famous people and description of the same.

Writing: Instruction, Product / Process description and Advertisements (Normal and Block).

Language and Vocabulary development: Adjectives- Degrees of Comparison, Tenses – Present, Compound Nouns, Homonyms, Homophones and Discourse markers – connective and sequence words.

UNIT IV CLASSIFICATION AND INTERPRETATION

9

Listening: Listening to Ted Talks.

Speaking: Recreating a Ted talk session in the class.

Reading: Newspaper Reading (Editorial) and understanding.

Writing: Note making, Blogging, Interpretation of charts and graphs.

Language and Vocabulary development: Articles, Collocations and Phrasal Verbs.

UNIT V EXPRESSION OF THOUGHTS AND IDEAS

9

Listening: Listening to audio books and answering questions.

Speaking: Presentation on a non-technical topic.

Reading: Editorials from newspaper.

Writing: Essay writing – Descriptive and Narrative essays.

Language and Vocabulary development: Tenses – future, Negative statements and questions, Punctuations, Cause and Effect, Content and Function words.

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, learners will be able

1. To strengthen the basics of grammar.
2. To narrate informal and informal situations.
3. To describe a process/product and express opinion.
4. To interpret and analyse the content/information given.

5. To write short essays, personal letters and emails in English.

TEXT BOOKS

1. English for Science and Technology Cambridge University Press, 2021.
Dr.Veena Selvam, Dr.Sujatha Priyadarshini, Dr. Deep Mary Francis,
Dr.K.N.Shoba and Dr.Lourdes Joevani, Department of English, Anna
University.
2. Technical Communication – Principles and Practice by Meenakshi Raman &
Sangeeta Sharma, Oxford Univ.Press, 2016, New Delhi.

REFERENCE BOOKS

1. Effective Communication Skill, Kulbhusan Kumar, R.S.Salaria, Khanna
Publishing House.
2. Wings of Fire - An Autobiography by A.P.J Abdul Kalam with Arun Tiwari,
Sangam Books Ltd , Edition: 50, 1999.
3. World's Most Popular Short Stories Saki Maupassant, Anton Chekhov, O
Henry Paperback.
4. Professional Speaking skills, Aruna Koneru, Oxford University Press.
5. English For Engineers and Technologists, Orient Blackswan Private Ltd.
Department of English, Anna University, 2020.

MAPPING OF COs WITH POs AND PSOs

COs	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	2	2	2	-	-	-	-	3	-	-	-	-	-	-
2	2	2	-	-	-	-	-	-	-	3	1	1	-	-	-	-
3	2	-	2	2	-	-	-	-	-	3	-	1	-	-	-	-
4	3	3	-	2	-	-	2	-	-	3	-	-	-	-	-	-
5	1	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
Avg.	2.2	2	2	2	2		2			2.8	1	1				

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

COURSE OBJECTIVES

1. To understand and apply matrix techniques for engineering applications.
2. To familiarize the student with basic calculus and calculus traditions.
3. To solve the problems in single and multivariable calculus and plays an important role in science, economics, engineering.
4. Vector calculus can be widely used for modeling the various laws of physics.
5. To familiarize the student with multiple integrals and their usage in find the area and volume of two and three dimensional objects.

UNIT I MATRICES**9L+3T**

Eigen values and Eigen vectors of a real matrix - Characteristic equation - Properties of Eigen values and Eigen vectors - Statement and Applications of Cayley-Hamilton Theorem - Reduction of a quadratic form into canonical form by orthogonal transformation.

UNIT II DIFFERENTIAL CALCULUS OF ONE VARIABLE**9L+3T**

Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation- Rolle's Theorem and Mean Value theorem -Taylor's series- Maxima and Minima of functions of one variable.

UNIT III DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES**9L+3T**

Partial derivatives - Total derivatives - Jacobians and properties - Taylor's series for functions of two variables - Maxima and Minima of functions of two variables - Lagrange's method of undetermined multipliers.

UNIT IV MULTIPLE INTEGRALS**9L+3T**

Double integrals in Cartesian and polar coordinates - Change of order of integration - Area enclosed by plane curves - Change of variables in Polar coordinates - Triple integrals - Volume of solids.

UNIT V VECTOR CALCULUS

9L+3T

Gradient and directional derivative – Divergence and curl – Vector identities – Irrotational and Solenoidal vector fields – Vector Integration Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

TOTAL: 45L +15T PERIODS

COURSE OUTCOMES

1. To apply the idea of reducing complex problems into simple form using matrix technique.
2. Basic application of calculus in engineering problems and to tackle for different geometries.
3. This course equips the students to have basic knowledge and understanding the Partial derivatives and maxima and minima by Lagrange's method.
4. Basic application of Double and Triple integrals used in Engineering real life problems
5. To study Vector differentiation and vector integration by using standard theorems.

TEXT BOOKS

1. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, 2011.3. Gupta S.C and Kapoor V.K, "Fundamentals of Mathematical Statistics", S.Chand Private Ltd.,11th Edition, 2005.
2. Veerarajan.T, "Engineering Mathematics", McGrawHill Education(India) Private Ltd 2019.

REFERENCE BOOKS

1. Bali N.P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt. Ltd., 2011.
2. James Stewart, " Calculus : Early Transcendentals ", Cengage Learning, 8th Edition, New Delhi, 2015
3. Sivarama Krishna Das P. and Rukmangadachari E., "Engineering Mathematics", Volume I, Second Edition, Pearson Publishing, 2017.

4. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2012.

MAPPING OF COs WITH POs AND PSOs

COs	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
2	3	2	2	1	-	-	-		-	-	-	1	-	-	-	-
3	3	2	2	1	-	-	-		-	-	-	1	-	-	-	-
4	3	2	2	1	-	-	-		-	-	-	1	-	-	-	-
5	3	2	2	1	-	-	-		-	-	-	1	-	-	-	-
Avg.	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-

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

COURSE OBJECTIVES

1. To enhance the fundamental knowledge in crystalline materials and its applications.
2. To explore the knowledge in the production of ultrasonic waves and application in the engineering field.
3. To familiarize the basics of laser and their technical advances in scientific, industrial and health care areas.
4. To understand the principle of fibre optical fibre and its applications.
5. To explore basic concepts of quantum and dual nature of particle.

UNIT I PROPERTIES OF MATERIALS**9**

Elasticity - Hooke's law - Stress-strain and its uses - Poisson ratio - factors affecting elastic modulus and tensile strength. Single crystalline, polycrystalline and amorphous materials - unit cell - space lattice - crystal systems - Bravais lattice - Miller indices - d-spacing - characteristics of unit cell - SC, BCC, FCC and HCP structure - thermal and mechanical properties of materials - crystal growth techniques - Czochralski and Bridgmann.

UNIT II ULTRASONICS**9**

Introduction - Properties - Production: Magnetostriction method and Piezoelectric method - Acoustical grating - determination of ultrasonic velocity in liquid - Application: Detection of flaw in materials (NonDestructive Testing) - ultrasonic soldering, welding - SONAR - diagnostic sonography - cars' air bag sensor-dispersion of fog - Probe sonication for 2D material formation.

UNIT III LASERS AND ITS APPLICATIONS**9**

Basic concepts and characteristics - Einstein's A and B coefficients (derivation) - population inversion - Pumping methods - Nd-YAG laser - CO₂ laser - Semiconductor lasers: homo junction and heterojunction - applications: laser welding, laser cutting, laser cooling, pattern formation by laser etching, laser bar

code scanner - LIDAR - Laser tissue interaction, laser surgery - Holography - NLO - electro-optic effect.

UNIT IV FIBRE OPTICS

9

Structure and principle - Propagation of light through optical fibre - acceptance angle, numerical aperture - fractional index change - Types of optical fibres (material, mode and refractive index) - Attenuation: absorption, scattering and bending - Dispersion - Fibre optic communication system (Block diagram) and advantages over conventional methods - fibre optic sensors: pressure and displacement- Endoscope.

UNIT V QUANTUM PHYSICS

9

Black body radiation and energy distribution spectrum - Planck's theory of radiation - matter waves - de-Broglie wavelength in terms of energy, voltage and temperature - Electron diffraction - G.P.Thomson experiment - wave function and its physical significance - Schrödinger's wave equation - time independent and time dependent equations - Particle in a one-dimensional box- Normalization of wave function - Quantum Tunnelling - Scanning Tunnelling Microscope.

TOTAL: 45 PERIODS

COURSE OUTCOMES

After completion of this course, the students should be able to

1. To understand the properties of materials, crystalline material and growth techniques.
2. To understand the basics, generation and application of ultrasonics.
3. To acquire knowledge on the concepts of lasers and their applications in industry and medical field.
4. To conversant on principle behind the fibres and their applications in communication and devices made out of optical fibre.
5. To get knowledge on advanced physics concepts of quantum theory and its applications.

TEXT BOOKS

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.
4. Brijlal and Subramanyam, "Properties of Matter", S .Chand publishing, 2002.
5. M.N.Avadhanulu & P.G.Krishnasagar, "A Text Book of Engineering Physics" – IX Edition, S.Chand Publications, 2014.
6. V. Rajendiran, Engineering Physics, Tata McGraw-Hill, New Delhi. 2011.

REFERENCE BOOKS

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.
3. Shatendra Sharma & Jyotsna Sharma, "Engineering Physics". Pearson, 2018

MAPPING OF COs WITH POs AND PSOs

COs	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	1	-	-	1	1	-	-	-	-	1	-	-	-	-
2	3	1	1	1	2	1	1	-	-	-		1	-	-	-	-
3	3	2	2	1	1	1	1	-	-	-	-	1	-	-	-	-
4	3	2	2	1	1	1	1	-	-	-	-	1	-	-	-	-
5	2	1	1	1	1	1	1	-	-	-	-	1	-	-	-	-
Avg.	2.8	1.4	1.4	1	1.3	1	1	-	-	-	-	1	-	-	-	-

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

CH3124	ENGINEERING CHEMISTRY	L	T	P	C
	(First Semester-Common to all branches)	3	0	0	3

COURSE OBJECTIVES

1. To make the students familiar with boiler feed water requirements, related problems and domestic water treatment techniques.
2. To introduce the basic concepts and applications of chemical thermodynamics.
3. To acquaint the student with the principles of chemical kinetics and its applications towards engineering.
4. To make the student conversant with the basics of surface chemistry and catalysis.
5. To inculcate the students with the basics principles and preparatory methods of nanomaterials.

UNIT I WATER TECHNOLOGY 9

Introduction-sources of water-impurities present in water-hard water and hardness – types, Municipal water treatment: primary treatment and disinfection - Desalination of brackish water: Reverse Osmosis, Boiler troubles: scale and sludge, caustic embrittlement, boiler corrosion priming and foaming, Treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and Calgon conditioning). External treatment: Ion exchange process, cooling waters (Langelier index).

UNIT II CHEMICAL THERMODYNAMICS 9

Introduction-terminology of thermodynamics, the first law of thermodynamics: enthalpy, second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions: Clausius inequality. Free energy and work function: Helmholtz and Gibbs free energy functions, Criteria of spontaneity; Gibbs-Helmholtz equation, Clausius-Clapeyron equation, Maxwell relations, Van't Hoff isotherm and isochore.

UNIT III CHEMICAL KINETICS 9

Introduction-factors influencing the rate of reaction, order and molecularity of a

reaction, kinetic equations of different orders (first, second and third order) - determination of the order of a reaction, the temperature dependence of reaction rates, unimolecular reactions, photochemical reactions and chain reactions, Theories of reaction rates, lasers in chemistry, fast reactions.

UNIT IV SURFACE CHEMISTRY AND CATALYSIS

9

Adsorption: classification - adsorption of gases on solids - adsorption from solutions - adsorption isotherms - applications of adsorption - Freundlich's adsorption isotherm - Langmuir's adsorption isotherm, B.E.T isotherm. Catalysis: introduction - types of catalysis - criteria - autocatalysis - catalytic poisoning and catalytic promoters - acid -base catalysis - enzyme catalysis - Michaelis - Menten equation.

UNIT V NANOCHEMISTRY

9

Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties; Types of nanomaterials: Definition, properties and uses of - nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electrospinning. Applications of nanomaterials in medicine, agriculture, food science and energy resources.

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should be able:

1. To infer the quality of water from quality parameter data and propose suitable treatment.
2. To apply the knowledge of chemical thermodynamics for material design and aspects.
3. To recommend the proper chemical kinetics for engineering processes and applications.
4. To recognize the surface morphology and its engineering applications.
5. To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.

TEXT BOOKS

1. Payal B. Joshi and Shashank Deep, "Engineering Chemistry", Oxford University Press, New Delhi, 2019.
2. Shikha Agarwal, "Engineering Chemistry"-Fundamentals and Applications, 2nd Edition, Cambridge University Press, New Delhi, 2019.
3. P. C. Jain and Monika Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2019.

REFERENCE BOOKS

1. R. V. Gadag and A. Nithyananda Shetty, "Engineering Chemistry", 3rd Edition, Wiley & I.K. International (P), LTD, New Delhi, 2019.
2. S.S. Dara and S.S. Umare, "A Text Book of Engineering Chemistry", 12th Edition, S. Chand & Company LTD, New Delhi, 2018.
3. B. Sivasankar, "Engineering Chemistry", Tata McGraw-Hill Publishing Company LTD, 2023.
4. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.

MAPPING OF COs WITH POs AND PSOs

COs	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	3	2	-	1	3	-	-	-	-	2	-	-	-	-
2	3	1	2	1	-	-	-	-	-	-	-	-	-	1	-	-
3	3	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
4	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
5	2	2	3	2	1	-	1	-	-	-	-	2	-	1	-	-
Avg.	2.8	1.8	2.2	1.5	1	1	2	-	-	-	-	2	-	1	-	-

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

GE3133	BASIC CIVIL AND MECHANICAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To impart basic knowledge on Civil and Mechanical Engineering.
2. To familiarize the materials and measurements used in Civil Engineering.
3. To provide the exposure on the fundamental elements of civil engineering structures and construction method.
4. To enable the students to distinguish the components and working principle of power plant units, boilers, IC engines and Electric vehicle.
5. To understand the concepts and working principle of pumps and refrigeration and air conditioning system.

A – OVER VIEW

UNIT I SCOPE OF CIVIL AND MECHANICAL ENGINEERING 9

Overview of Civil Engineering: Civil Engineering contributions to the welfare of Society – Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering. Overview of Mechanical Engineering: Mechanical Engineering contributions to the welfare of Society –Specialized sub disciplines in Mechanical Engineering - Production, Automobile, Energy Engineering - Interdisciplinary concepts in Civil and Mechanical Engineering.

B – CIVIL ENGINEERING

UNIT II SURVEYING AND CIVIL ENGINEERING MATERIALS 9

Surveying: Objects – classification – principles – measurements of distances – angles - determination of areas– contours - examples.

Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel - timber – modern materials.

UNIT III BUILDING COMPONENTS AND STRUCTURES 9

Foundations: Types of foundations – Requirement of good foundations.

Civil Engineering Structures: Brick masonry – stone masonry – beams – columns – lintels – roofing– flooring – plastering – floor area, carpet area and floor space index - Rain water harvesting - introduction to high way and railway.

C – MECHANICAL ENGINEERING

UNIT IV INTERNAL COMBUSTION ENGINES AND POWER PLANTS 9

Introduction to internal combustion engine – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines-Introduction to Electric vehicle. Classification of Power Plants-Working principle of steam, Gas, Diesel, Hydro – electric and Nuclear Power plants-working principle of Cochran, La-mont, Benson Boilers.

UNIT V PUMPS , REFRIGERATION AND AIR CONDITIONING 9

Reciprocating Pumps -single acting and double acting and Centrifugal Pumps. Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system – Layout of typical domestic refrigerator – Window and Split type room Air conditioner.

TOTAL : 45 PERIODS

COURSE OUTCOMES

1. Knowledge of basics in various sub-disciplines of civil and mechanical Engineering.
2. Use the basics of surveying for calculation of area and volume in basic construction works
3. Fundamental elements of civil engineering structures and construction methods.
4. Understand the energy sources, working principle of power plants and working principle of IC Engines and Electric vehicle.
5. Understand the working principle of pumps and function of refrigeration and air conditioning system.

TEXT BOOKS

1. Shanmugam G and Palanichamy MS, “Basic Civil and Mechanical Engineering”, Tata McGraw Hill Publishing Co., New Delhi, 2018.
2. Basant Agrawal and C.M.Agrawal, “Basic Mechanical Engineering”, Wiley Publications Pvt Ltd., New Delhi, 2018.
3. Venugopal K. and Prabhu Raja V., “ Basic Civil and Mechanical Engineering”,

Anuradha publications Pvt Ltd., Chennai, 2014.

4. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals, Second Edition" CRC Press, Taylor & Francis Group, Second Edition, 2011.
5. Satheesh Gopi, "Basic Civil Engineering", Pearson publications, 2009.

REFERENCE BOOKS

1. Rajput R.K., "Thermal Engineering", Laxmi Publications (P) Ltd, 10 th Edition, 2018.
2. Ramamrutham S., "Basic Civil Engineering", Dhanpat Rai Publishing Co.(P) Ltd, 2015.
3. Kothandaraman C.P., Domkundwar S., Dhanpat Rai, "Thermal Engineering", Publishing Co.(P) Ltd., 6 th Edition, 2015.
4. MehrdadEhsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel cell Vehicles" CRC Press, Taylor & Francis Group, Second Edition (2010)

MAPPING OF COs WITH POs AND PSOs

COs	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	2	-	-	3	2	1	-	-	-	1	1	-	1	2
2	3	3	2	1	-	1	-	-	-	-	-	-	2	1	-	2
3	3	1	2	1	-	1	1	-	-	-	-	-	2	1	-	2
4	3	2	2	1	-	1	-	-	-	-	-	1	2	1	1	2
5	3	2	2	1	-	-	-	-	-	-	-	-	1	-	-	1
Avg.	3	1.8	2	1	-	1.5	1.5	1	-	-	-	1	1.6	1	1	1.8

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

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 கருத்துகள்- தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமணப் பெளத்த 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
– சிற்பக் கலை
3

நடுகல் முதல் நவீன சிற்பங்கள் வரை –ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள் , பொம்மைகள்- தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள்.

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்**3**

நாட்டுப்புற கதைகள், பாடல்கள்-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 –தமிழ் சங்கம்-சங்கம் வளர்த்த தமிழ்- சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும்- சங்ககால

நகரங்களும் துறைமுகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய

3

பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு இந்தியா மற்றும் வெளிநாட்டின் பிற பகுதிகளின் தமிழ்ப் பண்பாட்டின் தாக்கம்-சுயமாரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு- கல்வெட்டுகள், கையெழுத்துப்படிகள் – தமிழ்ப் புத்தகங்களின் அச்ச வரலாறு.

TOTAL: 15 PERIODS

TEXT CUM REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித்தமிழ் – முனைவர். இல.சுந்தரம். (விகடன் பிரசுரம்)
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருதை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

10. Studies in the History of India with Special Reference to Tamil Nadu
(Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL)
– Reference Book.

TEXT CUM REFERENCES

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

GE3121	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
(Common to all branches of B.E. / B.Tech Programmes)		0	0	4	2

PHYSICS LABORATORY: (Any five experiments to be conducted)

COURSE OBJECTIVES:

1. To learn the proper use of various kinds of physics laboratory equipment.
2. To learn how data can be collected, presented and interpreted in a clear and concise manner.
3. To learn problem solving skills related to physics principles and interpretation of experimental data.
4. To determine error in experimental measurements and techniques used to minimize such error.
5. To make the student as an active participant in each part of all lab exercises.

LIST OF EXPERIMENTS

- 1 Calculation of lattice cell parameter – X-ray diffraction method.
- 2 Determination of velocity of sound and compressibility of liquid– Ultrasonic interferometer.
- 3 (a). Compact disc- Determination of width of the groove using Laser.
(b). Determination of particle size using Laser.
- 4 (a) Determination of wavelength using Laser
(b) Determination of acceptance angle and numerical aperture in an optical fiber.
- 5 Determination of Planck's constant using LED.
- 6 Determination of thickness of a thin wire – Air wedge method.
- 7 Determination of wavelength of mercury spectrum – spectrometer grating.
- 8 Determination of rigidity modulus – Torsion pendulum.
- 9 Determination of Young's modulus by non-uniform bending method.

TOTAL: 30 PERIODS

COURSE OUTCOMES

At the end of the course, the student should be able:

1. To understand the functioning of various physics laboratory equipment.
2. To Use graphical models to analyze laboratory data.
3. To Use mathematical models as a medium for quantitative reasoning and describing physical reality.
4. To Access, process and analyze scientific information.
5. To Solve problems individually and collaboratively.

REFERENCE BOOKS

1. Wilson J.D. and Hernandez Hall C.A., —Physics Laboratory Experiments, Houghton Mifflin Company, New York, 2005.
2. S. Srinivasan, A Text Book of Practical Physics, S. Sultan Chand publications. 2005.
3. R. Sasikumar, Practical Physics, PHI Learning Pvt. Ltd, New Delhi, 2011.

CHEMISTRY LABORATORY: (Any five experiments to be conducted)

COURSE OBJECTIVES

1. To inculcate experimental skills to test basic understanding of water quality parameters, such as acidity, alkalinity, hardness, DO, chloride, and chlorine.
2. To familiarise the students with electro analytical techniques such as conductometry and flame photometry to determine of impurities in aqueous solution.
3. To find the various characteristics of domestic water.
4. To understand the Pseudo first-order kinetics reaction.
5. To make the students know the synthesis of nanoparticles.

LIST OF EXPERIMENTS

- 1 Determination of chloride content of water sample by Argentometric method.
- 2 Determination of total, temporary & permanent hardness of water by EDTA method.
- 3 Determination of DO content of water sample by Winkler's method.

- 4 Preparation of Na_2CO_3 as a primary standard and estimation of acidity of a water sample using the primary standard.
- 5 Determination of types and amount of alkalinity in water samples.
- 6 Estimation of available chlorine in bleaching powder solution.
- 7 Conductometric titration of barium chloride against sodium sulfate (Precipitation titration).
- 8 Estimation of sodium/potassium present in water using a flame photometer.
- 9 Estimation of TDS of a water sample by gravimetry.
- 10 Preparation of nanoparticles ($\text{Ag}/\text{Au}/\text{TiO}_2/\text{ZnO}/\text{CuO}$).
- 11 Pseudo first-order kinetics- ester hydrolysis.

TOTAL: 30 PERIODS

COURSE OUTCOMES

At the end of the course, the student should be able:

1. To infer the quality of water samples for alkalinity, hardness, DO, TDS, chloride, and chlorine.
2. To apply the knowledge on the estimation of metal ions, acidity and its precipitation nature towards their process.
3. To recognize the threshold limit for various characteristics of domestic water.
4. To identify the simple method of synthesis of nanoparticles.
5. To understand the pseudo first-order kinetics reaction from ester hydrolysis.

TEXT BOOKS

1. Vogel's Textbook of Quantitative Chemical Analysis (8th Edition, 2014).
2. Suchi Tiwari, Engineering Chemistry Lab Manual, Scitech Publications (India) Pvt. Ltd. (2nd Edition, 2013).
3. Pushpendra Kumar, Laboratory Manual for Engineering Chemistry, Reyansh Authortopic Pvt. Ltd., (1st Edition, 2022).

MAPPING OF COs WITH POs AND PSOs (PHYSICS LAB)

COs	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
2	3	3	2	1	1	-	-	-	-	-		-	-	-		-
3	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
4	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
5	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
Avg.	3	2.4	2.6	1	1	-	-	-	-	-	-	-	-	-	-	-

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

MAPPING OF COs WITH POs AND PSOs (CHEMISTRY LAB)

COs	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	1	1	1	1	-	1	-	-	-	-	-	-	-	-	-
2	2	1	1	1	1	-	-	-	-	-	-	-	-	2	-	-
3	2	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-
4	2	1	1	1	2	-	-	-	-	-	-	1	-	-	-	-
5	2	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-
Avg.	2	1	0.8	1	1.2	-	0.2	-	-	-	-	0.2	-	0.4	-	-

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

GE3134	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

1. To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.
2. To provide hands on training for fabrication of components using carpentry, sheet metal and welding equipment / tools.
3. To gain the skills for making fitting joints and assembling air conditioner.
4. To develop the skills for making simple electrical wiring connections using suitable tools.
5. To provide hands on experience for soldering and gain knowledge about the behavior of electronics components.

GROUP A (CIVIL & MECHANICAL)

LIST OF EXPERIMENTS: CIVIL

a) Buildings

- 1 Study of plumbing and carpentry components of residential and industrial buildings safety aspects.

b) Plumbing Works:

- 1 Study of pipeline joints, its location and functions : valves, taps, couplings, unions, reducers, elbows in house hold fittings.
- 2 Study of pipe connections requirements for pumps and turbines.
- 3 Preparation of plumbing line sketches for water supply and sewage works.
- 4 Hands-on-exercise:
Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
- 5 Demonstration of plumbing requirements of high-rise buildings.

Carpentry works:

- 1 Study of the joints in roofs, doors, windows and furniture.
- 2 Hands-on-exercise:
Wood work, joints by sawing, planning and cutting.

LIST OF EXPERIMENTS : MECHANICAL

a) Welding:

- 1 Preparation of butt joints, lap joints and T-joints by Shielded metal arc welding.
- 2 Gas welding practice - Study

b) Basic Machining:

- 1 Facing
- 2 Simple Turning
- 3 Step Turning

c) Sheet Metal Work:

- 1 Forming & Bending
- 2 Model making–Trays

d) Demonstration on:

- 1 Smithy operations, upsetting, swaging, setting down and bending.
- 2 Foundry operations like mould preparation for gear and step cone pulley.
- 3 Assembly of centrifugal pump.
- 4 Assembly of air conditioner.

GROUP B (ELECTRICAL & ELECTRONICS)

LIST OF EXPERIMENTS : ELECTRICAL

1. Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket.
2. Fluorescent Lamp Wiring.
3. Staircase Wiring.
4. Measurement of Voltage, Current, Power and Power factor in electrical circuit.
5. Measurement of Energy using Analog & Digital Energy meter.
6. Measurement of Earth Resistance.
7. Study of Industrial house wiring.
8. Identification & Study of protective devices: Fuses & Fuse carriers, MCB, ELCB and Isolators with ratings and usage.

LIST OF EXPERIMENTS: ELECTRONICS

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, RMS period, frequency) using CRO.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components, Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 60 PERIODS

COURSE OUTCOMES

At the end of the course, the student should be able:

1. To Carry out various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.
2. To Fabricate carpentry components and pipe connections including plumbing works and use welding equipment's to join the structures.
3. To Carry out the basic machining operations, make the models using sheet Metal works. Illustrate on centrifugal pump, air conditioner, operations of smithy, foundry and fittings.
4. To Carry out basic home electrical works and measure the electrical quantities.
5. To Elaborate on the electronics components, gates and soldering practices.

REFERENCE BOOKS

1. Laboratory Manual prepared by Course Coordinator

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

Sl. No.	Description of Equipment	Required numbers (for batch of 30 students)
---------	--------------------------	--

ELECTRICAL

1.	Assorted electrical components for house wiring	15 SETS
2.	Fluorescent Lamp	15 SETS
3.	Electrical measuring instruments	10 SETS
4.	Analog & Digital energy meter	5 SETS
5.	Meggar	2

ELECTRONICS

1.	Soldering guns	10Nos.
2.	Assorted electronic components for making circuits	50Nos.
3.	Small PCBs	10 Nos.
4.	Multimeters	10Nos.
5.	Study purpose items: Telephone, FM radio, low-voltage power supply.	

MAPPING OF COs WITH POs AND PSOs

COs	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3					1						1				
2		1	2		3						1					
3				3	2							1				
4		2	3	1	2											
5		3	2	2					1							
Avg.	3	2	2.3	2	2.3	1	-	-	1	-	1	1	-	-	-	-

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

EN3119	ENGLISH LANGUAGE LEARNING LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

The course aims to

1. Enhance the employability and career skills of students.
2. Orient the students towards grooming as a professional.
3. Make them industry ready.
4. Develop their confidence and help them attend interviews successfully.
5. Help students to interact confidently in a professional scenario.

UNIT I PRONUNCIATION 6

Tone- Pronunciation – Intonation- Reading Aloud and Addressing- Syllable- Rhythm-Accent- Wrongly Pronounced words -Poetry Reading.

UNIT II NON VERBAL COMMUNICATION 6

Non Verbal Communication -Facial expressions- Eye contact - Subtle (and not so subtle) gestures -Tone of voice – Touch- Posture -Personal space.

UNIT III SELF ANALYSIS 6

Self Introduction- Introducing oneself to the audience- Introducing the Topic answering questions – Individual Presentation Practice – Presenting Visuals effectively -5 Minute Presentations.

UNIT IV BASICS OF SOFT SKILLS 6

Recognizing differences between groups and teams – managing time – networking professionally – Respecting social protocols- understanding career management – Developing a long - term career plan- making career changes.

UNIT V GROUP DISCUSSION 6

Introduction to Group Discussion – Participating in Group discussions – Understanding group dynamics – Brainstorming the Topic – Questioning and Clarifying – GD Strategies – activities to improve GD Skills.

TOTAL: 30 PERIODS

COURSE OUTCOMES

At the end of the course, the student should be able:

1. Pronounce the words correctly.
2. Understand the non verbal clues.
3. Make an effective presentation.
4. Adequate soft skills required for the workplace.
5. Participate confidently in Group Discussions.

REFERENCE BOOKS

1. Professional Communication by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2014.
2. Soft Skills by S. Hariharan , N. Soundarajaran and S.P. Shanmugapriya MJP Publishers, Edition: 2013.
3. Soft Skills for Everyone by Butterfield, Jeff, Cengage Learning India Pvt. Ltd., 2015. New Delhi.

MAPPING OF COs WITH POs AND PSOs

COs	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	-	-	1	-	-	-	-	-	3	-	1	-	-	-	-
2	1	1	-	-	-	-	1	-	-	2	-	1	-	-	-	-
3	2	2	1	2	2	-	-	-	-	3	-	1	-	-	-	-
4	2	1	1	-	-	-	3	-	-	3	-	1	-	-	-	-
5	-	1	-	1	-	-	-	-	-	3	-	1	-	-	-	-
Avg.	1.7	1.3	1	1.3	2	-	2	-	-	2.8	-	1	-	-	-	-

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

SEMESTER II

EN3211	PROFESSIONAL ENGLISH – II	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The course prepares the second semester Engineering students

1. To develop strategies and techniques to enhance their reading skills.
2. To engage them in meaningful activities in order to improve their listening, speaking, reading and writing skills.
3. To improve their ability to write effective job application, resumes and draft impressive reports.
4. To develop analytical thinking skills for problem solving in communicative contexts.
5. To participate in group discussions.

UNIT I MAKING COMPARISON 9

Listening: Clippings of Ted talk, cartoon and interviews of sports personalities for listening and discussion.

Speaking: Descriptions and discussions based on newspaper.

Reading: Learning shades of meaning (using Thesaurus) and inferring the context from general passages.

Writing: Compare & Contrast essays and Jumbled Sentences.

Language and Vocabulary development: Prepositional phrases, contextual meaning of words. Verbal Analogy, Same word used as Noun and Verb.

UNIT II EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING 9

Listening: Anecdotes to be read from books like Chicken Soup books. Evaluative listening – Advertisement and Product description.

Speaking: Marketing a product, persuasive speech

Reading: Description of any product / jewellery, Brochures and Manual.

Writing: Formal letters- letters of complaint, appreciation, and suggestion, Comprehension and E-mail (formal)

Language and Vocabulary development: Active & Passive, Infinitive, Gerund, Purpose Statements, Adverbs and Word formation.

UNIT III ABILITY TO PUT IDEAS OR INFORMATION COGENTLY 9

Listening: Listen to English songs and find the lyrics/new words

Speaking: Role play and Interviews

Reading: Reading magazine articles, Excerpts from literary texts

Writing: Job Application, Resume, Cover letter, SWOC Analysis and Recommendations.

Language and Vocabulary development: Correction of errors, If conditional, Sentence completion and Connotations.

UNIT IV ANALYZING PROBLEMS AND EXPRESSING SOLUTIONS 9

Listening: Watching Stand-up comedies and comprehending ideas expressed there.

Speaking: Speak about the Stand-up comedies viewed and express personal views about the same

Reading: Reading different types of books (novels, short stories, biographies, magazines etc. and speaking about the same.

Writing: Dialogue Writing, Checklist and Problem Solving essays.

Language and Vocabulary development: Reported Speech, Modals, Slogan writing and Conjunctions.

UNIT V REPORTING EVENTS 9

Listening: Listening to spot errors, listening to varied dialects and accents of English.

Speaking: Group discussion- Expression of opinions, assertion, coercion etc.

Reading: Reading life experiences of common man from magazines.

Writing: Accident Report / Survey Report and Letters to the Editor.

Language and Vocabulary development: Numerical Adjective, Idioms, Vocabulary – Shades of Meaning.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

1. To compare and contrast ideas and information from technical texts.
2. To incorporate basic grammar structures to express appreciation, suggestion and complaint in writing.
3. To draft effective resumes using appropriate vocabulary and to avoid common errors.
4. To analyse problems so as to arrive at appropriate solutions and to communicate relevantly.
5. To draft technical reports, letters and to express ideas creatively.

TEXT BOOKS

1. English for Science and Technology Cambridge University Press, 2021.
Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deep Mary Francis,
Dr. K. N. Shoba and Dr. Lourdes Joevani, Department of English, Anna
University.
2. Technical Communication – Principles and Practice by Meenakshi Raman &
Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
3. Technical English for Professional – Advanced by C. Gangalakshmi,
B. Rathika and L. Saranraj, Cengage Learning India Pvt. Ltd., 2022.

REFERENCE BOOKS

1. Learning to communicate – Dr. V. Chellammal, Oxford Univ. Press, 2001,
New Delhi.
2. Business Correspondence and Report Writing by Prof. R. C. Sharma &
Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
3. Developing Communication Skills by Krishna Mohan, Meera Bannerji-
Macmillan India Ltd. 1990, Delhi.
4. Improve Your Writing ed. V.N Arora Laxmi Chandra, Oxford Univ. Press,
2001, New Delhi.
5. English For Engineers and Technologists, Orient Blackswan Private Ltd.
Department of English, Anna University, 2020.

MAPPING OF COs WITH POs AND PSOs

COs	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	1	2	1	-	-	-	-	-	3	-	1	-	-	-	-
2	2	2	1	2	2	-	-	-	-	3	1	1	-	-	-	-
3	-	-	1	-	-	-	-	-	-	3	-	-	-	-	-	-
4	2	3	2	3	-	-	2	-	-	3	-	-	-	-	-	-
5	2	-	1		-	-	-	-	-	2	-	-	-	-	-	-
Avg.	2	2	1.4	2	2	-	2	-	-	2.8	1	1	-	-	-	-

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

MA3222	STATISTICS AND NUMERICAL METHODS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

1. This course aims at providing the necessary basic concepts of statistical and Numerical Methods for solving numerically different problems of engineering and Technology.
2. To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
3. To introduce the basic concepts of solving algebraic and transcendental equations.
4. To introduce the numerical techniques of interpolation in various intervals and differentiation and integration in engineering and technology disciplines.
5. To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I STATISTICAL HYPOTHESIS TESTS 9L+3T

Sampling distributions - Tests for single mean and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes.

UNIT II EXPERIMENTAL DESIGN FOR ANOVA 9L+3T

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design.

UNIT III SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS 9L+3T

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton - Raphson method - Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative method of Gauss Seidel –Dominant Eigen value of a matrix by Power method.

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND 9L+3T NUMERICAL INTEGRATION

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical integrations using Trapezoidal, Simpson's rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL 9L+3T EQUATIONS

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.

TOTAL: 45L+15T PERIODS

COURSE OUTCOMES

1. Apply the concept of testing of hypothesis for small and large samples in real life problems.
2. Apply the basic concepts of classifications design of experiments in the field of agriculture.
3. Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
4. Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
5. Solve the ordinary differential equations with initial and boundary conditions by using certain techniques with engineering application.

TEXT BOOKS

1. Grewal. B.S. and Grewal. J.S., "Numerical Methods in Engineering and Science", 10th Edition, Khanna Publishers, New Delhi, 2015.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

REFERENCE BOOKS

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald.C.F., Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 2006.

MAPPING OF COs WITH POs AND PSOs

COs	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-
2	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-
3	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-
4	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-
5	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Avg.	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-

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

PH3223	PHYSICS FOR ELECTRONICS ENGINEERING	L	T	P	C
	For Second Semester - B.E / B.Tech	3	0	0	3
	(Common to EEE, ECE and EIE)				

COURSE OBJECTIVES

1. To understand the concept of free electron theories and to get knowledge on conducting and superconducting materials.
2. To impart the knowledge about basics of doping and types of semiconductors.
3. To enable the idea of magnetism and dielectric properties.
4. To explore the basics of interaction of photon with materials.
5. To enhance the fundamental knowledge of molecular electronics and nanodevices.

UNIT I CONDUCTING AND SUPERCONDUCTING MATERIALS 9

Classical free electron theory-Postulates - Expression for electrical conductivity and Thermal conductivity-Wiedemann-Franz law-Success and failures – Quantum free electron theory (qualitative) - Fermi Distribution function - Density of energy states - carrier concentration – Superconductors – Properties - Applications: Magnetic levitation, Cryotron and SQUID.

UNIT II SEMICONDUCTOR AND TRANSPORT PHYSICS 9

Properties - Direct and indirect semiconductors - Intrinsic Semiconductors - Carrier concentration in intrinsic semiconductors - Extrinsic semiconductors - Carrier concentration in N -type & P- type semiconductors - Fermi energy - Variation of fermi level with temperature - Carrier transport - Drift and Diffusion transport - Hall Effect- Theory and Experiment- PN junction diode - Forward and reverse bias characteristics.

UNIT III MEMORY STORAGE MATERIALS AND DIELECTRIC MATERIALS 9

Magnetism in materials - Diamagnetic material, Paramagnetic material and Ferromagnetic material - Ferromagnetic domain theory - Hysteresis Curve - Hard

and soft magnetic material - Bubble memory – Dielectric material : Electronic polarization, Ionic polarization, Orientational polarization and Space - charge polarization - dielectric loss – dielectric breakdown- high – k dielectrics.

UNIT IV OPTO ELECTRONIC DEVICES

9

Classification of optical materials Optical processes in semiconductors: optical absorption and emission - carrier injection and recombination - photo diode - solar cell - photodetectors- Light Emitting Diode - Organic LED - Optical switching – Plasmonics.

UNIT V MOLECULAR ELECTRONICS

9

Introduction to Nanotechnology - Size dependence of Fermi energy - quantum confinement – Excitons – HOMO - LUMO - Organic semiconductor (qualitative) – quantum structures - Quantum wire, Quantum Well, Quantum Dot laser – quantum interference effects – Tunneling: Resonant Tunnelling Diode (RTD) - Resonant Tunnelling Transistor (RTT) – Coulomb blockade effects - Single electron phenomena and Single electron Transistor-Nano Robotics.

TOTAL: 45 PERIODS

COURSE OUTCOMES

After the completion of the course, the students should be able

1. To gain knowledge in energy bandstructures and superconducting materials.
2. To acquire knowledge on basics of semiconductor physics and its applications in various devices.
3. To gain knowledge about the properties and applications of magnetic and dielectric materials.
4. To have the necessary understanding on the functioning of optical materials for optoelectronic devices.
5. To understand the basics of quantum structures and their applications in nano electronics.

TEXT BOOKS

1. Kasap, S. O., "Principles of Electronic Materials and Devices", McGraw-Hill Education, 2007.
2. M. Arumugam, "Semiconductor Physics and optoelectronics", Anuradha agencies, 2003.
3. Wahab, M.A., "Solid State Physics: Structure and Properties of Materials". Narosa Publishing House, 2009.
4. Kittel, C., "Introduction to Solid State Physics", Wiley, 2005.
5. B.K. Pandey., S. Chaturvedi., "Engineering Physics", Cengage Learning, 2012.
6. S. Salivahnan, A. Rajalakshmi, S. Karthie and N.P. Rajesh, Physics for Electronics Engineering and Information Science, McGraw Hill Education; 2018.

REFERENCE BOOKS

1. B. N. Sankar., S. O. Pillai., "Engineering Physics" New age international publishers, 2007.
2. Donald .A. Neamen., "Semiconductor Physics and devices" Tata Mc Graw-Hill, New Delhi. 2007.
3. Rogers, B., Adams, J. & Pennathur, S. "Nanotechnology: Understanding Small Systems", CRC Press, 2014.

MAPPING OF COs WITH POs AND PSOs

COs	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	-	-	1	1	-	-	-	-	-	1				
2	3	2	2	-	2	-	-	-	-	-	-	1				
3	3	2	1	1	-	2	-	-	-	-	-	1				
4	3	-	1	-	3	2	3	-	-	-	-	1				
5	3	-	2	1	2	1	-	-	-	-	-	1				
Avg.	3	1.7	1.5	1	2	1.5	3					1				

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

CH3223	CHEMISTRY OF ELECTRONIC MATERIALS	L	T	P	C
	Second Semester-B.E./B.Tech.	3	0	0	3
	(Common to ECE, EEE and EIE)				

COURSE OBJECTIVES

1. To make the students accustomed to carbon-based materials, their synthetic properties, and their application in the field of electrical and electronics.
2. To comprehend the synthetic properties and applications of polymers in engineering applications.
3. To acquaint the student with the principles of electrochemical reactions, and corrosion.
4. To understand the working principle and applications of analytical instruments in chemical analysis.
5. To make the student conversant with the basics of energy sources and storage devices, their properties, and applications.

UNIT I CHEMISTRY OF CARBON 9

Catenation property of carbon-carbon based compounds-structure and bonding - hydrocarbons: fuels, carbon-based organic materials, activated carbon, and allotrope of carbon: properties-applications of diamond, graphite, graphene, fullerenes, and carbon-nanotubes types – preparation – properties-applications (electrical and electronic field) - future perspective in energy conversion and storage.

UNIT II ENGINEERING POLYMERS 9

Polymers: Classification - types of polymerization - plastic and its types – applications-Engineering polymers: ABS, PVC, Nylon-6, Nylon-6,6, Teflon, Kevlar and PEEK - preparation, properties and uses-fiber reinforced polymers- conducting polymers: types, and applications - applications of polymers in medicine and surgery.

UNIT III ELECTROCHEMISTRY AND CORROSION 9

Electrode - electrode reaction - redox reaction - origin of electrode potential, oxidation potential - reduction potential - measurement and applications, electrochemical series and its significance - electrochemical cell - Nernst equation

(derivation). Corrosion - causes - factors - types - chemical, electrochemical corrosion (galvanic, differential aeration), corrosion control - material selection and design aspects - electroplating of Au - electroless plating of Ni - paints - constituents and function.

UNIT IV ENERGY SOURCES AND STORAGE DEVICES 9

Introduction - nuclear energy - light water nuclear power plant - breeder reactor, solar energy conversion - solar cells: principle, working and applications, types of batteries - primary battery (alkaline battery), secondary battery (lead acid battery, NICAD battery, lithium-ion battery), fuel cells (H_2 - O_2 fuel cell). Super capacitors: storage principle, applications. Electric vehicles-working principles.

UNIT V INSTRUMENTAL METHODS AND ANALYSIS 9

Introduction, absorption of radiation, types of spectra, UV-Visible and IR Spectrophotometer: Instrumentation and applications, cyclic voltammetry for redox system. Thermal methods of analysis TGA, DTA, DSC. Sensors: oxygen, pulse oximeter, biometrics, and glucose sensor.

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should be able:

1. To explain the carbon-based materials properties and their engineering applications.
2. To gain knowledge on various types of engineering polymers.
3. To understand the process of electrochemistry and its application in corrosion control.
4. To appraise the working principles and applications of analytical instruments.
5. To ability to understand energy sources and storage devices.

TEXT BOOKS

1. Shikha Agarwal, "Engineering Chemistry"-Fundamentals and Applications, 2nd Edition, Cambridge University Press, New Delhi, 2019.

2. P. C. Jain and Monika Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2019.
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013.

REFERENCE BOOKS

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2. S.S. Dara and S.S. Umare, "A Text Book of Engineering Chemistry", 12th Edition, S. Chand & Company LTD, New Delhi, 2018.
3. B. Sivasankar, "Engineering Chemistry", Tata McGraw-Hill Publishing Company LTD, 2023.
4. R. V. Gadag and A. Nithyananda Shetty, "Engineering Chemistry", 3rd Edition, Wiley & I.K. International (P), LTD, New Delhi, 2019.

MAPPING OF COs WITH POs AND PSOs

COs	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	2	3	2	2	-	-	-	-	-	-	3	-	-	-	-
2	2	2	1	2	1	1	-	-	-	-	-	2	-	-	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	1	-	-	-
4	3	3	3	2	2	-	-	-	-	-	-	1	2	-	-	-
5	3	3	3	2	2	-	1	-	-	-	-	3	-	-	-	-
Avg.	2.6	2.4	2.2	1.8	1.8	1	1	-	-	-	-	2	1.5	-	-	-

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

GE3231	PROBLEM SOLVING AND PYTHON	L	T	P	C
	PROGRAMMING	3	0	0	3

COURSE OBJECTIVES

1. To know the basics of Python programming and write simple programs.
2. To develop Python programs with conditionals and loops.
3. To define Python functions and call them.
4. To use Python data structures and its implementation – lists, tuples, dictionaries.
5. To understand Object Oriented Concept in Python.

UNIT I PYTHON BASICS 9

Introduction to Python – Literals – Variables and Identifiers – Data Types – Input Operation – Comments – Reserved words – Indentation – Operators and Expressions – Modes of python. Conditionals: Boolean values and operators - conditional if - alternative if - chained conditional - Iteration, Illustrative programs: Basic Arithmetic Operations, GCD of numbers, Square root (Newton's Method).

UNIT II FUNCTIONS, LIST, TUPLES 9

Functions, function definition and use. **Fruitful functions:** return values, parameters, local and global scope, recursion. **Lists:** list operations, list slices, list methods, list loop, mutability, list parameters; **Tuples:** tuple assignment, tuple as return value. Comparison of Lists and tuples. Illustrative programs: exchange the values of two variables, square root, Linear and Binary search. Fibonacci series using functions.

UNIT III STRINGS, DICTIONARY, SET 9

Strings: string slices, immutability, string functions and methods, string module. **Dictionaries:** Operations (create, access, add, remove) and methods. (Insert, delete). Set operation (Access, Add, Remove). Illustrative programs: creates a dictionary of radius of a circle and its circumference.

UNIT IV FILES, EXCEPTIONS, MODULES AND PACKAGES

9

Files and exception: Text Files, Reading and Writing files, Format operator; Errors and Exceptions, Handling Exceptions, Multiple Except blocks, Modules, Packages; Illustrative programs: word count, copy file, Creating user defined Exceptions.

UNIT V CLASSES AND OBJECTS

9

Classes and Objects: Introduction, Classes and Objects, Defining Classes, Creating Objects, Data Abstraction and Hiding, The Class Method and Self Argument, The `__init__()` method, Class Variables and Object Variables, Public and Private data members, Private Methods. Illustrative Programs: Creating Student Class and Objects.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

1. Develop simple computational problems using control flow statements.
2. Decompose a Python program into functions, Modules and Packages.
3. Represent compound data using Python lists, tuples, Strings, Set and dictionaries.
5. Read and write data from/to files and Exception handling in Python Programs.
5. Understand the concepts of object oriented Programming and to develop real time applications.

TEXT BOOKS

1. Reema Thareja, “**Python Programming using Problem solving Approach**”, Oxford Higher Education, 2018.
2. Allen B. Downey, “**Think Python: How to Think Like a Computer Scientist**”, 2nd edition, Updated for Python 3, Shroff/O’Reilly Publishers, 2016 (<http://greenteapress.com/wp/think-python/>)
3. Guido van Rossum and Fred L. Drake Jr, “**An Introduction to Python**” – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCE BOOKS

1. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus", Wiley India Edition, 2013.
2. John V Guttag, "Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press ,2013.
3. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
4. Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction to Computer Science using Python 3", Second edition, Pragmatic Programmers,LLC,2013.
5. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India Education Services Pvt. Ltd.,2016.

WEB REFERENCES

1. <http://greenteapress.com/wp/think-python/>
2. www.docs.python.org
3. <https://nptel.ac.in/courses/106/106/106106182/>

MAPPING OF COs WITH POs AND PSOs

COs	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	3	2	-	-	-	-	-	2	2	2			1
2	3	3	3	3	2	-	-	-	-	-	2	2			3	
3	3	3	3	3	2	-	-	-	-	-	2	-			1	
4	2	2	-	2	2	-	-	-	-	-	1	-	3		2	
5	1	2	-	-	1	-	-	-	-	-	1	-				1
6	2	2	-	-	2	-	-	-	-	-	1	-	1			
Avg.	2.3	2.5	3.0	2.8	1.8	-	-	-	-	-	1.5	2.0	2.0		2.0	1.0

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

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 தொழில்நுட்பம் 3

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாகச் செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின்

அலகு IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் 3

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குழுவித் 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: 15 PERIODS

TEXT – CUM – REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித்தமிழ் – முனைவர். இல.சுந்தரம். (விகடன் பிரசுரம்)
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருளை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and

Educational Services Corporation, Tamil Nadu)

10. Studies in the History of India with Special Reference to Tamil Nadu
(Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL)
– Reference Book.

GE3211	TAMILS AND TECHNOLOGY	L	T	P	C
		1	0	0	1

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 Priod – 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 beats – Archeological evidences – Gem stone types described in Silappathikaram.

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoomp of Chola Perio, 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: 15 PERIODS

TEXT – CUM – REFERENCE BOOKS

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

GE3233	ENGINEERING GRAPHICS AND DESIGN	L	T	P	C
	(Common to all branches of B.E. / B.Tech. Programmes)	1	0	4	3

COURSE OBJECTIVES

The main learning objective of this course is to impart knowledge

1. To draw the conics curves and special curves, use BIS conventions, and specifications for engineering drawing.
2. To draw the orthographic projection of lines and plane surfaces.
3. To draw the projections and solids and Isometric projection of simple solids.
4. To draw the section of solids and the development of surfaces.
5. To draw free hand sketching of basic geometrical constructions, multiple views of objects and Perspective Projection of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination) 1

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND SPECIAL CURVES 11

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid (Rolling Circle rolls on flat surface only). construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 12

Orthographic projection- Principles-Principal planes - First angle projection- projection of points at the First Quadrant only. 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. Projection of planes (polygonal and circular surfaces) which inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS AND ISOMETRIC PROJECTION 12

Projection of simple solids like prisms, pyramids, cylinders and cones when the axis is inclined to one of the principal planes by the rotating object method. Principles of isometric projection – isometric scale – Isometric projections of simple solids - Prisms, pyramids, cylinders, cones - isometric view of the object from the 2D coded

plan.

UNIT IV PROJECTION OF SECTIONED SOLIDS & DEVELOPMENT OF SURFACES 12

Sectioning of the above solids in the simple vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other – obtaining the true shape of the section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

UNIT V FREE-HAND SKETCHING AND PERSPECTIVE PROJECTIONS 12

Free Hand sketching: Visualization principles – Representation of Three-Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects. Perspective projection of simple solids-Prisms and pyramids by visual ray method.

TOTAL: 60 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able:

1. To construct the conics curves and special curves.
2. To construct the orthographic projection of lines and plane surfaces.
3. To construct the projections and solids and Isometric projection of simple solids.
4. To construct projections of section of solids and development of surfaces.
5. To construct free hand sketching of basic geometrical constructions, multiple views of objects and Perspective Projection of simple solids

TEXTBOOKS

1. N.D.Bhatt, "Engineering Drawing (Plane and Solid Geometry)", Charotar Publishing House PVT. LTD. 53rd Edition 2019 (Fifth Reprint).
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 15th Edition 2018.

REFERENCE BOOKS

1. T. Jeyapoovan, "Engineering Graphics Using Auto CAD", Vikas Publishing House Pvt. LTD, seventh Edition, 2015.
2. 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.

3. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2nd Edition, 2011.
4. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2nd Edition, 2011.
5. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2013.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scales to fit solutions within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

MAPPING OF COs WITH POs AND PSOs

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	-	3	-	1	-	-	-	1	3	-	2	2	1	1	1
2	2	-	3	-	1	-	-	-	1	3	-	2	2	1	1	1
3	2	-	3	-	1	-	-	-	1	3	-	2	2	1	1	1
4	2	-	3	-	1	-	-	-	1	3	-	2	2	1	1	1
5	2	-	3	-	1	-	-	-	1	3	-	2	2	1	1	1
Avg.	2	-	3	-	1	-	-	-	1	3	-	2	2	1	1	1

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

GE3221	ENGINEERING SCIENCES LABORATORY	L	T	P	C
	(Common to all branches of B.E. / B.Tech Programmes)	0	0	4	2

PHYSICS LABORATORY: (Any five experiments to be conducted

COURSE OBJECTIVES

1. To gain practical knowledge and to correlate with the theoretical studies.
2. To achieve perfectness in experimental skills and the study of practical applications.
3. To bring more confidence and ability to develop and fabricate engineering and technical equipment.

LIST OF EXPERIMENTS : PHYSICS LABORATORY (Any 5 Experiments)

- 1 Determination of the electrical conductivity of metals by plotting a current-voltage characteristic curve.
- 2 Determination of band gap of a semiconductor.
- 3 Determination of Fermi energy. (Measurement of Fermi energy in copper)
- 4 Study of I-V characteristics of solar cell and determination of its efficiency
- 5 Determination of electrical resistivity of metal and alloy –Carey foster Bridge.
- 6 Measurement of susceptibility of paramagnetic solution by Quinke's method.
- 7 Study of magnetic Hysteresis-B-H curve.
- 8 Determination of the dark resistance of light detective resister (LDR).
- 9 Measurement of Temperature using LM35.

TOTAL: 30 PERIODS

COURSE OUTCOMES

At the end of the course, the students should be able

1. To understand the functioning of various physics laboratory equipment.
2. To use graphical models to analyze the laboratory data and to solve problems individually and collaboratively.

TEXTBOOKS:

- 1 Wilson J.D. and Hernandez Hall C.A., —Physics Laboratory Experiments, Houghton Mifflin Company, New York, 2005.
- 2 S. Srinivasan, A Text Book of Practical Physics, S. Sultan Chand publications. 2005.
- 3 R. Sasikumar, Practical Physics, PHI Learning Pvt. Ltd, New Delhi, 2011.

CHEMISTRY LABORATORY: (Any five experiments to be conducted)**COURSE OBJECTIVES**

1. To train the students in basic experimental skills in water contaminants such as copper and chromium.
2. To familiarise the students with electroanalytical techniques such as pH metry, potentiometry, and conductometry to determine impurities in aqueous solutions.
3. To familiarize the students with the determination of the molecular weight of a polymer by a viscometer.
4. To make the student up-to-date with the properties and nature of alloys experimentally.
5. To demonstrate the analysis of coal.

LIST OF EXPERIMENTS

1. Estimation of copper content of the given solution by Iodometry.
2. Determination of strength and amount of acids in a mixture of acids using a conductivity meter.
3. Determination of strength and amount of HCl present in the whole of the given solution using a conductivity meter.
4. Estimation of the iron content of the given solution using a potentiometer.
5. Determination of chromium by EDTA titration.
6. Determination of strength of given hydrochloric acid using a pH meter.
7. Determine the molecular weight of the polyvinyl alcohol using an Oswald viscometer.
8. Estimation of Nickel in steel.
9. Proximate Analysis of Coal.

10. Corrosion experiment-weight loss method.
11. Determination of COD value of industrial effluents.

TOTAL: 30 PERIODS

COURSE OUTCOMES

At the end of the course, the student should be able:

1. To find the quality of water samples for copper and chromium present in water.
2. To recognize the amount of various ions present in the water sample through volumetric and instrumentation techniques.
3. To identify the molecular weight of the polymer using an Ostwald viscometer.
4. To recognize an environmental hazardous and threshold limit for industrial effluents.
5. To recommend quality of coal and steel when it is exposed to various environment.

TEXT BOOKS

1. Vogel's Textbook of Quantitative Chemical Analysis (8th Edition, 2014).
2. Suchi Tiwari, Engineering Chemistry Lab Manual, Scitech Publications (India) Pvt. Ltd. (2nd Edition, 2013).
3. Pushpendra Kumar, Laboratory Manual for Engineering Chemistry, Reyansh Authortopic Pvt. Ltd., (1st Edition, 2022).

MAPPING OF COs WITH POs AND PSOs (PHYSICS)

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
2	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
3	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
4	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
5	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
Avg.	3	2.4	2.6	1	1	-	-	-	-	-	-	-	-	-	-	-

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

MAPPING OF COs WITH POs AND PSOs (CHEMISTRY)

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	1	1	1	1	-	1	-	-	-	-	-	-	-	-	-
2	2	2	1	1	1	-	-	-	-	-	-	-	-	2	-	-
3	2	1	1	1	2	-	-	-	-	-	-	-	-	-	-	-
4	2	2	1	1	1	2	2	2	-	-	-	-	-	-	-	-
5	2	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-
Avg.	2	1.4	1	1	1.2	2	1.5	2	-	-	-	-	-	2	-	-

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

GE3232	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
	LABORATORY	0	0	4	2

COURSE OBJECTIVES

1. To write, test, and debug simple Python programs.
2. To implement Python programs with conditionals and loops.
3. Use functions for structuring Python programs.
4. Represent compound data using Python lists, tuples, and dictionaries.
5. Read and write data from/to files in Python.
6. Knowing about Object Oriented Concepts.

LIST OF PROGRAMS

1. Compute the GCD of two numbers.
2. Find the square root of a number. (Newton's method)
3. Find exponentiation of a number. (power of a number)
4. Find the maximum of a list of numbers.
5. Program for basic calculator operations using functions.
6. Generate Fibonacci series using function.
7. Program for Armstrong number.
8. Program for check the number is Palindrome or Not.
9. Program for sum of array of numbers.
10. How to create, slice, change, add, delete and index elements using list.
11. Linear search and Binary search.
12. Find First n prime numbers.
13. Program to remove duplicate elements from a list.
14. Program for addition and transpose of a matrix.
15. How to create, slice, change, delete and index elements using Tuple.
16. Write a program to reverse the string.
17. How to change, delete, add and remove elements in Dictionary.
18. Create a dictionary of radius of circle and its circumference.
19. Program for count the number of words in a file.
20. Find the most frequent words in a text read from a file.
21. Program for student information system using class and objects.

22. Program for Employee Payroll Processing using class and objects.

TOTAL: 60 PERIODS

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux

COURSE OUTCOMES

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

1. Develop solutions to simple computational problems using Python programs.
2. Solve problems using conditionals and loops in Python.
3. Develop Python programs by defining functions and calling them.
4. Use Python lists, tuples and dictionaries for representing compound data.
5. Develop Python programs using files and OOPS concept.

MAPPING OF COs WITH POs AND PSOs

COs	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	3	3	-	-	-	-	-	3	2	1	3		
2	3	3	3	3	3	-	-	-	-	-	3	2			2	
3	3	3	3	3	2	-	-	-	-	-	2	-		3		2
4	3	2	-	2	2	-	-	-	-	-	1	-			1	
5	1	2	-	-	1	-	-	-	-	-	1	-	1		2	2
6	2	-	-	-	2	-	-	-	-	-	1	-	1		1	
Avg.	2.5	2.6	3	2.8	2.2	-	-	-	-	-	1.8	2	1	3	1.5	2

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

GE3251	NATIONAL SERVICE SCHEME (NSS)	L	T	P	C
		0	0	0	0

COURSE OBJECTIVES

1. To help learners know about NSS in the context of youth, community and voluntary service. .
2. To teach the importance of health, hygiene and sanitation for a healthy Nation.
3. To understand the community in which they work.
4. To identify the problems of the community and involve them in problem-solving.
5. To develop the capacity to meet emergencies and natural disasters.
6. To practice the National integration and social harmony.
7. To utilize their knowledge in finding practical solutions to individual and community.

UNIT I Introduction and Basic Concepts of NSS 8

- a. History – Aim – Objectives of NSS
- b. Emblem – Motto – Badge - Song
- c. Organizational structure - Roles and Responsibilities of NSS
- d. Regular activities
- d. Any approved indoor / outdoor programs by the Principal

UNIT II Youth Leadership, Social Harmony and National Integration 8

- a. Meaning and types of Leadership
- b. Qualities of good leaders and leadership
- c. Importance and role of youth leadership
- d. Role of youth in peace and Nation building
- e. Any approved indoor / outdoor programs by the Principal

UNIT III Health, Hygiene and Sanitation and Youth Health 8

- a. Definition, Needs and Scope of Health Education
- b. Swachh Bharat Abhiyan
- c. Healthy Lifestyles

- d. HIV, AIDS, Drugs abuse
- e. Any approved indoor / outdoor programs by the Principal

UNIT IV Environment Issues, Emergencies and Disaster Management 8

- a. Environment conservation, enrichment and sustainability
- b. Waste management
- c. Natural resource management [Rain water harvesting and Energy conservation]
- d. Introduction to Disaster Management, Classification of Disasters
- e. Any approved indoor / outdoor programs by the Principal

TOTAL: 32 PERIODS

COURSE OUTCOMES

Learners will have the knowledge about NSS and its role in the fields of health, hygiene, emergencies & natural disasters and involve them in problem-solving of the nearest community so as to build a strong country.

REFERENCE BOOKS

1. National Service Scheme Manual (Revised) 2006, Government of India, Ministry of Youth Affairs and Sports, New Delhi.
2. National Youth Policy, Government of India, Ministry of Youth Affairs and Sports, New Delhi.
3. <https://nss.gov.in/>

GE3251	YOUTH RED CROSS (YRC)	L	T	P	C
	Social Service based activities	0	0	0	0

COURSE OBJECTIVES

1. To enhance the societal awareness
2. To upgrade the Personality

ACTIVITY I HEALTH PROMOTION 2

Activities that promotes health

ACTIVITY II SOCIETAL SERVICEG 2

Social Service activities

ACTIVITY III FRIENDSHIP BUILDING 1

Friendship building activities between communities

TOTAL: 5 PERIODS

COURSE OUTCOMES

1. Enhanced Social Awareness
2. Personality development of the individual

REFERENCE BOOKS

1. IRCS/YRC Handbook
2. <https://www.indianredcross.org/youth/Guidelines-for-JYRC-LR.pdf>

GE3251	National Sports Organization (NSO)	L	T	P	C
		0	0	0	0

COURSE OBJECTIVES

1. To create awareness about basic fitness and mental strength
2. To promote the development of physical fitness
3. To develop the sporting activities of the youth
4. To create the social responsibilities and social interaction through participation

ACTIVITY I INTRODUCTION 1

Introduction of NSO & Physical Fitness and games Skills

ACTIVITY II PHYSICAL FITNESS ACTIVITIES 2

Importance of Basic Physical Fitness - BMI Calculation - Identification of deformities

ACTIVITY III SPORTS PRACTICE 2

Games and fitness activities Physical Fitness Activities

TOTAL: 5 PERIODS

COURSE OUTCOMES

1. Get basic knowledge about physical and mental fitness
2. NSO create self-esteem and self confidence
3. NSO provide opportunity get social interaction
4. Development of character and personality through participation

REFERENCE BOOKS

1. www.google.com
3. <https://scholar.google.com/>
4. <https://www.medindia.net/patients/lifestyleandwellness/five-essential-components-of-physical-fitness-references.htm>
5. <https://pubmed.ncbi.nlm.nih.gov/>

பாடத்திட்டத்தின் நோக்கங்கள்

1. மாணவர்களை சிறந்த மேடைப்பேச்சாளர்களாக உருவாக்குவது.
2. தாய்மொழியின் மேன்மையை பாதுகாப்பது.

பயிற்சித் திட்டம்

1. பேச்சுக்கலைப் பயிற்சி
2. கவிதை மற்றும் கட்டுரைகள் எழுதும் பயிற்சி
3. அறிவியல் பொறியியல் தொழில்நுட்பங்களைத் தமிழில் எழுதுதல்.
4. பட்டிமன்ற மேடைகளில் பேசும் பயிற்சி.
5. நாட்டுப்புறப்பாடல்கள் பாடுதல் மற்றும் கதைகள் எழுதும் பயிற்சி.

கற்றல் முடிவு

1. பேச்சுக்கலைப் தேர்ச்சி
2. நாட்டுப்புறப்பாடல்கள் பற்றிய புரிதல்

மேற்கோள்கள்

<https://eegarai.darkbb.com/t63483-topic>

<https://poriyari.in/>

GE3251	Eclectic Lingua – Skill based activities	L	T	P	C
		0	0	0	0

COURSE OBJECTIVES

1. To enhance the communicative competence of the first-year engineering students by means of creating opportunity for impromptu/ /spontaneous speeches.
2. To upgrade the English language skills of students by introducing appropriate vocabulary in different situations.

ACTIVITY I Extempore 2

Giving expression to thoughts

ACTIVITY II Building Vocabulary 2

Using relevant set of words for different contexts

ACTIVITY III Pronunciation 1

Speaking accurately and fluently

TOTAL: 5 PERIODS

COURSE OUTCOMES

1. To enable students to express themselves easily and coherently.
2. To help students to speak the language using the right words and pronouncing them correctly.

REFERENCE BOOKS

1. <https://www.cambridgeenglish.org/learning-english/activities-for-learners/?skill=pronunciation>
2. <https://www.quillsandquotes.ca/post/12-fun-games-to-get-students-public-speaking>

GE3251	CATALYSIS – SKILL-BASED ACTIVITIES	L	T	P	C
		0	0	0	0

COURSE OBJECTIVES

1. To inculcate a scientific attitude and temper.
2. To provide an opportunity to develop constructive, explorative & inventive ideas among the students.
3. To develop training in the scientific method of problem-solving for engineering

ACTIVITY I Quiz/debate **2**
the latest advancement in Chemistry towards engineering

ACTIVITY II Essay competition/Chart preparation **2**
Environmental sustainability

ACTIVITY III Nature Study **1**
field visit to eco-parks etc.

TOTAL: 5 PERIODS

COURSE OUTCOMES

1. To promote inquisitiveness among the students and inculcate scientific mind mapping.
2. To develop students, interest and participation in the practical applications of the knowledge related to environmental sciences.
3. Take part in practical, hands-on science activities close to nature.

REFERENCE BOOKS

1. M. Senapati, Advanced Engineering Chemistry, Infinity science press, New Delhi, 2007.
2. <https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/environmental-sustainability>
3. <https://www.indiabix.com/general-knowledge/chemistry>.

GE3251	RESONANCE – SKILL BASED ACTIVITIES	L	T	P	C
		0	0	0	0

COURSE OBJECTIVES

1. To know the basics and general principles of Physics.
2. To provide knowledge of the current trends in Physics.
3. To develop a solid scientific and technical competence for investigating and applying the relationships of Physics phenomena in various fields of Physics.

ACTIVITY I QUIZ **1**
Basics and general principle

ACTIVITY II PAPER PRESENTATION **2**
Current trends

ACTIVITY III PROJECTS **2**
Fun with Physics

TOTAL: 5 PERIODS

COURSE OUTCOMES

1. Recollect the general principles of Physics.
2. To explore the topics in the current trends in Physics.
3. Develop practical expertise in various areas of Physics.

REFERENCE BOOKS

1. Principles of Physics, 10Ed, Isv by Robert Resnick Jearl Walker, David Halliday (2015)
2. 'The Feynman Lectures on Physics' (Volume I, II and III) , Matthew Sands, Richard Feynman, and Robert B. Leighton.
3. <https://www.science-sparks.com/top-5-physics-experiments-you-can-try-at-home>
4. <https://www.electronicsforu.com/category/electronics-projects/hardware-diy>.

GE3251	Fine Arts Club VECTORIANS – Skill based activities	L	T	P	C
		0	0	0	0

COURSE OBJECTIVES

1. To enhance the Logical reasoning of the first-year engineering students by means of creating opportunity to improve the aptitude skill.
2. To explore the applications of Mathematics in the field of Engineering, Science and Technology and to utilize this skill for their academic activities.

ACTIVITY I OLYMPIAD**1**

The students will be provided with 25 questions in Engineering Mathematics. This should be completed in one hour.

ACTIVITY II MATHEMATICAL MODELLING**2**

The students are expected to present physical models (Working as well as static models) based on the application of Engineering Mathematics

ACTIVITY III PAPER PRESENTATION**2**

Students will be provided 5-7 minutes of time to present their findings in application of Mathematics.

TOTAL: 5 PERIODS**COURSE OUTCOMES**

1. To enable students to explore their mathematical reasoning skills.
2. To motivate the students to apply Mathematics in Engineering and Technology and demonstrate their work by means of Physical model and present their research article.

REFERENCE BOOKS

1. Advanced Engineering Mathematics , Erwin Kreyszig, 10th Edition, Wiley India Pvt Ltd.
2. <https://www.stewartcalculus.com/>

SEMESTER III

MA3321	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To introduce the effective mathematical tools for the solutions of partial differential equations.
2. To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
3. Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering.
4. To acquaint the student with Fourier transform techniques used in wide variety of situations.
5. To model several physical problems to develop Z transform techniques for discrete time systems.

UNIT I	PARTIAL DIFFERENTIAL EQUATIONS	9
---------------	---------------------------------------	----------

Solutions Lagrange's linear equation — linear partial differential equations of second and higher order with constant coefficients of homogeneous type.

UNIT-II FOURIER SERIES 9

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Harmonic analysis.

UNIT III LAPLACE TRANSFORMS 9

Existence conditions – Transforms of elementary functions – Basic properties – Inverse transforms – Convolution theorem – Transform of periodic functions.

UNIT IV FOURIER TRANSFORMS 9

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

Z- Transforms – Elementary properties – Inverse Z – transform (using partial fraction and residues) – Solution of difference equations using Z – transform.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Understand the fundamental concept of the concepts of Partial differential Equations.
2. Understand the basic concepts of mathematical principles on Fourier & Z-transforms.
3. Laplace transform and inverse transform of simple functions, properties, are studied.
4. Apply the concept of Understand the concept Fourier series and apply the concept in solving PDE.
5. Understand the fundamental concept of the concepts of Solution of difference equations

TEXT BOOKS

1. Veerarajan. T., “Transforms and Partial Differential Equations”, Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
2. Grewal. B.S., “Higher Engineering Mathematics”, 42nd Edition, Khanna Publishers, Delhi, 2012.
3. Narayanan.S., Manicavachagom Pillay.T.K and Ramanaiah.G “Advanced Mathematics for Engineering Students” Vol. II & III, S. Viswanathan Publishers Pvt. Ltd.1998.

REFERENCE BOOKS

1. Bali.N.P and Manish Goyal, “A Textbook of Engineering Mathematics”, 7th Edition, Laxmi Publications Pvt Ltd, 2007.
2. Ramana.B.V., “Higher Engineering Mathematics”, Tata McGraw Hill Publishing Company Limited, NewDelhi, 2008.
3. Glyn James, “Advanced Modern Engineering Mathematics”, 3rd Edition, Pearson Education, 2007.

4. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2007.
5. Ray Wylie. C and Barrett.L.C, "Advanced Engineering Mathematics" Tata McGraw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012.
6. P.Sivaramakrishna Das, C.Vijayakumari, Transforms and Partial Differential Equations, Pearson India Education Services Pvt. Ltd, 2019.

MAPPING OF COs WITH POs AND PSOs

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
2	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
3	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
4	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
5	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
Avg.	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-

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

COURSE OBJECTIVES

1. To introduce electric circuits and its analysis
2. To impart knowledge on solving circuit equations using network theorems
3. To educate the transient response of circuits.
4. To introduce the phenomenon of resonance in coupled circuits.
5. To introduce Phasor diagrams and analysis of single & three phase circuits

UNIT I BASIC CIRCUITS ANALYSIS 9

Ohm's Law - Kirchhoff's Laws – DC Circuits – Resistors in series and parallel circuits - A.C Circuits – Average and RMS Value – Complex Impedance – Phasor diagram - Real and Reactive Power, Power Factor, Energy - Mesh current and node voltage methods of analysis D.C and A.C Circuits

UNIT II NETWORK REDUCTION AND THEOREMS FOR DC AND AC CIRCUITS 9

Network reduction: voltage and current division, source transformation – star delta conversion. Theorems – Superposition, Thevenin's and Norton's Theorem – Maximum power transfer theorem – Reciprocity Theorem – Millman's theorem.

UNIT III TRANSIENT RESPONSE ANALYSIS 9

Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. with sinusoidal input – Characterization of two port networks in terms of Z, Y and h parameters.

UNIT IV THREE PHASE CIRCUITS 9

Three phase balanced / unbalanced voltage sources – analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & unbalanced – phasor diagram of voltages and currents – power and power factor measurements in three phase circuits.

UNIT V RESONANCE AND COUPLED CIRCUITS

9

Series and parallel resonance –frequency response – Quality factor and Bandwidth – Self and mutual inductance – Coefficient of coupling Analysis of coupled circuits– Single Tuned circuits.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. To acquire knowledge on Ohm's Law and Kirchhoff 's laws.
2. Ability to determine behavior of the DC and AC circuit by using mesh analysis/ nodal analysis / network theorems.
3. Ability to Compute the transient response of first order and second order systems to step and sinusoidal input.
4. To acquire knowledge on line/ phase voltage and currents of the three-phase circuits.
5. To understand the concepts of the frequency response of series and parallel RLC circuits.

TEXT BOOKS

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, 9th edition, New Delhi, 2020.
2. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, 2019.
3. Allan H. Robbins, Wilhelm C. Miller, "Circuit Analysis Theory and Practice", Cengage Learning India, 2013.

REFERENCE BOOKS

1. Chakrabarti A, "Circuits Theory (Analysis and synthesis), Dhanpat Rai & Sons, New Delhi, 2020.
2. Joseph A. Edminister, Mahmood Nahvi, "Electric circuits", Schaum's series, McGraw-Hill, First Edition, 2019.
3. M E Van Valkenburg, "Network Analysis", Prentice-Hall of India Pvt Ltd, New Delhi, 2015.
4. Richard C. Dorf and James A. Svoboda, "Introduction to Electric Circuits", 7th Edition, John Wiley Sons, Inc. 2018.
5. Sudhakar A and Shyam Mohan SP, "Circuits and Networks Analysis and Synthesis", McGraw Hill , 2015.

MAPPING OF COs WITH POs AND PSOs

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	1	-	-	-	-	-	-	-	-	3	-	1	-	2	-
2	1	-	1	2	-	-	-	-	-	-	-	3	1	-	-	-
3	1	-	1	-	2	-	-	3	-	-	-	-	1	-	2	3
4	1	1	1	-		-	-	-	-	-	3	1	1	1	-	-
5	1	1	-	-	2	-	-	-	-	-	-	-	1	-	-	3
Avg.	1	1	1	2	2	-	-	3	-	-	3	2	1	1	2	3

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

COURSE OBJECTIVES

- 1 To understand the structure, operation and applications of electronic devices.
- 2 To familiarize Characteristics & Small signal Model of BJT.
- 3 To explore the Characteristics & Small signal Model of Field Effect Transistor and Operation of Thyristor.
- 4 To learn the function of Differential amplifier and power.
- 5 To provide adequate knowledge in negative feedback amplifiers and to design RC and LC tuned oscillators for a given frequency.

UNIT I PN JUNCTION DEVICES**9**

PN junction diode – Structure, Operation and V-I characteristics, Diffusion and Transition capacitance - Rectifiers – Half Wave and Full Wave Rectifier – Zener diode - Zener Reverse characteristics – Zener diode as voltage regulator - Display devices- LED, Laser diodes, Photo diode.

UNIT II BJT AND SMALL SIGNAL AMPLIFIERS**9**

BJT - structure, operation of NPN and PNP transistor, Input and output characteristics of CE, CB and CC configurations. Two port Devices and Hybrid Model of BJT for CE, CB and CC configurations - small signal model – Analysis of CE, CB, CC amplifiers.

UNIT III FIELD EFFECT TRANSISTORS AND THYRISTORS**9**

JFET, MOSFET and IGBT - Structure, operation and characteristics - FET small signal model - Analysis of CS,CG and CD amplifier. Thyristor - SCR operation and characteristics, UJT - operation and characteristics.

UNIT IV DIFFERENTIAL AMPLIFIER AND POWER AMPLIFIERS**9**

Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response –Power amplifiers –Types:- Class A, B, AB and C Power amplifiers-Push-Pull amplifiers (Qualitative analysis only).

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS**9**

Advantages of Negative feedback – voltage / current, Series, Shunt feedback – Positive feedback – Condition for oscillations, RC Phase shift, Wien bridge, Hartley, Colpitts and Crystal oscillators.

TOTAL: 45 PERIODS**COURSE OUTCOMES**

- 1 Explain the operation and characteristics of Semiconductor Diodes.
- 2 Formulate the expression for voltage gain, current gain, input resistance and output resistance of BJT CE, CB and CC amplifier using h-parameter model.
- 3 Formulate the expression for voltage gain, input resistance and output resistance of FET amplifier under CS, CG and CD and operation of Thyristor.
- 4 Explain the operation of differential amplifier, single tuned amplifier and power amplifiers.
- 5 Analyze the operation of negative feedback amplifiers and to design RC and LC tuned Oscillators for a given frequency range.

TEXT BOOKS

- 1 David A. Bell, "Electronic devices and circuits", Oxford University higher education, 5th edition 2008.
- 2 Sedra and Smith, "Microelectronic circuits", 8th Ed., Oxford University Press 2020.
- 3 R.S.Sedha, "A textbook of Electronic circuits", S.Chand and Company Ltd.4/, 2010.
- 4 S. Salivahanan, N. Suresh Kumar, "Electronic Devices and Circuits", McGraw Hill Education (India) Private Limited, 4th Edition, 2017.

REFERENCE BOOKS

- 1 Balbir Kumar, Shail.B.Jain, "Electronic devices and circuits" PHI learning private limited, 2nd edition 2014.
- 2 Thomas L.Floyd, "Electronic devices" Conventional current version, Pearson prentice hall, 10th Edition, 2017.

- 3 Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition, 2003.
- 4 Robert Boylestad and Louis Nashelsky., "Electron Device and Circuit Theory" Prentice Hall Private Limited, 11th edition, 2017.
- 5 Jacob Millman, Christos C Halkias, Satyabrata Jit, 'Electronic Devices and circuits', McGraw Hill education, 4th edition, 2015.

MAPPING OF COs WITH POs AND PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	1	1	-	-	-	1		1	-	-	2	3	-
2	3	3	3	3	-	-	-	1		1	-	-	-	3	-
3	3	3	3	3	-	-	-	1		1	-	-	-	2	2
4	2	2	1	1	-	-	-	1		1	-	-	-	3	-
5	3	3	3	2	-	-	-	1		1	-	-	-	2	2
Avg.	2.6	2.6	2.2	2	-	-	-	1		1	-	-	2	2.6	2

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

EI3362	ELECTRICAL AND ELECTRONIC INSTRUMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To introduce the meters used to measure current & voltage.
2. To have an adequate knowledge in the measurement techniques for power and energy, power and energy meters are included.
3. To have an adequate knowledge in the measurement techniques for resistance, inductance and capacitor.
4. To provide knowledge on various types of electronic and digital meters.
5. To provide knowledge on various types of cathode ray oscilloscopes, their applications and different types of signal analyzers.

UNIT I ELECTRICAL MEASUREMENTS 9

General features and Classification of electro mechanical instruments. Principles of Moving coil, moving iron, dynamometer type, rectifier type, thermal instruments. Extension of instrument range: shunt and multipliers, Current transformers and Potential transformers.

UNIT II MEASUREMENT OF POWER 9

Electrodynamic wattmeter's, Low Power Factor (LPF) wattmeter, errors, calibration of wattmeter. Single and three phase power measurement, Hall effect wattmeter, thermal type wattmeter.

UNIT III MEASUREMENT OF RESISTANCE, INDUCTANCE AND CAPACITANCE 9

Low, high and precise resistance measurement, Megger, Ohmmeters, Classical AC bridges: Inductance and capacitance measurements. Detectors in bridge measurement, Wagner earth, transformer ratio bridges.

UNIT IV ELECTRONIC AND DIGITAL MEASUREMENTS 9

Electronic voltmeter, current measurement with electronic instruments, Digital voltmeter, Analog and digital multi-meters, Digital frequency meters. Digital LCR meter, Q-Meter, Digital wattmeter and energy meters. Wave analyzers, Logic

analyser, spectrum analyser – Signal and function generators

UNIT V DISPLAY AND RECORDING INSTRUMENTS

9

DSO, MSO, Function generators, Signal generators, Waveform analyzers, Spectrum analyzers, Distortion analyzers, LED, LCD and Organic LED displays.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Ability to understand the construction and principle of instruments used for electrical measurement.
2. Ability to measure power using different types of wattmeter.
3. Ability to understand the measurement of resistance, inductance and capacitance.
4. Ability to understand various types of signal Analyzers and their applications.
5. Ability to understand various types of cathode ray oscilloscopes and their applications.

TEXTBOOKS

1. E.W. Golding & F.C.Widdis, 'Electrical Measurements & Measuring Instruments', A.H.Wheeler & Co, 2001.
2. H.S. Kalsi, Electronic Instrumentation, McGraw-Hill Education, New Delhi, 2010.
3. A.K. Sawhney, A Course in Electrical & Electronic Measurements & Instrumentation, Dhanpat Rai and Co, New Delhi, 2019.

REFERENCE BOOKS

1. S.K.Singh, 'Industrial Instrumentation and control', Tata McGraw Hill, 2nd edn., 2002.
2. J.B.Gupta, 'A Course in Electronic and Electrical Measurements and Instrumentation', S.K.Kataria & Sons, Delhi, 2003.
3. Martin U. Reissland, 'Electrical Measurement – Fundamental Concepts and Applications', New Age International (P) Ltd., 2001.
4. R.B. Northrop, Introduction to Instrumentation and Measurements, Taylor & Francis, New Delhi, 2008

5. M.M.S. Anand, "Electronics Instruments and Instrumentation Technology", Prentice Hall India, NewDelhi, 2009.
6. J.J.Carr, "Elements of Electronic Instrumentation and Measurement", Pearson Education India, New Delhi, 2011.

MAPPING OF Cos WITH Pos AND PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	1	1	2	2	-	-	-	-	1	-	3	1	-
2	3	3	2	3	2	-	-	-	-	-	-	-	3	1	-
3	3	1	2	3	2	-	-	-	-	-	-	-	2	2	-
4	2	2	3	2	2	-	-	-	-	-	-	-	1	3	-
5	3	3	3	3	3	2	2	1	-	-	-	1	2	3	-
Avg.	2.6	2.2	2.2	2.4	2.2	2	2	1	-	-	1	1	2.2	2	-

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

COURSE OBJECTIVES

1. Get to know the methods of measurement, classification of transducers and to analyze error.
2. To understand the behavior of transducers under static and dynamic conditions and hence to model the transducer.
3. Get exposed to different types of resistive transducers and their application areas.
4. To acquire knowledge on capacitive and inductive transducers.
5. To gain knowledge on variety of transducers and get introduced to MEMS and Smart transducers.

UNIT I SCIENCE OF MEASUREMENTS AND CLASSIFICATION OF 9
TRANSDUCERS

Units and standards, Functional elements of measurement system – Static calibration – Classification of errors, Limiting error and probable error– Error analysis – Statistical methods – Odds and uncertainty – Classification of transducers – Selection of transducers.

UNIT II CHARACTERISTICS OF TRANSDUCERS 9

Static characteristics: accuracy, precision, sensitivity, linearity, resolution, hysteresis, threshold, input impedance, loading effect, range and span. Dynamic characteristics: Mathematical model of transducer – zero, first and second order instruments – impulse, step, ramp and frequency response of the above instruments.

UNIT III RESISTIVE TRANSDUCERS 9

Principle of operation, construction details, characteristics and applications of potentiometer, strain gauge, resistance thermometer, thermistor, photo resistor (LDR), hot-wire anemometer, piezo-resistive sensor and humidity sensor

UNIT IV INDUCTIVE AND CAPACITIVE TRANSDUCERS 9

Inductive transducers: Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer – variable reluctance transducers – Synchros – Microsyn. Capacitive transducers: Principle of operation, construction details, characteristics, different types and applications – capacitor microphone, capacitive pressure sensor, proximity sensor.

UNIT V OTHER SENSORS AND TRANSDUCERS 9

Piezoelectric transducer – Hall Effect transducer – Magneto elastic sensor – Digital transducers – Fiber optic sensors – Smart Sensors – Film sensor, MEMS & Nano Sensors, LASER sensors – Environmental Monitoring sensors for Water Quality and Air pollution

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Ability to apply the mathematical knowledge and science & engineering fundamentals gained to solve problems pertaining to measurement applications.
2. Ability to analyze the problems related to sensors & transducers.
3. Ability to select the right sensor/transducer for a given application.
4. Ability to determine the static and dynamic characteristics of transducers.
5. Ability to understand fiber optic sensor, smart traducers and its applications.

TEXTBOOKS

1. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2019.
2. A.K. Sawhney, A Course in Electrical & Electronic Measurements & Instrumentation, Dhanpat Rai and Co, New Delhi, 2014.

REFERENCE BOOKS

1. Bela G.Liptak, Instrument and Automation Engineers' Handbook, Process Measurement and Analysis, 5th Edition, Vol. 1, ISA/CRC Press, 2016.
2. D. Patranabis, Sensors and Transducers, 2nd edition, Prentice Hall of India, 2011.

3. E.A. John P. Bentley, Principles of Measurement Systems, IV Edition, Pearson Education, 2005
4. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999
5. Neubert H.K.P. Instrument Transducers – An Introduction to their Performance and Design, Oxford University Press, Cambridge, 2003

List of Open-Source Software/ Learning website:

1. <https://nptel.ac.in/courses/108108147>
2. <https://nptel.ac.in/courses/108105064>
3. <https://electronics-tutorials.ws/io/io->

MAPPING OF Cos WITH Pos AND PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
2	-	3	-	-	-	-	-	-	-	-	-	-	1	3	1
3	-	-	1	-	2	3	-	-	-	-	-	1	-	2	2
4	-	-	-	-	2	2	-	-	-	-	-	-	1	3	1
5	-	-	-	1	1	1	-	-	-	-	-	1	-	2	2
Avg.	3	3	1	1	1.7	2	-	-	-	-	-	1	1.7	2.2	1.5

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

ME3366	APPLIED FLUID DYNAMICS AND	L	T	P	C
	THERMODYNAMICS	3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. To make students understand fluids properties and application of orifice and venturimeter.
2. To impart knowledge on the dimensional analysis.
3. To understand the working principle of different types of pumps and its applications.
4. To understand the thermodynamics laws and basic IC engines functions.
5. To understand the properties of steam and application of ranking cycle.

UNIT-I BASIC CONCEPTS OF FLUID MECHANICS & FLOW OF FLUIDS 9

Introduction – classification - types of fluids – properties - laws of pressure - atmospheric, gauge, absolute pressure, pressure measurement – manometers - mechanical gauges. Head of a liquid - Bernoulli's theorem - orifice and venturimeter.

UNIT-II DIMENSIONAL ANALYSIS 9

Introduction – dimensions - dimensional analyses - Rayleigh's and Buckingham's method.

UNIT-III PUMPS AND TURBINES 9

Introduction - types of pumps - reciprocating pump - construction details - co-efficient of discharge – slip - power required - centrifugal pump – classification - working principle – specific speed – turbines – classification – working principle.

UNIT-IV LAWS OF THERMODYNAMICS AND BASIC IC ENGINE CYCLES 9

Systems, Zeroth law, first law of thermodynamics - concept of internal energy and enthalpy - applications of closed and open systems - second law of thermodynamics. Basic IC engine, 2-stroke and 4-stroke engine.

**UNIT-V BASIC STEAM POWER CYCLES, REFRIGERATORS AND
HEAT PUMPS**

9

Properties of steam - Ranking cycle - Brayton cycle - Boilers and its accessories
- Basic thermodynamics of refrigerators and heat pumps.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of this course, the students will be able to:

1. Understand fluids properties and application of orifice and venturimeter.
2. Understand the dimensional analysis.
3. Understand the working principle of different types of pumps and its applications.
4. Understand the thermodynamics laws and basic IC engines functions.
5. Understand the properties of steam and application of ranking cycle and heat pumps.

TEXTBOOKS:

1. Bansal.R.K,'Fluid Mechanics and Hydraulic Machines', Laxmi Publications' (P) Ltd,2018.
2. Nag, P.K., Engineering Thermodynamics, Tata McGraw-Hill Co. Ltd., 2013.

REFERENCE BOOKS:

1. Shames, I.H., 'Mechanics of fluids', Kogakusha, Tokyo, 2013
2. Reynolds, Thermodynamics, Int. Student Edition, McGraw-Hill Co. Ltd., 1990.
3. Ramalingam. K.K, "Thermodynamics", Sci-Tech Publications, 2009.
4. Yunus A. Çengel, Michael A. Boles, Thermodynamics: An Engineering Approach, McGraw- Hill Higher Education, 2014.
5. Sarkar, B.K, "Thermal Engineering", Tata McGraw-Hill Publishers, 2007.

MAPPING OF Cos WITH Pos AND PSOs

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	2	1	-	-	-	-	-	-	-	-	1	1	1	-	-
2	2	2	1	-	-	-	-	-	-	-	-	1	1	1	-	-
3	2	2	1	-	-	-	-	-	-	-	-	1	1	1	-	-
4	2	2	1	-	-	-	-	-	-	-	-	1	1	1	-	-
5	2	2	1	-	-	-	-	-	-	-	-	1	1	1	-	-
Avg.	2	2	1	-	-	-	-	-	-	-	-	1	1	1	-	-

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

EI3364	MEASUREMENTS AND TRANSDUCERS	L	T	P	C
	LABORATORY	0	0	3	1.5

COURSE OBJECTIVES

1. To make the students aware of basic concepts of measurement and operation of different types of transducers.
2. To make the students conscious about static and dynamic characteristics of different types of transducers
3. To make the students to analyze step response of thermistor, RTD and thermocouple.
4. To make the student to measure resistance, inductance and capacitance using bridge circuits.
5. To make the students to calibrate the electrical instruments.

LIST OF EXPERIMENTS

- 1 Determination of characteristics of a potentiometric transducer and LDR.
- 2 Determination of characteristics of Strain gauge and Load cell.
- 3 Determination of characteristics of LVDT and Hall Effect transducer.
- 4 Determination of static and dynamic characteristics of thermocouple.
- 5 Determination of static and dynamic characteristics of thermistor.
- 6 Determination of static and dynamic characteristics of RTD.
- 7 Measurement of Angular displacement using resistive and Capacitive transducer.
- 8 Measurement of temperature using filled system thermometer.
- 9 Measurement of resistance using Wheatstone bridge and Kelvin's double bridge.
- 10 Measurement of inductance using Anderson bridge and capacitance measurement using Schering bridge.
- 11 Calibration of Ammeter and Voltmeter.
- 12 Calibration of wattmeter and Single-phase Energy meter.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Understand the concepts of measurement, error and uncertainty.
2. Understand the static and dynamic characteristics of measuring instruments.
3. Gain knowledge about the principle of operation and characteristics of different types of resistance, capacitance and inductance transducers
4. Acquire knowledge of analyzing different stages of signal conditioning units.
5. Ability to work as a member of a team while carrying out experiments

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

1	Experimental setup for the Measurement of Linear displacement using Potentiometer.	01
2	Experimental setup for Strain gauge and Load cell characterization.	01
3	Experimental setup for LVDT characteristics.	01
4	Experimental setup for Hall Effect characteristics.	01
5	Experimental setup for the Measurement of Angular displacement.	01
6	Experimental setup for Thermistor characteristics.	01
7	Experimental setup for Thermocouple characteristics.	01
8	Experimental setup for RTD characteristics.	01
10	AC –Ammeters.	02
11	AC –Voltmeters.	02
12	Single Phase Wattmeter.	02
13	Single Energy meter.	01
14	Sufficient number of power supply, Galvanometer, Bread board, Multimeter, resistors, Decade Capacitance box, Decade resistance box, Decade Inductance box,CRO.	As Required

MAPPING OF Cos WITH Pos AND PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	-	2	-	2	-	-	-	-	-	-	-	3	1	-
2	-	-	-	-	3	-	-	-	-	-	-	-	2	2	-
3	-	-	-	-	1	2	-	-	-	-	-	-	1	2	2
4	-	-	-	-	1	-	-	-	-	-	-	-	-	3	1
5	-	-	-	-	1	2	-	-	-	-	-	-	2	1	-
Avg.	3	-	2	-	1.6	2	-	-	-	-	-	-	2	1.8	1.5

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

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. To simulate various electric circuits using Pspice/Matlab/e-Sim/Scilab / Ltspice
2. To gain practical experience on electric circuits and verification of theorems.
3. To gain practical experience on frequency response of RC and RLC circuit.
4. To gain practical experience on two port networks.
5. To simulate and gain practical experience on 3 phase balanced circuit.

LIST OF EXPERIMENTS

1. Simulation and experimental verification of electrical circuit problems using Kirchhoff's voltage and current laws.
2. Simulation and experimental verification of electrical circuit problems using Thevenin's theorem.
3. Simulation and experimental verification of electrical circuit problems using Norton's theorem.
4. Simulation and experimental verification of electrical circuit problems using Superposition theorem.
5. Simulation and experimental verification of Maximum Power transfer Theorem.
6. Study of Analog and digital oscilloscopes and measurement of sinusoidal voltage, frequency and power factor.
7. Simulation and Experimental validation of R-C electric circuit transients.
8. Simulation and Experimental validation of frequency response of RLC electric circuit.
9. Design and Simulation of series resonance circuit.
10. Design and Simulation of parallel resonant circuits.
11. Simulation of three phase balanced and unbalanced star, delta networks circuits.
12. Determination of Z and Y parameters of a Two - Port networks.

13. Simulation and experimental verification of Millman's theorem.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Ability to Understand and apply circuit theorems and concepts in engineering applications.
2. Ability to Simulate electric circuits.
3. Ability to understand concept of frequency response of the systems.
4. Ability to understand concept of 3 phase balanced circuit.
5. Ability to concept of 3 phase un-balanced circuit.

REFERENCES

1. Laboratory Manual

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Sl. No.	Description of Equipment	Required numbers (for batch of 30 students)
1.	Regulated Power Supply – 0 – 15 V D.C	10
2.	Function Generator (1 MHz)	10
3.	Single Phase Energy Meter	01
4.	Oscilloscope (20 MHz)	10
5.	Digital Storage Oscilloscope (20 MHz)	01
6.	PC	10
7.	Circuit Simulation Software (e-Sim/ Scilab/ Pspice / MATLAB / other Equivalent software Package)	Min.10 users
8.	Printer	01
9.	AC/DC - Voltmeters	10
10.	Ammeters	10
11.	Multi-meters	10
12.	Single Phase Wattmeter	03
13.	Decade Resistance Box, Decade Inductance Box	6.nos each
14.	Decade Capacitance Box	06

- | | | |
|-----|--|-------------|
| 15. | Circuit Connection Boards | 10 |
| 16. | Resistors, Inductors, Capacitors of various capacities (Quarter Watt to 10 Watt) | As Required |

MAPPING OF COs WITH POs AND PSOs

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1						2		3				1			
2		1			1						2			2	2	
3	1			1			3	2			2			2		3
4		1										3			2	
5			1		1			2	3					3		
Avg.	1	1	1	1	1	-	2.5	2	3	-	2	3	1	2.3	2	3

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

EI3365	ELECTRON DEVICES AND CIRCUITS	L	T	P	C
	LABORATORY	0	0	3	1.5

COURSE OBJECTIVES

1. To understand the behavior of semiconductor devices and rectifiers experimentally.
2. To implement the characteristics of BJT under different configurations.
3. To get familiarized on JFET, SCR and UJT.
4. To design the amplifiers.
5. To develop oscillators.

LIST OF EXPERIMENTS

1. Characteristics of PN Junction diode.
2. Single phase half wave and full wave rectifiers with capacitive filters.
3. Characteristics of Zener diode and Zener as series voltage regulator.
4. Characteristics of photo diode, Study of light activated relay circuit.
5. Characteristics of Bipolar Junction Transistor under common emitter configuration.
6. Characteristics of BJT under common base configuration.
7. Characteristics of JFET.
8. Study the characteristics of SCR.
9. Study the Characteristics of UJT and generation of saw tooth waveforms.
10. Differential amplifiers using FET.
11. Design and testing of Feedback amplifiers (Any one type)
12. Design and testing of RC phase shift, LC oscillators.
13. Simulation of rectifier circuits using SIMULINK.

TOTAL: 45 PERIODS

COURSE OUTCOMES

- 1 Determine the Breakdown voltage, forward and reverse resistance of PN junction diode and Zener diode and calculate the ripple factor of rectifier circuits with filters.
- 2 Analyze the characteristics of BJT under CE and CB configuration.
- 3 Obtain the UJT, SCR and JFET parameters from the characteristics.
- 4 Calculate the gain of differential amplifier using FET.

- 5 Design the RC and LC tuned oscillators for a given oscillating frequency and develop feedback amplifiers.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Sl. No.	Description of Equipment	Required numbers (for batch of 30 students)
1.	Regulated Power Supply – Dual, 0-30V, variable	10
2.	Cathode Ray Oscilloscope, 0-30 MHz	8
3.	Digital Multimeter	10
4.	Function Generator, 0 – 20 MHz	8
5.	Breadboard	10
6.	PN Junction diode – 1N4007	20
7.	Zener diode – FZ5.6 / FZ9	10
8.	Photo diode – S7184	10
9.	BJT – BC107 / BC547	10
10.	JFET – BFW10 / BFW11	10
11.	UJT – 2N2646	10
12.	SCR - 2N2324	10
13.	Step-down transformer – 230V/12-0-12V	10
14.	Capacitors, assorted	10 each
15.	Resistors 1/4W, assorted	10 each
16.	Single-strand wires, different colours	10 each
17.	MATLAB Software	Few Licenses

MAPPING OF COs WITH POs AND PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	-	-	2	-	2	2	1	-	-	2	3	-
2	3	2	1	-	-	2	-	2	2	1	-	-	1	3	-
3	3	2	1	-	-	2	-	2	2	1	-	-	1	2	2
4	3	2	1	-	-	2	-	2	2	1	-	-	-	3	1
5	3	2	1	-	-	2	-	2	2	1	-	-	-	2	2
Avg.	3	2	1	-	-	2	-	2	2	1	-	-	1.3	2.6	1.7

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

SEMESTER IV

MA3423	APPLIED MATHEMATICS FOR ELECTRICAL AND INSTRUMENTATION ENGINEERING	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES

1. To develop the students with ordinary differential equations.
2. To develop the use of ordinary differential equations that is needed by engineers for practical application.
3. To develop an understanding of the standard techniques of complex variable theory in particular analytic function.
4. To develop an understanding of the standard techniques of complex variable theory in conformal mapping.
5. To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.

UNIT I ORDINARY DIFFERENTIAL EQUATIONS 6

Higher order linear differential equations with constant coefficients – Method of variation of parameters.

UNIT II APPLICATION OF ORDINARY DIFFERENTIAL EQUATIONS 6

Solution of ODE related to electric circuits, motion of a particle in a resisting medium and simple harmonic motion.

UNIT III ANALYTIC FUNCTIONS 6

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian coordinates - Properties – Harmonic conjugates – Construction of analytic function.

UNIT IV CONFORMAL MAPPING 6

Conformal mapping – Mapping by functions $w = z+c$, $w = cz$ and $w = 1/z$ – Bilinear transformation.

UNIT V COMPLEX INTEGRATION

6

Cauchy's integral theorem – Cauchy's integral formula – Singularities – Residues – Cauchy's Residue theorem – Applications of circular contour (with poles NOT on real axis).

TOTAL: 30 PERIODS

COURSE OUTCOMES

1. Understand how to solve the given ordinary differential equations.
2. Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
3. To develop an understanding of the standard techniques of complex variable theory in particular analytic function.
4. To familiarize the students with conformal mapping .
5. To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.

TEXTBOOKS

1. Grewal. B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi, 2012.
2. Narayanan.S, ManicavachagomPillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students" Vol. II & III, S. Viswanathan Publishers Pvt. Ltd.1998.

REFERENCE BOOKS

1. Ramana.B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, NewDelhi, 2008.
2. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2007.
4. Ray Wylie. C and Barrett.L.C, "Advanced Engineering Mathematics" Tata McGraw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012

MAPPING OF COs WITH POs AND PSOs

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
2	3	2	1	-	-	-	-	-	-	-	-	1	-	-	-	-
3	3	1	2	1	-	-	-	-	-	-	-	1	-	-	-	-
4	3	2	1	-	-	-	-	-	-	-	-	1	-	-	-	-
5	3	1	1	1	-	-	-	-	-	-	-	1	-	-	-	-
Avg.	3	1.6	1.4	1	-	-	-	-	-	-	-	1	-	-	-	-

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

COURSE OBJECTIVES

1. To impart basic knowledge on different AC& DC Machines.
2. To introduce the concept of special machines to motivate the students to solve complex problems related to machines.
3. To impart knowledge on testing and controlling of different machines.
4. Make the students familiar with the testing and controlling of different machines.
5. To introduce other special machines

UNIT I D.C. MACHINES 9

D.C. Machines: – Principle of operation and construction of motor and generator – EMF and torque equation – Various excitation schemes – Characteristics of Motor and Generator – Starting, Speed control and braking of D.C. Motor.

UNIT II TRANSFORMERS 9

Principle, Construction and Types of Transformer - EMF equation – Equivalent Circuit-Phasor diagrams - Regulation and efficiency of a transformer-Introduction to three phase transformer Connection, Autotransformer.

UNIT III SYNCHRONOUS MACHINES 9

Principle of Operation, types - EMF Equation and Phasor diagrams - Synchronous motor- Starting Methods, Torque equation- V Curves, inverted V curves.

UNIT IV THREE PHASE INDUCTION MOTORS 9

Construction – Production of rotating magnetic field- Principle of operation, Torque-slip characteristics - Starting methods and Speed control of induction motors.

UNIT V SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES 9

Types of single-phase induction motors –Double field revolving theory- Capacitor start motors – Shaded pole motor – Repulsion type motor – Universal motor –

Hysteresis motor - Switched reluctance motor – Brushless D.C motor-Stepper motor-Permanent magnet synchronous motor.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Ability to acquire knowledge to solve problems associated with DC and AC Machines.
2. Ability to test and control different machines based on the familiarity of basic concepts and working principle.
3. Ability to choose appropriate machines for a given application while carrying out projects.
4. Ability to apply the knowledge gained to choose appropriate machines for specific application useful for the society.
5. Ability to know about the latest developments related to machines and to learn their concepts even after the completion of the course.

TEXTBOOKS

1. Fitzgerald A.E, Kingsley C., Umans S. and Umans S.D., “Electric Machinery”, McGraw- Hill, 2017.
2. Theraja, B.L., and Theraja, A.K. “A Textbook of Electrical Technology”, Vol.II, S.C Chand and Co., New Delhi, 2007.

REFERENCE BOOKS

1. Abhijit Chakrabarti and Sudipta Debnath, “Electrical Machines”, McGraw- Hill Education, 2015.
2. Deshpande M. V., “Electrical Machines” PHI Learning Pvt. Ltd., New Delhi, 2011
3. B.S.Guru and H.R.Hiziroglu, “Electric Machinery and Transformer’, Oxford university Press 2007.
4. Del Toro V., “Electrical Engineering Fundamentals”, Prentice Hall of India, New Delhi, 1995.
5. Nagrath I. J and Kothari D. P. ‘Electric Machines’, Fourth Edition, McGraw Hill Education, 2010.
6. C.A.Gross, “Electric Machines”, CRC Press 2010.

7. NPTEL Video Lecture series on “Electrical Machines I” and “Electrical Machines II” by Dr. Krishna Vasudevan, IIT Madras.

MAPPING OF COs WITH POs AND PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	-	-	-	-	-	-	-	-	-	1	1	1	2
2	3	3	2	2	-	-	-	-	-	-	-	1	2	1	2
3	3	3	1	2	-	-	-	-	-	-	-	1	1	2	2
4	3	3	1	2	-	-	-	-	-	-	-	1	-	1	2
5	3	3	1	2	-	-	-	-	-	-	-	1	-	2	2
Avg.	3	3	1.3	2	-	-	-	-	-	-	-	1	1.3	1.4	2

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

COURSE OBJECTIVES

1. To introduce the fundamentals of combinational and sequential digital circuits.
2. To study various number systems and to simplify the mathematical expressions using Boolean functions word problems.
3. To study implementation of combinational circuits using Gates` and MSI Devices.
4. To study the design of various synchronous and asynchronous circuits.
5. To introduce digital simulation techniques for development of application oriented logic Circuit.

UNIT I NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES 9

Number system, error detection, corrections & codes conversions, Boolean algebra: DeMorgan's theorem, switching functions and minimization using K-maps & Quine McCluskey method – Digital Logic Families -comparison of RTL, DTL, TTL, ECL and MOS families -operation, characteristics of digital logic family.

UNIT II COMBINATIONAL CIRCUITS 9

Combinational logic – representation of logic functions-SOP and POS forms, K-map representations – minimization using K maps – simplification and implementation of combinational logic – multiplexers and de multiplexers – code converters, adders, subtractors, Encoders and Decoders.

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Sequential logic- SR, JK, D and T flip flops – level triggering and edge triggering – counters -asynchronous and synchronous type – Modulo counters – Shift registers – design of synchronous sequential circuits –Up-Down Counters, Ripple counter, state diagram; state reduction; state assignment with examples.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABILITY LOGIC DEVICES 9

Transition stability, flow stability-race conditions, hazards & errors in digital circuits;

analysis of asynchronous sequential logic circuits introduction to Programmability
Logic Devices: PROM – PLA –PAL, CPLD-FPGA.

UNIT V VHDL

9

RTL Design – combinational logic – Sequential circuit – Operators – Introduction to Packages – Subprograms – Test bench. (Simulation /Tutorial Examples: adders, counters, flip flops, Multiplexers & De multiplexers).

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Explain various number systems and characteristics of digital logic families.
2. Apply K-maps and Quine McCluskey methods to simplify the given Boolean Expressions and to explain the implementation of various combinational logic circuits.
3. Design of various synchronous logic circuits using Flip Flops
4. Explain asynchronous sequential circuits and programmable logic devices.
5. Use VHDL for simulating and testing RTL, combinatorial and sequential circuits.

TEXT BOOKS

1. Morris Mano.M, 'Digital Logic and Computer Design', Prentice Hall of India, 3rdEdition, 2005.
2. Donald D.Givone, 'Digital Principles and Design', Tata McGraw Hill,1st Edition, 2003.
3. Thomas L Floyd, 'Digital fundamentals', Pearson Education Limited, 11th Edition, 2018.

REFERENCE BOOKS

1. Tocci R.J., Neal S. Widmer, 'Digital Systems: Principles and Applications', Pearson Education Asia, 12th Edition, 2017
2. Donald P Leach, Albert Paul Malvino, Goutam Sha, 'Digital Principles and Applications', Tata McGraw Hill, 7th Edition, 2010.

MAPPING OF Cos WITH Pos AND PSOs

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	1	3	-	-	-	-	-	-	1	3	-	1	-
2	3	3	3	1	3	-	-	-	-	-	-	1	3	-	1	-
3	3	3	3	1	3	-	-	-	-	-	-	1	3	-	1	-
4	3	3	3	1	3	-	-	-	-	-	-	1	3	-	1	-
5	3	3	3	1	3	-	-	-	-	-	-	1	3	-	1	-
Avg.	3	3	3	1	3	-	-	-	-	-	-	1	3	-	1	-

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

EI3463	ELECTRONICS FOR ANALOG SIGNAL	L	T	P	C
	PROCESSING	3	0	0	3

COURSE OBJECTIVES

1. To introduce characteristics of operational amplifiers.
2. To impart knowledge on applications of operational amplifiers.
3. To study about comparators and waveform generators.
4. To educate on signal converter circuits.
5. To introduce various special ICs.

UNIT I OPERATIONAL AMPLIFIER CHARACTERISTICS 9

Introduction to Fabrication of integrated circuits, Functional block diagram and operation of Op-amp, Ideal Characteristics of Op-amp, DC Characteristics: Input bias current, Input offset current, Input offset voltage and Thermal drift, AC Characteristics: Frequency response, stability, frequency compensation, slew rate and methods of improving slew rate.

UNIT II APPLICATIONS OF OPAMP 9

Basic operation of Inverting and Non Inverting amplifiers, Voltage follower, Adder, Subtractor, Integrator, Differentiator, Instrumentation amplifier and its applications for transducer Bridge, Differential amplifier, Voltage to current and Current to voltage converters, clippers, clampers, peak detector, Precision rectifier, Sample and hold circuits.

UNIT III COMPARATORS AND WAVEFORM GENERATORS 9

Analog multiplier & Divider, first and second order active filters, Basic operation and applications of Comparator, Schmitt trigger, waveform generators, ICL 8038 function generator IC, Monostable, Astable and Bistable Multivibrators, Log and Antilog amplifier.

UNIT IV SIGNAL CONVERTERS 9

Need for D-A&A – D converter, D-A converter: Weighted resistor, R-2R ladder, and inverted R-2R types. A – D converter: Flash, Counter, Servo tracking, Successive

approximation, Dual slope types. DAC and ADC performance characteristics, examples of ADC, DAC IC's.

UNIT V SPECIAL ICs

9

Functional block, characteristics of 555 Timer and its PWM application - IC-566 voltage controlled oscillator IC; 565-phase locked loop IC, IC voltage regulators – LM78XX, LM79XX; Fixed voltage regulators its application as Linear power supply - LM317, 723 Variable voltage regulators, switching regulator- SMPS.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Acquire the knowledge in IC fabrication procedure and characteristics of operational amplifier
2. Analyze operational amplifier circuits and communicate the results effectively
3. Design circuits using operational amplifier and simulate them using software tools
4. Work effectively in a team and implement circuits using operational amplifier.
5. Recognize and acquire knowledge on the converters based on applications

TEXTBOOKS

1. Ramkant A Gayakwad, "Op-Amps and Linear Integrated Circuits" Prentice Hall of India, Fourth Edition, 2009
2. Robert F Coughlin, Frederick F Driscoll, "Operational amplifiers and Integrated Circuits" fourth edition Pearson India, 2009

REFERENCE BOOKS

1. William D Stanely, "Operational Amplifiers with Linear Integrated Circuits" Pearson Education, Fourth Edition, 2009.
2. Albert Malvino, David Bates, "Electronic Principles" Tata McGraw Hill, Seventh Edition, 2008
3. Roy D Choudhary&Shail B Jain, "Linear Integrated circuits", New age international publishers, 5 th edition, 2018

MAPPING OF COs WITH POs AND PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	1	1	-	-	-	-	-	-	-	2	3	-
2	-	-	-	-	3	-	-	-	1	-	1	1	2	3	-
3	-	-	-	-	2	-	-	-	1	-	1	1	1	3	1
4	2	2	-	-	-	-	-	-	-	-	-	-	-	3	1
5	2	2	-	-	-	-	-	-	-	-	-	-	-	2	2
Avg.	2.3	2	3	1	2	-	-	-	1	-	1	1	1.7	2.8	1.3

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

COURSE OBJECTIVES

1. To understand the use of transfer function models for analysis physical systems and introduce the control system components.
2. To provide adequate knowledge in the time response of systems and steady state error analysis.
3. To accord basic knowledge in obtaining the open loop and closed-loop frequency responses of systems.
4. To introduce stability analysis for systems design of Compensator.
5. State variable representation of physical systems.

UNIT I	SYSTEMS AND REPRESENTATION	9
---------------	-----------------------------------	----------

Basic elements in control systems: – Open and closed loop systems – Electrical analogy of mechanical system– Transfer function – AC and DC servomotors - Synchro – Block diagram reduction techniques – Signal flow graphs.

UNIT II TIME RESPONSE 9

Time response: – Time domain specifications – Types of test input – I and II order system response – Error coefficients – Generalized error series – Steady state error – Effects of P, PI, PID modes of feedback control – Time response analysis.

UNIT III FREQUENCY RESPONSE 9

Frequency response: – Bode plot – Polar plot – Determination of closed loop response from open loop response - Correlation between frequency domain and time domain specifications.

UNIT IV STABILITY 9

Characteristics equation – Location of roots in S plane for stability – Routh Hurwitz criterion – Root locus construction – Effect of pole, zero addition – Gain margin and phase margin – Nyquist stability criterion. Design of Compensators using Bode plots.

UNIT V STATE VARIABLE ANALYSIS

9

Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and observability.

TOTAL : 45 PERIODS

COURSE OUTCOMES

1. To represent and develop systems in different forms using the knowledge gained.
2. To analyses the system in time and frequency domain.
3. To discuss the effect of PID controller in closed loop systems.
4. To analyses the stability of physical systems and construct compensator for the linear systems.
5. Ability to design State variable representation of physical systems.

TEXT BOOKS:

1. I.J. Nagrath and M. Gopal, 'Control Systems Engineering', New Age International Publishers, 2021.
2. Benjamin C. Kuo, "Automatic Control systems", Wiley, 2014.
3. NagoorKaniA, "Control Systems Engineering", CBS Publishers and distributors, 2017.

REFERENCES:

1. M.Gopal, "Control System: Principle and design", McGraw Hill Education, 2012.
2. Katsuhiko Ogata, "Modern Control Engineering", Pearson, 2015.
3. Norman S. Nise, Control Systems Engineering, 4th Edition, John Wiley, New Delhi, 2007.
4. Samarajit Ghosh, Control systems, Pearson Education, New Delhi, 2017.

MAPPING OF COs WITH POs AND PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	2	-	-	-	2	-	-	-	-	2	2
2	3	3	2	3	2	-	-	-	2	-	-	-	-	2	3
3	3	3	3	3	2	-	-	-	2	-	-	1	-	1	3
4	3	3	3	3	3	-	-	-	2	-	-	1	-	2	3
5	3	3	3	3	3	-	-	-	2	-	-	1	-	3	3
Avg.	3	3	2.6	2.8	2.4	-	-	-	2	-	-	1	-	2	2.8

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

EI3465	MICROPROCEESORS AND MICROCONTROLLERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

To impart knowledge on the following Topics

1. Architecture of μ P8085 & μ C8051
2. Architecture of μ P8086
3. Addressing modes & instruction set of 8085 & 8051.
4. Need & use of Interrupt structure 8085 & 8051.
5. Simple applications development with programming 8085 & 8051.

UNIT I 8085 and 8086PROCESSOR 9

Hardware Architecture, pin-outs–Functional Building Blocks of Processor–Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts – 8086 Processor (Architecture only).

UNIT II PROGRAMMING OF 8085 PROCESSOR 9

Instruction -format and addressing modes – Assembly language format – Data transfer, data manipulation & control instructions – Programming: Loop structure with counting & Indexing –Lookup tability -Subroutine instructions-stack.

UNIT III 8051 MICRO CONTROLLER 9

Hardware Architecture, pin-outs–Functional Building Blocks of Processor–Memory organization – I/O ports and data transfer concepts – Timing Diagram–Interrupts-Data Transfer, Manipulation, Control Algorithms & I/O instructions, Comparison to Programming concepts with 8085.

UNIT IV PERIPHERAL INTERFACING 9

Study on need, Architecture, configuration and interfacing, with ICs: 8255, 8259, 8254, 8279, - A/D and D/A converters & Interfacing with 8085& 8051.

Simple programming exercises – keyboard and display interface–Control of servomotor & stepper motor control-Application to automation systems. PIC and ARM processors.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Ability to acquire knowledge in Addressing modes & instructions set of 8085 & 8051.
2. Ability to need & use of Interrupt structure 8085 & 8051.
3. Ability to understand the importance of Interfacing.
4. Ability to explain the architecture of Microprocessor and Microcontroller and its applications.
5. Ability to write the assembly language program.

TEXTBOOKS

1. Sunil Mathur & Jeebananda Panda, “Microprocessor and Microcontrollers”, PHI Learning Pvt.Ltd, 2016.
2. R.S.Gaonkar, “Microprocessor Architecture Programming and Application, with 8085 ”, Wiley Eastern Ltd., New Delhi, 2013.
3. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely, “The 8051 Micro Controller and Embedded Systems”, 2/e Pearson Education, 5th Indian reprint, 2012.

REFERENCE BOOKS

1. Krishna Kant, “Microprocessor and Microcontrollers”, Eastern Company Edition, PrenticeHall of India, 2nd Edition New Delhi, 2014.
2. B.RAM, “Computer Fundamentals Architecture and Organization” New Age International Private Limited, Fifth edition, 2017.
3. Sumitra Kumar Mandal, “Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085, 8086, 8051” , McGrawHill Edu, 2013.
4. Ajay V. Deshmukh, “Microcontroller Theory & Applications”, McGraw Hill Edu, 2016.

5. Douglas V.Hall, "Microprocessor and Interfacing", McGrawHillEdu, 2016.
6. Myke Predko, "Programming and customizing the PIC microcontroller", McGraw-Hill Education, 2008.

MAPPING OF COs WITH POs AND PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	2	2	-	-	-	2	-	-	-	-	3	1
2	3	2	2	1	1	-	2	-	1	-	2	-	-	2	2
3	3	2	1	1	3	-	-	-	3	-	2	2	-	2	3
4	1	2	2	3	3	-	-	-	-	-	3	1	-	2	2
5	1	2	1	2	3	-	-	-	-	-	1	2	-	3	1
Avg.	2.2	2.2	1.8	1.8	2.4	-	2	-	2	-	2	1.7	-	2.4	1.8

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

GE3451	NCC Credit Course Level – I	L	T	P	C
	(Common to Army, Navy & Air)	3	0	0	3

COURSE OBJECTIVES

1. To know the basic structure of NCC and Role of NCC
2. To improve the cadet's personality skill and leadership quality
3. To make the interest of cadets to involve in social activities
4. Preventing the potential damage and suffering
5. to destruction of the enemy's ability to fight and will to fight

UNIT I Introduction to NCC 9

Aims, Objectives & Organization of NCC, Incentives, Duties of NCC Cadet, NCC Camps and Types National Integration: Importance & Necessity, Factors Affecting National Integration, Unity in Diversity & Role of NCC in Nation Building, Threats to National Security.

UNIT II Personality Development 9

Personal Transformation, Personal Productivity Skills - time management, organizational and planning skills, problem solving and decision-making abilities, basics of psychology, Leadership, Meditation.

UNIT III Social Service and Community Development 9

Basics, Rural Development Programmes, NGOs, Contribution of Youth, Protection of Children and Women Safety, Road / Rail Travel Safety, New Initiatives, Cyber and Mobile Security Awareness..

UNIT IV Disaster Managements and its Awareness 9

Importance of Hazards and Disaster, Types of disasters, Earthquakes and its types, flood types and its management, landside and its managements case studies of disasters in Sikkim, Training and drills for disaster preparedness, Awareness generation program, Usages of GIS and Remote sensing techniques in disaster management.

UNIT V War and Peace in Contemporary World

9

Conceptual framework of War and Peace, Concepts of theories and approaches, Modern /war fare: Conventional, nuclear, Guerilla and Irregular Warfare, Limited and Specialized Warfare with reference to mountain, desert and jungle warfare, terrorism as a new mode of conflict, War as an Economic Problem, Defence and Development, Defence and Development, Defence and Development

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

1. Understand their roles and responsibilities
2. Demonstrate the knowledge of human values and morals
3. Actively participate in social service and development activities
4. Understand the importance of disaster management
5. Analyse the issues related to war and its effects.

TEXTBOOKS

1. R. Gupta's NCC Handbook of NCC Cadets 'A', 'B' and 'C' certificate Examinations

REFERENCE BOOKS

1. V. B. RAO, Personality Development and Soft Skills, BS Publications.
2. Harish K. Gupta, Disaster Management, Universities press.

EI3466	ELECTRICAL MACHINES AND CONTROL	L	T	P	C
	SYSTEMS LABORATORY	0	0	4	2

COURSE OBJECTIVES

1. To expose the students to the operation of D.C. machines.
2. To expose the students to the operation of transformers.
3. To expose the students to the operation of generators and induction motors.
4. To impart knowledge about modeling of the system and the design of controllers.
5. To understand the performance of the system.

LIST OF EXPERIMENTS

1. Determination of Open circuit and Load characteristics of a self-excited D.C. shunt generator.
2. Load test on DC shunt motor.
3. Load test on DC series motor.
4. Load test on single phase induction motor.
5. Load test on single phase transformer.
6. Speed control of DC shunt motor.
7. Determination of Transfer function of DC motor.
8. Study of characteristics of Synchros.
9. Determination of time and frequency responses of a Second order system.
10. Stability analysis of LTI system.
11. Design, Analysis and implementation of lag, lead and lag-lead compensators.
12. Effect of P, PD, PI, PID controller on a second order system (open loop stable and open loop unstable system).

TOTAL : 60 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the:

1. To understand and analyze DC Machine.
2. To understand and analyze AC Machine.
3. To identify the model of the system using various techniques.

4. To design and implementation of control techniques for various control application.
5. To obtain the performance of the system.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

1. DC Shunt Motor with Loading Arrangement – 3 nos
2. Single Phase Transformer – 4 nos
3. DC Series Motor with Loading Arrangement – 1 No.
4. Single Phase Induction Motor with Loading Arrangement – 1 No.
5. DC Shunt Motor Coupled With DC Shunt Generator – 1 No.
6. Tachometer -Digital/Analog – 8 nos
7. Single Phase Auto Transformer – 2 nos
8. Single Phase Resistive Loading Bank – 2 nos
9. SPST switch – 2 nos
10. DC Motor Transfer Function Module-2nos
11. Synchro Transmitter and Receive module – 2nos

MAPPING OF COs WITH POs AND PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	1	1	1	-	-	-	-	-	1	2	1	3
2	3	3	2	2	1	1	-	-	-	-	-	1	2	1	3
3	3	3	3	2	3	2	-	-	-	-	-	1	1	2	3
4	3	3	3	2	3	2	-	-	-	-	-	1	-	3	3
5	3	3	2	1	3	-	-	-	-	-	-	1	2	1	3
Avg.	3	3	2.4	1.6	2.2	1.5	-	-	-	-	-	1	1.8	1.6	3.0

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

EI3467	LINEAR AND DIGITAL INTEGRATED CIRCUITS	L	T	P	C
	LABORATORY	0	0	3	1.5

COURSE OBJECTIVES

1. To learn design, testing and characterizing of various combinational logic circuits.
2. To learn design, testing and characterizing of applications like Mux, Demux, Encoder and Decoder circuits.
3. To learn design, testing and characterizing of Synchronous and Asynchronous digital circuits.
4. To learn design, testing and characterizing of circuit behavior with analog ICs.
5. To study about working of 566 IC and LM 317 IC

LIST OF EXPERIMENTS

- 1 Design and implementation of adder, subtractor. (2 bit, 3 bit)
- 2 Design and implementation of Code converters: Excess-3 to BCD and Binary to Gray code converter and vice-versa
- 3 Design and implementation of Parity generator and parity checking
- 4 Design and implementation of Encoders and Decoders
- 5 Design and implementation of Mux and Demux (4:1)
- 6 Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO
- 7 Design and implementation of 3-bit modulo counters. (Synchronous /Asynchronous)
- 8 Application of Op-Amp: inverting and non-inverting amplifier, Adder, Subtractor.
- 9 Design and implementation of comparator, Integrator and Differentiator using opamp.
- 10 Astable, Monostable operation of Timer IC NE/SE 555 timer.
- 11 Voltage to frequency characteristics of NE/ SE 566 IC.
- 12 Variable Voltage Regulator using IC LM317.

TOTAL : 45 PERIODS

COURSEOUTCOMES

1. Ability to understand and implement combinational circuits Functions.
2. Ability to understand the importance of encoders, decoders, multiplexers and demultiplexers
3. Ability to Design and implement sequential circuits
4. Ability to acquire knowledge on Application of Op-Amp
5. Ability to Design and implement voltage regulators.
6. Ability to acquire knowledge on Application of timer and PLL

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

S.No	Name of the equipments / Components	Quantity Required
1	Dual ,(0-30V) variability Power Supply	10
2	CRO	9
3	Digital Multimeter	10
4	Function Generator	8
5	IC Tester (Analog)	2
6	Bread board	10
7	Computer (PSPICE installed)	1

Consumabilitys (sufficient quantity)

- 1 IC 741/ IC NE555/566/565
- 2 Digital IC types
- 3 LED
- 4 LM317
- 5 LM723
- 6 ICSG3524 / SG3525
- 7 Transistor – 2N3391
- 8 Diodes, IN4001, BY126

- 9 Zener diodes
- 10 Potentiometer
- 11 Step-down transformer 230V/12-0-12V
- 12 Capacitor
- 13 Resistors 1/4 Watt Assorted
- 14 Single Strand Wire

MAPPING OF COs WITH POs AND PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	2	3	3	3	-	-	-	1	1	-	1	-	3	1
2	-	1	3	3	-	-	-	-	1	1	-	-	-	3	1
3	-	-	3	3	-	-	-	-	-	-	-	-	-	2	3
4	1	-	2	-	-	-	-	-	-	1	-	-	-	3	1
5	1	-	-	-	-	-	-	1	-	1	-	-	-	3	1
6	-	1	3	3	-	-	-	-	1	-	-	-	-	2	3
Avg.	1	1.3	2.8	3	3	-	-	1	1	1	-	1	-	2.7	1.7

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

EI3468	MICROPROCESSORS AND	L	T	P	C
	MICROCONTROLLERS LABORATORY	0	0	3	1.5

COURSE OBJECTIVES

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

1. To provide training on programming of microprocessors
2. To provide training on programming of microcontrollers
3. To provide training on interfacing peripherals with microprocessors.
4. To provide training on interfacing peripherals with microcontrollers
5. To provide training on interfacing I/O devices with arduino/raspberry pi development boards.

LIST OF EXPERIMENTS: 8 Bit Microprocessor (Hardware/ simulation software)

- 1 Simple arithmetic operations: addition/ subtraction/ multiplication/ division.
- 2 Programming with control instructions:
 - a. Ascending/Descending order, Maximum/Minimum of numbers.
 - b. Programs using Rotate instructions.
 - c. Hex/ASCII/BCD code conversions.
- 3 Interface Experiments: with 8085
- 4 Traffic light controller.
- 5 I/O Port/ Serial communication
- 6 Read a key, interface display

8-Bit Microcontroller (Hardware/ simulation software)

- 7 Demonstration of basic instructions with 8051 Micro controller execution, including:
 - (i) Conditional jumps & looping
 - (ii) Calling subroutines.

- 8 Programming I/O Port and timer of 8051
- (i) Study on interface with A/D & D/A
- (ii) Study on interface with DC & AC motors
- 9 Application hardware development using embedded processors.
- 10 Interfacing of LEDs and sensor with arduino/raspberry pi modules.

TOTAL : 45 PERIODS

COURSE OUTCOMES

1. Understand programming logics for code conversion and arithmetic operations.
2. Perform interfacing of A/D and D/A converters and also speed control of DC and AC motor
3. Understand the basics of serial communication with microprocessors and microcontrollers
4. Perform LED and sensor interfacing with development board
5. Understand and apply computing platform and software for engineering problems.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

Sl.No.	Description of Equipment	Quantity required
1	8085 Microprocessor Trainer with Power Supply	15
2	8051 MicroController Trainer Kit with power Supply	15
3	8255 Interface boards	5
4	8251 Interface boards	5
5	8259 Interface boards	5
6	8279 Keyboard/ Display Interface boards	5
7	8254 timer/counters	5
8	ADC and DAC cards	5

- 9 AC & DC motor with Controllers
- 10 Traffic Light Control Systems
- 11 Arduino/Raspberry pi development board
- 12 Sensor(Temperature/Humidity)

MAPPING OF COs WITH POs AND PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	3	-	3	-	-	-	2	-	-	-	-	3	1
2	2	2	3	2	3	-	-	-	2	-	-	2	-	2	3
3	2	-	3	-	3	2	-	-	-	-	-	-	-	3	1
4	2	1	3	-	3	-	-	-	-	-	-	-	-	2	3
5	2	1	3	2	3	2	-	-	-	3	-	2	-	2	2
Avg.	2	1.5	3	2	3	2	-	-	2	3	-	2	-	2.3	2.2

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

SEMESTER V

EI3561	INDUSTRIAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the measurement techniques of viscosity, humidity and moisture
- To introduce the measurement of temperature and pressure.
- To introduce the flow measurement techniques.
- To introduce the electrical flow measurement techniques.
- To introduce the level measurement techniques and transmitters.

UNIT-I MEASUREMENT OF VISCOSITY, HUMIDITY, MOISTURE, 9 **FORCE, TORQUE AND SPEED.**

Viscosity: Saybolt viscometer - Rotameter type and Torque type viscometers. Humidity: Dry and wet bulb psychrometers – Resistive and capacitive type hygrometers – Dew cell – Commercial type dew meter. Moisture: Different methods of moisture measurements – Thermal, Conductivity and Capacitive sensors, Microwave, IR and NMR sensors, Application of moisture measurement - Moisture measurement in solids. Different types of load cells: Hydraulic, Pneumatic, Strain gauge, Magneto-elastic and Piezoelectric load cells - Different methods of torque measurement: Strain gauge, Relative angular twist. Speed measurement: Capacitive tacho, Drag cup type tacho, and D.C and A.C tacho generators - Stroboscope.

UNIT-II TEMPERATURE MEASUREMENT 9

Units of Temperature – Different types of filled in system thermometers – Bimetallic thermometers - IC sensors – Thermocouples, Signal conditioning for thermocouple, Commercial circuits for cold junction compensation, Special techniques for measuring high temperature using thermocouple – Radiation methods of temperature measurement – Total radiation pyrometers – Optical pyrometers – Fiber optic sensor for temperature measurement – Thermograph – Temperature sensor selection.

UNIT-III FLOW MEASUREMENT**9**

Units of Flow - Orifice plate: different types of orifice plates – Cd variation – pressure tapping– Venturi tube – Flow nozzle – Dall tube – Pitot tube, Installation and applications of head flowmeters, Positive displacement flow meters, Rotameter – theory, characteristics, installation and applications, Mass flow meter, Calibration of flow meters: – Dynamic weighing method - Electrical type flow meters Principle and constructional details of Electromagnetic flow meter – Ultrasonic flow meters – Laser Doppler anemometer – Vortex shedding flow meter – Target flow meter – Guidelines for selection of flow meter – Open channel flow measurement – Solid flow rate measurement.

UNIT-IV PRESSURE MEASUREMENT**9**

Units of pressure – Manometers: Different types, Elastic type pressure gauges: Bourdon tube, Bellows, Diaphragms and Capsules – Electrical methods: Elastic elements with LVDT and strain gauges – Capacitive type pressure gauge – Piezo resistive pressure sensor-Resonator pressure sensor – Measurement of vacuum: McLeod gauge, Thermal conductivity gauge, Ionization gauges, Cold cathode type and hot cathode type – Pressure gauge selection, installation and calibration using dead weight tester. Pressure Transmitter: Conventional and Smart transmitter- Elevation and suppression.

UNIT-V LEVEL MEASUREMENT AND TRANSMITTER**9**

Units of Level: Float gauges - Displacer type, Ultrasonic gauge – Boiler drum level measurement :– Differential pressure method and Hydra step method - Solid level measurement, Operation of Electronics and Smart transmitters – Principle of operation of flow, level, temperature and pressure transmitters.

TOTAL : 45 PERIODS**COURSE OUTCOMES:**

- Understand Principles and working of Viscosity, Humidity, Moisture, temperature, pressure, flow and level measuring Instruments.
- Calibrate temperature, flow, level and Pressure measuring devices.
- Apply measurement of Viscosity, Humidity, Moisture, temperature, pressure, flow and level in Industrial Applications.

- Select and install Industrial instruments for various applications.
- Understand various Electrical type Industrial Instruments.

TEXT BOOKS:

1. Doebelin, E.O. and Manik, D.N., “Measurement systems Application and Design”, 6th McGraw- Hill Education Pvt. Ltd, 2011.
2. A.K. Sawhney and Puneet Sawhney, “Mechanical Measurements and Instrumentation and Control”, Dhanpat Rai & Co. (P) Limited, 2015.

REFERENCE BOOKS:

1. Liptak, B.G., “Instrumentation Engineers Handbook (Measurement)”, CRC Press, 2005
2. Patranabis, D., “Principles of Industrial Instrumentation”, 3rd Edition, McGraw-Hill Education, 2017.
3. Eckman D.P., “Industrial Instrumentation”, Wiley Eastern Limited, 1990.
4. Singh, S.K., “Industrial Instrumentation and Control”, Tata Mc-Graw-Hill Education Pvt. Ltd., New Delhi, 2009.
5. <https://swayam.gov.in/> Principles of Industrial Engineering.
6. Alok Barua, “Lecture Notes on Industrial Instrumentation”, NPTEL, E-Learning Course, IIT Kharagpur.
7. Jayashankar, V., “Lecture Notes on Industrial Instrumentation”, NPTEL, E-Learning Course, IIT Madras.

MAPPING OF COs WITH POs AND PSOs

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	2	2	-	-	-	1	-	-	-	3	2	1
2	3	2	2	2	1	-	-	-	1	-	-	-	3	2	1
3	3	2	3	2	2	-	-	-	2	-	-	-	3	2	2
4	3	2	3	2	3	-	-	-	2	-	-	1	3	2	3
5	3	2	2	2	2	-	-	-	1	-	-	1	2	2	2
Avg.	3.0	2.0	2.4	2.0	2.0	-	-	-	1.4	-	-	0.4	2.8	2.0	1.8

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

EC3568	DISCRETE TIME SYSTEMS AND SIGNAL	L	T	P	C
	PROCESSING	3	0	0	3

COURSE OBJECTIVES:

- To introduce the concept of analyzing discrete time signals & systems in the time and frequency domain through mathematical representation.
- To analyze the various time to frequency domain transformation techniques.
- To Explained to Understand the computation algorithmic steps for Fourier Transform.
- To study about filters and their design for digital implementation.
- To understand the programmable digital signal processor & its application.
- To Introduce various processors and formats in digital signal processors.

UNIT-I INTRODUCTION 9

Classification of systems: Continuous, discrete, linear, causal, stable, dynamic, recursive, time variance - Classification of signals: continuous and discrete, energy and power-Mathematical representation of signals -Spectral density- Sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect -Digital signal representation.

UNIT-II DISCRETE TIME SYSTEM ANALYSIS 9

Z-transform and its properties, inverse z-transforms; difference equation – Solution by z-transform, application to discrete systems - Stability analysis, frequency response – Convolution –Introduction to Fourier Transform– Discrete time Fourier transform.

UNIT-III DISCRETE FOURIER TRANSFORM AND COMPUTATION 9

DFT properties, magnitude and phase representation - Computation of DFT using FFT algorithm –DIT & DIF - FFT using radix 2 – Butterfly structure.

UNIT-IV DESIGN OF DIGITAL FILTERS 9

FIR & IIR filter realization – Parallel & cascade forms. FIR design: Windowing Techniques – Need and choice of windows – Linear phase characteristics. IIR design: Analog filter design – Butterworth and Chebyshev approximations; digital

design using impulse invariant and bilinear transformation -Warping, pre warping - Frequency transformation.

UNIT-V DIGITAL SIGNAL PROCESSORS 9

Introduction – Architecture of DSP processor– Features – Addressing Formats– Functional modes - Introduction to Commercial Processors.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student will be able to

- Explain the concepts of digital signal processing
- Illustrate the system representation using transforms.
- Learn the transformation techniques for time to frequency conversion.
- Design suitable digital FIR, IIR algorithm for the given specification.
- Analyze the architecture and addressing formats of digital signal processors.

TEXT BOOKS:

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, 4th Edition 2007.
2. Robert J.Schilling & Sandra L.Harris , ' Introduction to Digital Signal Processing using MATLAB', Cengage Learning, 2nd Edition 2013.

REFERENCE BOOKS:

1. Emmanuel C Ifeakor and Barrie W Jervis , "Digital Signal Processing – A Practical approach" Pearson Education, Second edition, 2002.
2. Alan V. Oppenheim, Ronald W. Schaffer and John R. Buck, 'Discrete – Time Signal Processing', Pearson Education, New Delhi, 2nd Edition 2012.
3. SenM.kuo, Woonseng...s.gan, "Digital Signal Processors, Architecture, Implementations & Applications, Pearson, 1st Edition 2004.
4. S.K. Mitra, 'Digital Signal Processing – A Computer Based Approach', Tata McGraw Hill, New Delhi, 4th Edition 2013.
5. B. Venkataramani, M. Bhaskar, 'Digital Signal Processors, Architecture, Programming and Applications', Tata McGraw Hill, New Delhi, 2003, 1st Edition.

MAPPING OF COs WITH POs AND PSOs:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	3	2	2	1	-	-	-	-	-	-	-	1	2	-
2	2	3	3	2	2	-	-	-	-	-	-	-	2	3	-
3	3	3	3	3	3	-	-	-	-	-	-	-	2	2	-
4	3	3	3	3	3	-	-	-	-	-	-	-	3	2	-
5	3	2	3	2	1	-	-	-	1	-	-	-	2	2	-
Avg.	3	3	3	2	3	-	-	-	1	-	-	-	2	2	-

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

COURSE OBJECTIVES:

- To introduce technical terms and nomenclature associated with Process Control domain.
- To familiarize the students with characteristics, selection, sizing of control valves.
- To provide an overview of the features associated with Industrial type PID controller.
- To make the students understand the various PID tuning methods.
- To elaborate different types of control schemes such as cascade control, feed forward control and Model Based control schemes.

UNIT-I PROCESS MODELLING AND DYNAMICS 12

Need for process control – Mathematical model of Flow, Level, Pressure and Thermal processes – Interacting and non-interacting systems – Degrees of freedom – Continuous and batch processes – Self regulation – Servo and regulatory operations – Lumped and Distributed parameter models – Heat exchanger – CSTR – Linearization of nonlinear systems.

UNIT-II CONTROL ACTIONS 12

Characteristic of on-off, proportional, single speed floating, integral and derivative controllers – P+I, P+D and P+I+D control modes – Practical forms of PID Controller Electronic PID controller – Implementation Issues: Bumpless, Auto/manual Mode transfer, Anti-reset windup Techniques - Direct/reverse action.

UNIT-III CONTROLLER TUNING 12

Evaluation criteria – IAE, ISE, ITAE and $\frac{1}{4}$ decay ratio - Tuning:- Process reaction curve method, Continuous cycling method and Damped oscillation method – Determination of optimum settings for mathematically described processes using time response and frequency response approaches –Auto tuning.

UNIT-IV FINAL CONTROL ELEMENTS 12

Actuators: Pneumatic and electric actuators - Control Valve Terminology - Characteristic of Control Valves: Inherent and Installed characteristics - Valve Positioner - Modeling of a Pneumatically Actuated Control Valve - Control Valve Sizing: ISA S 75.01 standard flow equations for sizing Control Valves - Cavitation and flashing - Control Valve selection.

UNIT-V CONTROL SCHEMES 12

Feed-forward control – Ratio control – Cascade control – Inferential control – Split range control - Introduction to Multi-loop Control Schemes – Smith Predictor Control – IMC – Adaptive control - Control schemes for distillation column, CSTR and Heat Exchanger – P&ID diagram.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

- Understand technical terms and nomenclature associated with Process control domain.
- Build models using first principles approach as well as analyze models.
- Design, tune and implement PID Controllers to achieve desired performance for various processes
- Analyze Systems and design & implement control Schemes for various Processes.
- Identify, formulate and solve problems in the Process Control Domain

TEXT BOOKS:

1. Seborg, D.E., Edgar, T.F. and Melli champ, D.A., "Process Dynamics and Control", Wiley John and Sons, 2nd Edition, 2003.
2. Bequette, B.W., "Process Control Modeling, Design and Simulation", Prentice Hall of India, 2004.
3. Stephanopoulos, G., "Chemical Process Control - An Introduction to Theory and Practice", Prentice Hall of India, 2005

REFERENCE BOOKS:

1. Coughanowr, D.R., "Process Systems Analysis and Control", McGraw - Hill International Edition, 2004.
2. Curtis D. Johnson, "Process Control Instrumentation Technology", 8th Edition, Pearson, 2006.
3. Considine, D.M., Process Instruments and Controls Handbook, Second Edition, McGraw, 1999.
4. Bela.G.Liptak., "Process Control and Optimization", Instrument Engineers, Handbook., volume 2, CRC Press and ISA, 2005..
5. Ramesh C. Panda., T.Thyagarajan., "An Introduction to Process Modelling Identification and Control for Engineers", Narosa Publishing house Pvt. Ltd, 2017.

MAPPING OF COs WITH POs AND PSOs:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	1	1									1	1	1
2	2	3	1	2					1	1			2	2	3
3	2	3	2	3		3	2		2	1		1	2	2	1
4	2	1			1										1
5	2	1	3	1	3	2	2				2	2	1	2	1
Avg.	2.2	1.8	1.8	1.8	2	2.5	2		1.5	1	2	1.5	1.5	1.8	1.4

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

COURSE OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

UNIT-I ENVIRONMENT AND BIODIVERSITY 6

Definition, scope and importance of environment – need for public awareness. Ecosystem and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity –endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ and Wild Life Act.

UNIT-II ENVIRONMENTAL POLLUTION 6

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHSMS). Environmental protection, Environmental protection acts, Environmental policies and various Environmental Programmes conducted around the world.

UNIT-III RENEWABLE SOURCES OF ENERGY 6

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT-IV SUSTAINABILITY AND MANAGEMENT 6

Definition of Sustainability, Aspects of Sustainability, Transition from Millennium Development Goals (MDGs) to Sustainable Development Goals (SDGs). The Role of UN and the Need for SDGs and Adoption by the World, Scope and Inclusion and Agenda 2030, Our Common Future and Philosophy behind SDGs Design for sustainability, Thinking Alternatives and Innovation, Causal Mapping, Systemic Mapping and Problem Identification Identifying probable interventions for Sustainable Development, Framework and Structuring of Seventeen SDGs

UNIT-V SUSTAINABILITY PRACTICES 6

Zero waste and 3R concept, ISO 14000 Series, Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economical and technological change.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

- To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation
- To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.
- To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
- To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.

- To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

TEXT BOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
2. Daniel B. Botkin and Edward A. Keller "Environmental Science: Earth as a Living Planet", 8th Edition" Wiley India Publisher ,2024.
3. Deeksha Dave, S.S. Katewa, Chandana Mohanty, Sarbari Acharya, "Textbook of Environmental Studies (3rd Edition), Cengage India Publisher, 2024.
4. P.N. Palanisamy, P. Manikandan, A. Geetha, K. Manjula Rani, "Environmental Science", 4th Edition, Pearson Education Publisher,2023.
5. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 3rd edition, Pearson Education, 2023.
6. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall, 2011.
7. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering Applications in Sustainable Design and Development, Cengage learning, 2015.

REFERENCE BOOKS:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 . Edition 2010.
2. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers, 2018.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

MAPPING OF COs WITH POs AND PSOs:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	-	2	3	-	-	-	-	2	-	-	-
2	3	2	-	-	-	3	3	-	-	-	-	2	-	-	-
3	3	-	1	-	-	2	2	-	-	-	-	2	-	-	-
4	3	2	1	1	-	2	2	-	-	-	-	2	-	-	-
5	3	2	1	-	-	2	2	-	-	-	-	1	-	-	-
Avg.	2.8	1.8	1.0	1.0	-	2.2	2.4	-	-	-	-	1.8	-	-	-

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

COURSE OBJECTIVES:

- To know the basic principles of adventure program and creating awareness for social.
- To improve the cadet's knowledge in firefighting and their health's
- To create an interest in handling the weapons and read the map
- To know the handling the situation on ground in army battle
- To know about anchors, ropes and communication procedure in the Naval wing

UNIT-I ADVENTURE AND SOCIAL AWARENESS PROGRAM 9

Parasailing, Slithering, Rock Climbing, Cycling and Trekking, Obstacle training. Basic Social Service and its needs, Rural Development Programmes. NGOs: Role and Contribution, Responsibility of Swachh Bharat Abhiyanm, Contribution of Youth towards Social Welfare, Social Security Schemes, Social Evils viz Dowry/ Female Foeticide/ Child abuse and trafficking etc. Protection of Children.

UNIT-II FIRE FIGHTING AND HEALTH AND HYGIENE 9

Types of fire, Triangle of fire- Types of fire-fighting, water markings in the ship, NBCD organization and structure, Damage control, Aims of First Aid, Principle of First Aid, Motto of First Aid, List of items in First aid Box, Types of Bandages, Types of Fracture, Dislocation, Types of Wounds, Burns and Scalds, Sprain, Strain, Asphyxia, Drowning, Poison, Shock, Snake bite, Sun and Heat Stroke, Insect bite, Dog bite, Hanging, Artificial Respiration, Artificial respiration, carriage of sick and wounded.

UNIT-III WEAPON TRAINING AND MAP READING 9

Characteristics of a rifle/rifle ammunition and its fire power, Stripping, assembling, care and cleaning and sight setting of .22 rifle, Loading, cocking and unloading, The lying posn, holding and Aiming – 1, Range procedure and safety precautions, Theory of group and snap shooting, Introduction of types of Maps and conventional signs,

Scales and Grid system, Topographical forms and technical terms, Relief, contours and Gradients, Cardinal points and types of north, Types of Bearings and use of service protractor, Prismatic compass and its use and GPS, Setting a map, finding north and own position, Map to Ground, Ground to Map, Point to Point March.

UNIT-IV FIELD CRAFT AND BATTLE CRAFT 9

Introduction, Judging Distance, Description of ground, Recognition, description and indication of landmarks and targets, Observation, Camouflage and Concealment, Field Signals, Section Formations, Fire Control Orders, Fire and Movement, Types of knots and lashings.

UNIT-V SEAMANSHIP AND NAVAL COMMUNICATIONS 9

Anchor - parts of Anchor , parts of cable Types of Anchor, Rigging- Rope, Types of ropes, Care and maintenance of rope, Bends and Hitches, Shackles and Blocks, Introduction to naval modern communication, purpose and principles, duties of various communications department, Semaphore, letters and prosigns, reading and transmission of messages, phonetic alphabets, radio telephony procedure Sonar and Radar.

TOTAL : 45 PERIODS

Note: NCC Credit Course Level – II is offered for NCC students only. The grades earned by the students will be recorded in the marksheet, however the same shall not be considered for the computation of CGPA

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Understand the responsibilities of the social works and adventure.
- Learnt about the techniques of firefighting and importance of hygiene.
- Capable to handle the weapons (Rifle .22) and read the map.
- Understand the importance of field and battle craft.
- Devolve the skills about seamanship and naval communication techniques.

TEXT BOOKS:

1. E- Book , NCC Red Book, Director General NCC, Ministry of Defence, RK Puram New Delhi (link: red book 26-5-2017.pmd (s3waas.gov.in)).
2. Handbook of NCC Cadets for 'A', 'B' and 'C' Certificate Examinations, by RPH Editorial Board, Kindle Edition.

COURSE OBJECTIVES:

- To present the importance of automation in manufacturing and process industries.
- To impart the role of PLC in industrial automation.
- To expose the various tuning techniques employed in process control.
- To expose the various automation techniques employed in process control.
- To impart knowledge on different communication protocols used in process automation.

UNIT-I	AUTOMATION IN MANUFACTURING & PROCESS INDUSTRIES	12
---------------	---	-----------

Introduction: Automation in manufacturing system, Principles and strategies of automation, Basic elements of an automated system, Advanced automation functions, Levels of automations, Various Industrial Revolutions, Digitalization and the Networked Economy, Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0.

UNIT-II	PROGRAMMABLE LOGIC CONTROLLER (PLC)	12
----------------	--	-----------

Introduction to PLC, History of PLC, Architecture of PLC, CPU IO Modules Power Supply and Communications, Input and Output Devices, Need of PLC for Industrial Automation, Types of PLC Models. Introduction to PLC Programming: Types of Programming Languages, Ladder logic diagram, Examine On/OFF, timer, counter, data manipulation and other higher level programming instruction with case studies.

UNIT-III	OVERVIEW OF MATERIAL HANDLING SYSTEMS	12
-----------------	--	-----------

Overview of material handling systems: Types of material handling equipment, Design of the system, Conveyor system, Automated guided vehicle system. Automated Manufacturing Systems: Components, Classification and overview of manufacturing systems, Cellular manufacturing, Flexible manufacturing system (FMS).

UNIT-IV SCADA SYSTEMS 12

Introduction, definition and history of SCADA, typical SCADA System Architecture, Communication requirements, Desirable properties of SCADA system, Features, advantages, disadvantages and applications of SCADA. SCADA Architecture: First Generation-Monolithic, Second Generation-Distributed, Third Generation-Networked Architecture, SCADA systems in operation and case studies.

UNIT-V DISTRIBUTED CONTROL SYSTEMS (DCS) 12

Introduction - Local Control Unit (LCU) architecture, LCU Process Interfacing Issues, Block diagram and Exploring Various Security Design Strategies for Local Control Units (LCUs)- Networking of DCS. Information gathering, Real-time analysis of data stream from DCS, Historian, Integration of business inputs with process data, Leveraging remote terminal unit (RTU).

PRACTICAL EXERCISES:-

1. Study of PLC architecture and Field Device Interface Modules (AI,AO, DI, DO Modules).
2. Realization of discrete control sequence using Ladder Logic Programming.
3. Realization of Discrete control sequences using Functional Block Diagram(FBD) Programming.
4. Realization of Discrete control sequences using ST, IL and SFC Programming methods.
5. Interfacing Analog/Digital Input/output Devices with Industrial Type PLC.
6. Closed loop control of a typical process using PLC.
7. HMI/ SCADA Programming.
8. Architecture of DCS.
9. Interfacing of field devices with DCS.
10. Realization of control schemes for typical processes using DCS.
11. Interfacing smart field devices with DCS.
12. IOT Industrial gateway based monitoring of Level / Flow process.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

- Understand technical terms and nomenclature associated with Process control domain.
- Build models using first principles approach as well as analyze models.
- Design, tune and implement PID Controllers to achieve desired performance for various processes
- Analyze Systems and design & implement control Schemes for various Processes.
- Identify, formulate and solve problems in the Process Control Domain

TEXT BOOKS:

1. M.P.Groover, "Automation, Production Systems and Computer Integrated Manufacturing", 5 th Edition, Pearson Education, 2009.
2. John W. Webb and Ronald A. Reis, "Programmable Logic Controllers: Principles and Applications", 5th Edition, Prentice Hall Inc., New Jersey, 2003.
3. Krishna Kant, "Computer - Based Industrial Control", 2nd Edition, Prentice Hall, New Delhi, 2011.
4. Frank D. Petruzella, "Programmable Logic Controllers", 5th Edition, McGraw- Hill, New York, 2016.
5. Ronald L Krutz, "Securing SCADA System", First Edition, Wiley Publication, 2005.

REFERENCE BOOKS:

1. Curtis D. Johnson, "Process Control Instrumentation Technology", 8th Edition, Pearson New International, 2013.
2. Lukas M.P, "Distributed Control Systems", Van Nostrand Reinhold Co., New York, 1986.
3. N. Viswanandham, Y. Narahari, "Performance Modeling of Automated ManufacturingSystems", 1st Edition, 2009.
4. <https://nptel.ac.in/syllabus/108108098/>.
5. Smith Carlos and Corripio, "Principles and Practice of Automatic Process Control", 3rd Edition, John Wiley & Sons, 2006.z

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	2	2	-	-	-	1	-	-	-	2	1	1
2	3	3	3	3	2	-	-	-	1	-	-	1	2	2	2
3	3	3	3	3	3	-	-	-	2	-	-	1	2	2	3
4	3	3	3	3	3	-	-	-	2	-	-	1	3	2	3
5	3	3	3	3	3	-	-	-	2	-	-	2	2	3	3
Avg.	3.0	2.8	2.6	2.8	2.6	-	-	-	1.6	-	-	1.0	2.2	2.0	2.4

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

COURSE OBJECTIVES:

- To impart an adequate knowledge and expertise to handle equipment generally available in an industry.
- To make the students aware about calibration of meters, sensors and transmitters.
- To make the students conscious about the working and operation of different types of analytical Instruments.
- To understand the working of basic biomedical instruments.
- To identify, formulate, and analyze problems regarding sensors and transmitters.

LIST OF EXPERIMENTS:

1. Measurement of speed, torque and vibration.
2. Calibration of ammeter, voltmeter and wattmeter using multifunction calibrator.
3. Calibration of pressure gauge using dead weight tester.
4. Measurement of level using d/p transmitter and fibre optics system.
5. Measurement of flow using
 - a) Discharge coefficient of orifice plate
 - b) Calibration of Rotameter.
6. Design and Testing of Electromagnetic Flow meters.
7. Measurement of temperature using IR thermometer and IC sensor.
8. Measurement of Absorbance and Transmittance of Test solutions using UV- Spectrometer.
9. Measurement of Conductivity, Moisture and Viscosity of test solutions.
10. Standardization and measurement of pH values of different solutions.
11. Measurement and analysis of ECG and pulse rate.

Minimum of ten experiments to be offered from the list. Additional one or two experiments can be framed beyond the list or curriculum.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Ability to experimentally measure industrial process parameters such as flow, level, temperature, pressure and viscosity.
- Ability to measure and analyze pH, conductivity, UV absorbance and transmittance.
- Ability to measure and analyze physiological parameters such as BP, ECG and pulse rate.
- Ability to apply proper calibration method for measuring systems.
- Ability to do mathematical calculations regarding choosing equipment and identifying errors.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Orifice plate	- 1
2. Dead weight tester with pressure gauge	- 1
3. Torque trainer	- 1
4. Saybolt Viscometer	- 1
5. Vacuum gauge	- 1
6. DP transmitter	- 1
7. UV – Visible spectrophotometer	- 1
8. pH meter	- 1
9. Conductivity meter	- 1
10. ECG trainer	- 1
11. Pulse rate trainer	- 1
12. tacho meter	- 1

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	1	1	1								3	1	1
2	3	1	1	1	1								3	1	1
3	3	1	1	1	1								3	1	1
4	3	2	2	2	2								3	1	1
5	3	2	2	2	2								3	1	1
Avg.	3	1.4	1.4	1.4	1.4	-	-	-	-	-	-	-	3	1	1

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

COURSE OBJECTIVES:

- To experimentally verify the process control concepts on the selected process control loops.
- To experimentally verify the characteristics of On/OFF and PID controller.
- To impart theoretical and practical skills in process identification and PID controller tuning.
- To make the students aware of drives and MIMO system.
- To make the students aware of basic and advanced control schemes.

LIST OF EXPERIMENTS: (SIMULATION BASED)

1. Dynamic Characteristics of First & Second Order System with and without transportation lag.
2. Tuning of PID Controller for mathematically described processes
3. PID Enhancements using Cascade Control Scheme.
4. PID Enhancements using Feed-forward Control Scheme.
5. PID Implementation Issues.
6. Study of Multi-input Multi-output system.
7. Study of AC and DC drives.

LIST OF EXPERIMENTS: (HARDWARE BASED)

1. Characteristics of Pneumatically Actuated Control Valve (with and without Positioner).
2. Study and control of flow process using Compact Flow Control Unit.
3. Control of Level and Pressure using Process Control Training Plant.
4. Implementation of ON/OFF Controller for the Temperature Process.
5. Implementation of Interacting and non-interacting system.
6. Dynamic characteristics of P+I+D controller.
7. Design of PLC programming for practical applications.

Minimum of ten experiments to be offered from the list. Additional one or two experiments can be framed beyond the list or curriculum.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Ability to Understand and analyze process control engineering problems.
- Ability to Build dynamic models using input output data of a process.
- Ability to Work with real time control loops (flow / level / temperature / pressure).
- Ability to Make use of simulation tools such as MATLAB / LABVIEW / ASPEN for design and analysis.
- Ability to Learn and implement simple adaptive and model based control schemes.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Flow process station with all accessories
2. Analog / Digital PID controller
3. Control valve setup (with position for varying $\hat{I}^m P$ across the valve)
4. Flow meter
5. Level process station with all accessories
6. Temperature process station with all accessories
7. Pressure process station with all accessories
8. Personal computer-15 nos
9. MATLAB software
10. Two tank system with following accessories.
11. PLC Trainer Kit.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	2	2	-	-	-	1	-	-	1	2	2	3
2	3	3	3	3	2	-	-	-	1	-	-	1	2	2	3
3	3	3	2	3	3	-	-	-	2	-	-	1	3	2	3
4	3	2	2	2	3	-	-	-	2	-	-	1	2	2	2
5	3	3	3	3	3	-	-	-	2	-	-	1	2	3	3
Avg.	3.0	2.8	2.6	2.6	2.6	-	-	-	1.6	-	-	1.0	2.2	2.2	2.8

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

SEMESTER VI

EC3666	IoT CONCEPTS AND APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the various Internet of Things (IoT) Architectures.
- To explain the requirements of various communication models and protocols for the IoT applications.
- To introduce the protocols and recent technologies using IoT model.
- To describe the IoT programming using Arduino/Raspberry Pi open platform.
- To understand the concept of IoT in real world scenario

UNIT-I INTRODUCTION 9

Internet of Things (IoT) evolution – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT.

UNIT-II COMPONENTS 9

Functional Blocks of an IoT Ecosystem – Actuators, Sensors and Smart Objects – Control Units - Communication modules - Bluetooth, Zigbee, Wi-Fi, GPS, GSM Modules.

UNIT-III PROTOCOLS AND TECHNOLOGIES 9

IoT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, Big Data Analytics, Cloud Computing, Embedded Systems.

UNIT-IV OPEN PLATFORMS AND PROGRAMMING 9

IoT deployment for Raspberry Pi/Arduino platform - Architecture – Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.

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

TOTAL : 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student will be able to

- Describe the important concepts of IoT.
- Understand the various protocols and communication models of IoT.
- Gain the knowledge related to the Arduino/Raspberry Pi /open platform.
- Apply data analytics and use cloud offerings related to IoT.
- Infer the applications of IoT in real time scenario.

TEXT BOOKS:

1. Hanes, David, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, and Jerome Henry. IoT fundamentals: Networking technologies, protocols, and use cases for the internet of things. Cisco Press, 2017.
2. Greengard, Samuel. The internet of things. MIT press, 2021.

REFERENCE BOOKS:

1. Lea, Perry. Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security. Packt Publishing Ltd, 2018.
2. Hersent, Olivier, David Boswarthick, and Omar Elloumi. The Internet of Things: Key applications and protocols. John Wiley & Sons, 2012.
3. Uckelmann, Dieter, Mark Harrison, and Florian Michahelles, eds. Architecting the Internet of Things. Germany: Springer Berlin Heidelberg, 2014.
4. Bahga, Arshdeep., Madiseti, Vijay. Internet of Things: A Hands-on Approach. United Kingdom: Arshdeep Bahga & Vijay Madiseti, 2014.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	3	3	2	-	-	-	-	-	-	-	2	2	2
2	2	3	3	2	-	-	-	-	-	-	-	2	2	2
3	2	3	2	2	-	-	-	-	-	-	-	2	2	2
4	2	3	3	2	-	-	-	-	-	-	-	2	2	2
5	2	3	3	2	-	-	-	-	-	-	-	2	2	2
Avg.	2	3	3	2	-	-	-	-	-	-	-	2	2	2

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

COURSE OBJECTIVES:

- To understand the concepts of ADTs.
- To Learn linear data structures – lists, stacks, and queues.
- To Learn non linear data structures – Trees and its application
- To learn non linear data structures – Graphs and its application.
- To understand sorting, searching and hashing algorithms

UNIT-I LINEAR DATA STRUCTURES – LIST 9

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation —singly linked lists- circularly linked lists- doubly-linked lists – applications of lists –Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).

UNIT-II LINEAR DATA STRUCTURES – STACKS, QUEUES 9

Stack ADT – Operations - Applications - Evaluating arithmetic expressions- Conversion of Infix to postfix expression - Queue ADT – Operations - Circular Queue – Priority Queue - deQueue – applications of queues.

UNIT-III NON LINEAR DATA STRUCTURES – TREES 9

Tree ADT – tree traversals - Binary Tree ADT – expression trees – applications of trees – binary search tree ADT –Threaded Binary Trees- AVL Trees – B-Tree - B+ Tree - Heap – Applications of heap.

UNIT-IV NON LINEAR DATA STRUCTURES - GRAPHS 9

Definition – Representation of Graph – Types of graph - Breadth-first traversal - Depth-first traversal – Topological Sort – Bi-connectivity – Cut vertex – Euler circuits – Applications of graphs

UNIT-V SEARCHING, SORTING AND HASHING TECHNIQUES 9

Searching- Linear Search - Binary Search. Sorting - Bubble sort - Selection sort - Insertion sort - Shell sort – Radix sort. Hashing- Hash Functions – Separate

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Implement abstract data types for linear data structures.
- Apply the different linear data structures to problem solutions.
- Apply the different non-linear data structures to problem solutions.
- Critically analyze the various sorting algorithms.
- Critically analyze the various searching algorithms.

TEXT BOOKS:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2017.
2. Reema Thareja, "Data Structures Using C", Second Edition, Oxford University Press, 2014.

REFERENCE BOOKS:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", Second Edition, McGraw Hill, 2009.
2. Aho, Hopcroft and Ullman, "Data Structures and Algorithms", Pearson Education, 2002.
3. Stephen G. Kochan, "Programming in C", 3rd edition, Pearson Education.
4. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, University Press, 2008.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	1	3	1	3	-	-	-	3	2	2	2	3	1	2	2
2	2	1	3	2	1	-	-	-	2	1	1	3	3	3	2	1
3	3	3	1	2	2	-	-	-	3	2	1	2	3	1	3	2
4	3	1	2	2	2	-	-	-	1	2	1	3	3	1	1	2
5	1	1	2	3	2	-	-	-	3	2	1	2	3	3	3	1
Avg.	2	1.4	2.2	2	2	-	-	-	2.4	1.8	1.2	2.4	3	1.8	2.2	1.6

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

COURSE OBJECTIVES:

- To get familiarized with the embedded hardware architecture.
- To acquire knowledge about various embedded software development tools.
- To get an insight over various wired and wireless communication protocols used in embedded system design.
- To understand the basics of RTOS.
- To build knowledge on programming and realize the concept of peripheral interface.

UNIT-I EMBEDDED HARDWARE ARCHITECTURE 9

CISC Architecture:- Introduction to MCS51 Family - 8051 Microcontroller - Architecture - Timers - Interrupts - Serial Data Communication - RISC Architecture:- overview of PIC 16F487x family - PIC16F877A - Architecture - Timers - Interrupts - Serial ports.

UNIT-II ARM & EMBEDDED SOFTWARE DEVELOPMENT TOOLS 9

Introduction to ARM - LPC4088 Architecture - Software Development Tools: - IDE Tools - ISP Tools - ARM Development Tools.

UNIT-III COMMUNICATION INTERFACES 9

Wired Communication protocols:- Serial communication interface:- RS232, RS485, I2C SPI and USB - Parallel communication interface - IEEE 488 - Wireless communication protocols: - Bluetooth classic, BLE, IEEE 802.15.4, Zigbee, IEEE 802.11 and LoRaWAN.

UNIT-IV REAL TIME OPERATING SYSTEM 9

Operating System Basics:- The Kernel and its subsystems, Kernel Space and User Space - Types of RTOS - Functions of RTOS - Task, process and Threads, Interrupt handling, Multiprocessing & Multitasking and Task scheduling - Comparative study of various RTOSs.

Embedded C and Python Programming for Embedded Applications - Input and output devices Interface, ADC Interface - DAC Interface - PWM Generation - sensor Interface.

TOTAL : 45+30 = 75 PERIODS

1. Implementation of specific tasks using Embedded C/Python programming
2. Interfacing input devices with 8051/PIC16F877A/LPC4088.
3. Interfacing output devices with 8051/PIC16F877A/LPC4088.
4. Implementation of recurring tasks using the timers and interrupts of 8051/PIC microcontroller/ LPC4088.
5. Interfacing ADC & DAC with 8051 microcontroller.
6. PWM generation using PIC16F877A/LPC4088.
7. Interfacing RTC with microcontroller.
8. Establishing serial data transmission through UART.
9. Establishing serial data communication using I2C and SPI protocols.
10. Wireless data communication using IoT (Zigbee/ GSM/ Bluetooth)
11. Design and implementation of ON/OFF control strategy.
12. Implementation of basic experiments using Raspberry PI / Arduino.

**SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/
Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)**

1. Interpretation of Embedded systems architecture.
2. Selection of Micro controller for applications.
3. Familiarization of any one relevant software tool (MATLAB/ SCILAB/ LABVIEW/ Proteus/Equivalent open source software).
4. Design and verification of embedded systems and RTOS applications in any of the software.
5. Realization of embedded and RTOS in hardware.
6. Introduction to other advanced micro controller not covered in the above syllabus

COURSE OUTCOMES:

- Understand the concept of embedded system and its architectural features.
- Develop embedded software using Embedded C and Python.
- Experiment real world field devices with microcontrollers.

- Construct real world signals using suitable data converters for control applications.
- Use the power of RTOS for embedded applications.
- Design embedded systems with the right choice of microcontroller and the associated peripherals for a given embedded application.

TEXT BOOKS:

1. Rajkamal, 'Embedded system-Architecture, Programming, Design', Tata Mcgraw Hill,2011.
2. Peckol, "Embedded System Design", John Wiley,2010.

REFERENCE BOOKS:

1. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006.
2. Han-Way Huang, "Embedded system Design using C8051", Cengage Learning,2009.
3. Rajib Mall "Real-Time systems Theory and Practice" Pearson Education, 2007.
4. Shibu.k.v, "Introduction to Embedded Systems", Tata Mcgraw Hill, 2009.

List of Open Source Software/ Learning website:

1. <https://nptel.ac.in/courses/108105057>
2. <https://nptel.ac.in/courses/106105193>
3. <https://nptel.ac.in/courses/106105172>
4. https://www.iare.ac.in/sites/default/files/lecture_notes/ESD%20NOTES-A70440.pdf
5. <https://www.udemy.com/course/embedded-device-interfacing>

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	2	-	-	-	1	-	-	1	2	3	2
2	3	3	3	3	3	-	-	-	2	-	-	2	2	3	2
3	3	3	3	3	3	-	-	-	2	-	-	2	3	3	3
4	3	3	2	3	3	-	-	-	2	-	-	2	3	3	3
5	3	3	3	3	3	-	-	-	2	-	-	2	2	3	3
6	3	3	3	3	3	-	-	-	2	-	-	2	3	3	3
AVG.	3.0	3.0	2.7	2.8	2.8	-	-	-	1.8	-	-	1.8	2.5	3.0	2.7

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

COURSE OBJECTIVES:

- To implement linear data structures.
- To implement non linear data structures.
- To understand the different operations of search trees.
- To implement graph traversal algorithms.
- To get familiarized to sorting and searching algorithms.

LIST OF EXPERIMENTS:

1. Array implementation of Stack and Queue ADTs.
2. Array implementation of List ADT.
3. Linked list implementation of List, Stack and Queue ADTs.
4. Applications of List, Stack and Queue ADTs.
5. Implementation of Binary Trees and operations of Binary Trees.
6. Implementation of Binary Search Trees.
7. Implementation of AVL Trees.
8. Implementation of Heaps using Priority Queues.
9. Graph representation and Traversal algorithms.
10. Applications of Graphs.
11. Implementation of searching and sorting algorithms.
12. Hashing – any two collision techniques

TOTAL : 45 PERIODS**COURSE OUTCOMES:**

At the end of the course, the students will be able to:

- Write functions to implement linear and non-linear data structure operations.
- Suggest appropriate linear / non-linear data structure operations for solving a given problem.
- Appropriately use the linear / non-linear data structure operations for a given problem.

- Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	1	2	1	–	–	–	–	1	2	2	2	1	2	3	2
2	2	1	3	1	–	–	–	–	2	3	3	2	1	3	1	2
3	2	2	1	2	1	–	–	–	1	2	1	3	2	3	2	1
4	2	2	1	3	–	–	–	–	3	1	1	1	2	1	2	1
5	1	3	3	1	3	–	–	–	1	1	1	1	2	1	2	2
AVG.	1.8	1.8	2.0	1.6	2.0	–	–	–	1.6	1.8	1.6	1.8	1.6	2	2	1.6

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

EN3649	PROFESSIONAL COMMUNICATION	L	T	P	C
	LABORATORY	0	0	2	1

COURSE OBJECTIVES:

- To enhance the Employability and Career Skills of students.
- To orient the students towards grooming as a professional.
- To learn how to speak in Group Discussions.
- To make them employable Graduates and help them attend interviews successfully.
- To develop their confidence and help them express views clearly.

UNIT-I GENERAL ENGLISH FOR COMPETITIVE EXAMS 6

English for competitive exams —general awareness of current affairs – multiple choice – cloze – vocabulary structure.

UNIT-II MECHANICS OF INTERPERSONAL COMMUNICATION 6

Introduction to soft skills - Interpersonal communication - Introducing oneself to the audience — answering questions – writing a message – memo –mail – asking for comments – giving information – agreeing to requests – apologizing – Complaining – Business proposal – short report – summarizing.

UNIT-III BASICS OF GROUP DISCUSSION 6

Introduction to Group Discussion— participating in Group Discussions – questioning and clarifying – GD strategies –monologues – dialogues.

UNIT-IV FUNDAMENTALS OF INTERVIEW SKILLS 6

Interview etiquette – Portfolio development - attending job interviews – FAQs related to job interviews - Interview types – expressing opinions – present circumstances - past experiences – future plans.

UNIT-V SPECIFIC SKILLS FOR CAREER ADVANCEMENT 6

Recognizing differences between groups and teams - networking professionally- respecting social protocols- understanding career management- developing a long-term career plan- making career changes. – organizing a larger unit of discourse – expressing and justifying opinions – negotiating – collaborating – disagreeing –

speculating – decision taking.

TOTAL : 30 PERIODS

The lab course is offered as an **Employability Enhancement Course**. The course is offered as a one credit paper with an End Semester Examination.

COURSE OUTCOMES:

At the end of the course learners will be able to:

- Make effective presentations and participate confidently in Group Discussions.
- Attend job interviews and interacting in different situations.
- Able to write business reports, proposals and related correspondence.
- Develop adequate Soft Skills required for the workplace.

REFERENCE BOOKS:

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015.
2. Interact English Lab Manual for Undergraduate Students, Orient Blackswan: Hyderabad, 2016.
3. E.Suresh Kumar Communication for Professional Success. Orient Blackswan: Hyderabad, 2015.
4. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014.
5. S. Hariharan. Soft Skills. MJP Publishers: Chennai, 2010.
6. Successful Presentations: DVD and Student's Book. A video series teaching business communication skills for adult professionals by John Huges and Andrew Mallett- OUP 2012.
7. Goodheart-Willcox, "Professional Communication", First Edition , 2017. Online test book.
8. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India, 6 Edition, 2015.
9. English for success in Competitive exams. Philip Sunil Solomon – OUP 2009.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	2	3	3					3		1	2	2	1	2
2	3	2	2	2	2		3			2		1	2	2	1	2
3	3	2		3						3		1	2	2		
4	3	3					3			3		1	2	2	1	1
5	3	2	3							3		1	1	1	1	1
AVG.	3	2.4	2.3	2.7	2.5		3			2.8		1	1.8	1.8	1	1.5

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

COURSE OBJECTIVES:

- Make students able to demonstrate the ability to collaborate with others as they work on intellectual projects.
- Provide a platform to the students to implement their technical skills on a given/selected task.
- To get the Knowledge for the assembling of electronics circuit with components on PCB (Printed Circuit Board) of circuit design.
- Design and development of Small electronic project based on hardware and software for electronics systems.
- Design solutions for real life problems using engineering knowledge.

The students in a group of 5 to 6 works on a topic approved by the head of the department and prepare a comprehensive mini project report after completing the work to the satisfaction. The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A mini project report is required at the end of the semester. The mini project work is evaluated based on oral presentation and the mini project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL : 60 PERIODS**COURSE OUTCOMES:**

1. Students will be able to practice acquired knowledge within the chosen area of technology for project development.
2. Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.
3. Reproduce, improve and refine technical aspects for engineering projects.
4. Work as an individual or in a team in development of technical projects.
5. Communicate and report effectively project related activities and findings.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	3							3	3	3	2
2	2	3	2	2	3		2					3	3	3	2
3	3	3	2	2	3		2					3	3	3	2
4									3	3	2	2			1
5										3	2	1			
Avg.	2.7	3	2	2	3	-	2	-	3	3	2	2.4	3	3	1.8

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

SEMESTER VII

EI3761	APPLIED MACHINE LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To give an introduction on several fundamental concepts and methods for machine learning.
- To familiarize with some basics and techniques of Data Preprocessing.
- To provide the knowledge related to analyzing and handling data sets using Supervised Learning.
- To provide the knowledge related to analyzing and handling data sets using Clustering and Unsupervised Learning.
- To give an introduction on fundamental concepts of Neural Networks.

UNIT-I INTRODUCTION TO MACHINE LEARNING 9

Objectives of machine learning – Human learning/ Machine learning – Types of Machine learning:- Supervised Learning – Unsupervised learning – Regression – Classification – The Machine Learning Process:- Data Collection and Preparation – Feature Selection – Algorithm Choice – Parameter and Model Selection – Training – Evaluation – Bias-Variance Trade off – Under fitting and Overfitting Problems.

UNIT-II DATA PREPROCESSING 9

Data quality – Data preprocessing: – Data Cleaning:- Handling missing data and noisy data – Data integration:- Redundancy and correlation analysis – Continuous and Categorical Variables – Data Reduction:- Dimensionality reduction (Linear Discriminant Analysis – Principal Components Analysis).

UNIT-III SUPERVISED LEARNING 9

Linearly separable and nonlinearly separable populations – Logistic Regression – Radial Basis Function Network – Support Vector Machines: – Kernels – Risk and Loss Functions – Support Vector Machine Algorithm – Multi-Class Classification – Support Vector Regression.

UNIT-IV CLUSTERING AND UNSUPERVISED LEARNING 9

Introduction – Clustering:- Partitioning Methods:- K-means algorithm – Mean Shift Clustering – Hierarchical clustering – Clustering using Gaussian Mixture Models – Clustering High-Dimensional Data:- Problems – Challenges.

UNIT-V NEURAL NETWORKS 9

Multi-Layer Perceptron – Backpropagation Learning Algorithm – Neural Network fundamentals – Activation functions – Types of Loss Function – Optimization: Gradient Descent Algorithm – Stochastic Gradient Descent – case study : Human activity recognition, Self Driving Cars.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. To give an introduction on several fundamental concepts and methods for machine learning.
2. To familiarize with some basics and techniques of Data Preprocessing.
3. To provide the knowledge related to analyzing and handling data sets using Supervised Learning.
4. To provide the knowledge related to analyzing and handling data sets using Clustering and Unsupervised Learning.
5. To give an introduction on fundamental concepts of Neural Networks.

TEXT BOOKS:

1. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning with Applications in R, Springer Texts in Statistics, 2013.
2. Thomas A. Runkler, Data Analytics: Models and Algorithms for Intelligent Data Analysis, Springer Vieweg, 2nd Edition, 2016.

REFERENCE BOOKS:

1. Ethem Alpaydin, — Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.
2. Stephen Marsland, — Machine Learning: An Algorithmic Perspective, CRC Press, 2009.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2						3						
2	1	1		1	2									2	1
3	3	2	2	2	2							3	2	2	1
4		2			2							3	2	2	1
5	3	1	3		3	2						3			1
Avg.	2	1.8	2.3	1.5	2.3	2	-	-	3	-	-	3	2	2	1

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

COURSE OBJECTIVES:

- To educate on the basic concepts of data networks
- To introduce the basics of internetworking and serial communications
- To provide details on HART and Field buses
- To educate on MODBUS, PROFIBUS and other communication protocol
- To introduce industrial Ethernet and wireless communication

UNIT-I DATA NETWORK FUNDAMENTALS 9

Networks hierarchy and switching – Open System Interconnection model of ISO - Data link control protocol - Media access protocol - Command / response - Token passing -CSMA/CD,TCP/IP.

UNIT-II INTERNET WORKING and RS 232, RS485 9

Bridges - Routers - Gateways - Standard ETHERNET and ARCNET configuration special requirement for networks used for control - RS 232, RS 485 configuration Actuator Sensor (AS) – interface, Devicenet.

UNIT-III INDUSTRIAL NETWORK PROTOCOL 9

Introduction - Evolution of signal standard - HART communication protocol - HART networks - HART commands - HART applications - Fieldbus - Introduction - General Fieldbus architecture - Basic requirements of Fieldbus standard - Fieldbus topology - Interoperability - Interchangeability - Introduction to OLE for process control (OPC).

UNIT-IV MODBUS AND PROFIBUS 9

MODBUS protocol structure - function codes – troubleshooting Profibus, Introduction, Profibus protocol stack, Profibus communication model - communication objects - system operation - troubleshooting - review of foundation fieldbus - Data Highway.

UNIT-V INDUSTRIAL ETHERNET AND WIRELESS COMMUNICATION 9

Industrial Ethernet, Introduction, 10 Mbps Ethernet, 100 Mbps Ethernet - Radio and wireless communication, Introduction, components of radio link - radio spectrum and frequency allocation - radio MODEMs-Introduction to wireless HART and ISA100.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Ability to define basic concepts of data communication and its importance.
2. Ability to explain the various internetworking devices involved in industrial networks
3. Ability to explain the various serial communication used in process industries.
4. Ability to illustrate, compare & explain the working of HART and Field bus used in process digital communication.
5. Ability to summarize the operation of MODBUS, PROFIBUS protocol & its applications.

TEXT BOOKS:

1. Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, Practical Industrial DataNetworks Design, Installation and Troubleshooting' Newnes Publication, Elsevier FirstEdition, 2004.
2. William Buchanan, Computer Buses, CRC Press, 2000.
3. BehrouzForouzan ,Data Communications & Networking ,3RD edition, Tata McGraw hill,2006

REFERENCE BOOKS:

1. Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, Prentice Hall of India Pvt. Ltd., 5th Edition. 2011.
2. Theodore S Rappaport, Wireless Communication: Principles and Practice, Prentice Hall of India 2nd Edition, 2001.
3. William Stallings, Wireless Communication & Networks, Prentice Hall of India, 2nd Edition, 2005

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	2	2	-	-	-	1	-	-	1	2	2	2
2	3	3	2	3	2	-	-	-	2	-	-	1	3	2	3
3	3	3	3	3	2	-	-	-	2	-	-	1	3	3	3
4	3	3	3	3	3	-	-	-	2	-	-	2	3	3	3
5	3	3	3	3	3	-	-	-	2	-	-	2	3	3	3
Avg.	3.0	2.8	2.4	2.8	2.4	-	-	-	1.8	-	-	1.4	2.8	2.6	2.8

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

COURSE OBJECTIVES:

- To introduce and educate the students on the concept of Human Values.
- To support students to understand the need, basic guidelines, content and process of value education.
- To facilitate the students to understand harmony at all the levels of human living.
- To help the students to understand social ethics and live accordingly.
- To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life

UNIT-I	HUMAN VALUES	6
---------------	---------------------	----------

Human value – needs, Values and its Types - Ethics. Moral values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character.

UNIT-II	VALUE EDUCATION	6
----------------	------------------------	----------

Value Education: Definition, Concept and Need for Value Education. The Content and Process of Value Education. Basic Guidelines for Value Education.

UNIT-III	HARMONY	6
-----------------	----------------	----------

Harmony in the Family- the basic unit of human interaction, Trust and Respect,
Harmony of the Self with the Body: Self -regulation and Health. Harmony in Society:
Dimensions system of Human Order. Harmony in Nature: The Four Orders in
Nature.

UNIT-IV	SOCIAL ETHICS	6
----------------	----------------------	----------

The Basics for Ethical Human conduct - Defects in Ethical Human Conduct - Holistic and Universal order - Universal Human Order and Ethical Conduct.

UNIT-V ETHICS IN PROFESSION**6**

Professional Integrity, Respect & Equality, Privacy, Positive co-operation, Respecting the competence of other professions. - Business ethics - Environmental ethics - Internet ethics - Engineers as expert witnesses and advisors.

TOTAL : 30 PERIODS**COURSE OUTCOMES:**

1. Students will be able to understand the significance of value inputs in a classroom and start applying them in their life and profession.
2. Students will be able to understand the need, basic guidelines, content and process of value education.
3. Students will be able to the role of a human being in ensuring harmony in society and nature.
4. Students will be able to understand social ethics.
Students will be able to Distinguish between ethical and unethical practices and start working out the strategy to actualize a harmonious environment wherever they work
5. Students will be able to understand the significance of value inputs in a classroom and start applying them in their life and profession.

REFERENCE BOOKS:

1. Professional Ethics and Human Values by Prof.D.R.Kiran-Tata McGraw-Hill – 2013.
2. Ethics in Engineering by Mike W. Martin and Roland Schinzinger - Tata McGraw-Hill - 2003.
3. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics, Excel Books First Edition 2009.
4. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Professional Ethics and Human Values", Prentice Hall of India, New Delhi, 2013.
5. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York, 3rd edition (2017).
6. R. Subramanian, 'Professional Ethics' Oxford University Press, 2nd Edition 2017.

7. R. S. Nagarazan, 'A Textbook on Professional Ethics and Human Values' New Age International Publishers, 2015.
8. World Community Service Centre, "Value Education", Vethathiri publications, Erode, 2011.
9. Langford, Duncan (EDT): Internet Ethics, London, Macmillan Press Ltd., 2000.
10. Erwann, M. David, Michele S. Shauf, Computers, Ethics and Society, Oxford University Press, 2003.
11. Suresh Jayshree, 2003, Human Values and Professional Ethics, S. Chand Publishing, Third Revised Edition.

E-BOOK :

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics, Excel Books First Edition 2009.
2. R. S. Nagarazan, 'A Textbook on Professional Ethics and Human Values' New Age International Publishers, 2015

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
2	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
4	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Avg.	-	-	1	1.5	-	-	1	-	-	-	-	-	-	-	-

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

LABORATORY**0 0 3 1.5****COURSE OBJECTIVES:**

- To obtain adequate knowledge in design of various signal conditioning circuits and Instrumentation systems.
- To impart design knowledge of controller, control valve and transmitter.
- To acquire the knowledge of piping diagram of industrial standard
- To make the students aware of industry project and implementation issues.
- To make the students aware of project planning and scheduling.

LIST OF EXPERIMENTS:

1. Design of Instrumentation amplifier.
2. Design of active filters – LPF, HPF and BPF
3. Design of regulated power supply
4. Design of V/I and I/V converters.
5. Design of signal conditioning circuit for strain gauge and RTD.
6. Design of orifice plate and rotameter.
7. Design of Control valve (sizing and flow-lift characteristics)
8. Design of PID controller (using operational amplifier and microprocessor)
9. Design of a multi-channel data acquisition system
10. Design of multi range DP transmitter
11. Piping and Instrumentation Diagram – case study.
12. Preparation of documentation of instrumentation project and project scheduling for the above case study. (process flow sheet, instrument index sheet and instrument specifications sheet, job scheduling, installation procedures and safety regulations).

Minimum of ten experiments to be offered from the list. Additional one or two experiments can be framed beyond the list or curriculum.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Ability to understand design of signal conditioning circuits and instrumentation systems.
- Ability to design controller, control valve and transmitter.
- Be able to design and draw the piping diagram for industrial application projects.
- Be able to design the multi-channel data acquisition system and transmitter.
- Understand the use and application of instrument/component data sheets, manuals, manufacture's catalogues in consultation with handbooks, reference books etc.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	1	1	2								2		3
2	2	2	2	2	2									2	
3	2	3	1	1	2								2		
4	3	2	2	2	2								2	2	2
5	3	2	3	2	2								1	2	
Avg.	2.4	2	1.8	1.6	2	-	-	-	-	-	-	-	1.8	2	2.5

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

COURSE OBJECTIVES:

- To explore career interests while applying knowledge and skills learned in the classroom in a work setting.
- To learn and provides an opportunity to build professional networks.

The students should undergo Industrial training for a period as specified in the Curriculum during summer / winter vacation. In this case the training has to be undergone either 2 or 4 weeks period.

The students may undergo Internship at Research organization / University (after due approval from the Head of the Institution) for a period prescribed in the curriculum during summer / winter vacation, in lieu of Industrial training.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

1. Gain practical experience within the business environment.
2. Acquire knowledge of the industry in which the internship is done.
3. Apply knowledge and skills learned in the classroom in a work setting.
4. Develop a greater understanding about career options while more clearly defining personal career goals.
5. Experience the activities and functions of business professionals.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3
2	-	-	-	-	3	3	-	-	-	-	-	-	3	-	-
3	-	-	-	-	-	-	3	-	3	-	-	-	-	-	3
4	-	-	-	-	-	-	-	3	3	3	3	-	-	-	3
5	-	-	-	-	-	-	-	-	-	-	-	3	3	3	3
Avg.	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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

EI3764	SYSTEM IDENTIFICATION, MODELING AND	L	T	P	C
	SIMULATION LABORATORY	0	0	3	1.5

COURSE OBJECTIVES:

- To impart theoretical and practical skills in process identification and PID controller tuning.
- To experimentally verify the process control concepts on the selected process control loops.
- To make the students aware of basic and advanced control schemes.
- To impart theoretical and practical skills in process identification and PID controller tuning.

LIST OF EXPERIMENTS: (SIMULATION BASED)

1. Simulation of lumped /distributed parameter system.
2. Mathematical model of a typical industrial process using nonparametric identification methods.
3. Tuning of PID Controller for mathematically described processes.
4. Design and Implementation of Multi-loop PID Controller on the simulated model of a typical industrial process.
5. Simulation of Process Loop
 - I. Digital Input
 - II. Analog Input
 - III. Digital Output
 - IV. Analog Output
6. Design of analog and digital interfaces, interrupts and timer handling.
7. Design of controllers for linear systems.
8. Design of controllers for non linear systems.
9. Hardware in loop simulation of system.
 - I. Microcontroller
 - II. PC based Data acquisition and Control.
10. Hardware simulation of closed loop control system.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Ability to Understand and system identification problems.
- Ability to understand and analyze process control engineering problems.
- Ability to working with real time control loops (flow / level / temperature / pressure).
- Ability to design controllers for both linear and nonlinear system.
- Ability to perform both hardware and software simulation.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	2	-	-	-	1	-	-	2	2	2	2
2	3	3	3	3	3	-	-	-	2	-	-	2	2	2	3
3	3	3	3	3	3	-	-	-	2	-	-	2	3	3	3
4	3	3	3	3	3	-	-	-	2	-	-	2	2	3	3
5	3	3	3	3	3	-	-	-	2	-	-	2	2	3	3
Avg.	3.0	3.0	2.8	2.8	2.8	-	-	-	1.8	-	-	2.0	2.2	2.6	2.8

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

SEMESTER VIII

EI3841

PROJECT WORK

L	T	P	C
0	0	20	10

COURSE OBJECTIVES:

- To enable students to use all concepts for creating a solution for a problem.
- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To develop their own innovative prototype of ideas.
- To improve the team building, communication and management skills of the students.
- To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL : 180 PERIODS

COURSE OUTCOMES:

1. Students will be able to Identify the problem by applying acquired knowledge.
2. Analyze and categorize executable project modules after considering risks.
3. Choose efficient tools for designing project modules.
4. Combine all the modules through effective team work after efficient testing.
5. Elaborate the completed task and compile the project report.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	3	2	-	2	-	2	2	2	3	2	2	2
2	3	2	3	3	3	-	2	-	3	2	2	3	2	2	2
3	3	2	3	3	3	-	2	-	2	2	2	3	3	3	3
4	3	2	3	3	3	-	3	-	3	3	3	3	3	3	3
5	3	2	2	2	3	-	2	-	2	3	3	3	2	2	2
Avg.	3.0	2.0	2.8	2.8	2.8	-	2.2	-	2.4	2.4	2.4	3.0	2.4	2.4	2.4

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

PROFESSIONAL ELECTIVES
Vertical- I (IoT and Automation)

PEI101	PLC AND SCADA	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To give an overview of the automation technologies such as PLCs, SCADA and DCS used in industries
- To provide a fundamental understanding of the different languages used for PLC programming.
- To provide insight into some of the advanced principles those are evolving for present and future automation.
- To give an overview of the automation by DCS used in industries.
- To understand the communication protocol in industry.

UNIT-I INTRODUCTION TO PLC & SCADA 9

PLC: Evolutions of PLCs – Programmable Controllers – Architecture, I/O modules – Comparative study of Industrial PLCs. SCADA: Remote terminal units- Master station - Communication architectures.

UNIT-II BASICS OF PLC PROGRAMMING (LADDER) 9

Basics of PLC programming – Ladder Logic – Relay type instructions – Timer/Counter instructions – Program control instructions – Data manipulation and math instructions – Programming Examples.

UNIT-III PLC PROGRAMMING (OTHER LANGUAGES) 9

Functional block programming - Sequential function chart – Instruction list – Structured text programming – PLC controlled sequential Process Examples.

UNIT-IV DISTRIBUTED CONTROL SYSTEM 9

DCS: Evolution & types – Hardware architecture – Field control station – Interfacing of conventional and smart field devices (Modbus and Profinet) with DCS Controller – Communication modules – Operator and Engineering Human interface stations – Study of any one DCS available in market

UNIT-V ADVANCED TOPICS IN AUTOMATION**9**

Introduction to Networked Control systems – Plant wide control – Internet of things
– Cloud based Automation – OLE for Process Control – Safety PLC – Case studies:
PLC - SCADA – DCS

TOTAL : 45 PERIODS**COURSE OUTCOMES:**

1. Ability to understand all the important components such as PLC, SCADA, DCS, I/O modules and field devices of an industrial automation system.
2. Ability to develop PLC program in different languages for industrial sequential applications
3. Able to select and use most appropriate automation technologies for a given application
4. Ability to gain knowledge on the recent developments in industrial automation.
5. Ability to gain knowledge on the recent communication protocols in industrial automation.

TEXT BOOKS:

1. Petruzella, F.D., "Programmable Logic Controllers", 3rd Edition, Tata McGraw-Hill, 2010.
2. Lucas, M.P., "Distributed Control System", Van Nostrand Reinhold Company, New York, 1986.

REFERENCE BOOKS:

1. Clarke, G., Reynders, D. and Wright, E. "Practical Modern SCADA Protocols: DNP3, IEC 60870.5 and Related Systems", Newnes, 1st Edition, 2004.
2. Hughes, T.A., "Programmable Logic Controllers: Resources for Measurements and Control Series", 3rd Edition, ISA Press, 2004.
3. McMillan, G.K., "Process/Industrial Instrument and Controls Handbook", 5th Edition, McGraw- Hill handbook, New York, 1999.
4. NPTEL Notes on, "Programmable Logic Control System" by Department of Electrical Engg., IIT Kharagpur.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	2	-	1	3	-	-	-	-	2	-	-	-
2	3	1	2	1	-	-	-	-	-	-	-	-	-	1	-
3	3	2	2	1	-	-	-	-	-	-	-	-	-	-	-
4	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
5	2	2	3	2	1	-	1	-	-	-	-	2	-	1	-
Avg.	2.8	1.8	2.2	1.5	1	1	2	-	-	-	-	2	-	1	-

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

COURSE OBJECTIVES:

- To impart knowledge on fundamentals of Robots and its applications
- To impart knowledge to analyze various drive systems and end effectors
- To apply knowledge to choose different sensors for robotic applications
- To Explain the concept of kinematics dynamics and design of robots
- To understand the programming and applications of robot.

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 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, two fingered and three fingered grippers, internal grippers and external grippers, selection and design considerations of a gripper - gripper force calculation and analysis.

UNIT-III 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-IV KINEMATICS, DYNAMICS AND DESIGN OF ROBOTS 9

Robot kinematics - Geometric approach for 2R, 3R manipulators, homogenous transformation using D-H representation, kinematics of WMR, Lagrangian formulation for 2R robot dynamics; Mechanical design aspects of a 2R manipulator.

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 : 45 PERIODS

COURSE OUTCOMES:

1. Understand the fundamentals of Robots and its applications.
2. Analyze various drive systems and end effectors.
3. Apply knowledge to choose different sensors for robotic applications.
4. Explain the concept of kinematics dynamics and design of robots.
5. Understand the programming and applications of robot.

TEXT BOOKS:

1. John. J.Craig, "Introduction to Robotics: Mechanics and Control" 2nd Edition, 2002.
2. Mikell.P.Groover , "Industrial Robotics – Technology, Programming and applications".

REFERENCE BOOKS:

1. Fu K.S. Gonalz R.C. and ice C.S.G."Robotics Control, Sensing, Vision andIntelligence", 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. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer India reprint, 2010.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	2	2	-	-	-	1	2	-	2	2	2	2
2	3	3	2	3	2	-	-	-	2	2	-	2	2	3	2
3	3	3	3	2	3	-	-	-	2	2	-	2	3	3	2
4	3	3	3	3	3	-	-	-	2	2	-	2	2	3	3
5	3	2	2	2	3	-	-	-	2	2	-	2	2	3	3
Avg.	3.0	2.6	2.4	2.4	2.6	-	-	-	1.8	2.0	-	2.0	2.2	2.8	2.4

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

COURSE OBJECTIVES:

- To impart basic idea in Industry 4.0.
- To provide students with good depth of knowledge of designing Industrial 4.0 Systems for various application.
- Learn the design and analysis of Industry 4.0 systems for Energy and smart vehicular applications.
- To teach a variety of classical methods and techniques for analysis and industry 4.0 and cyber physical system.
- To develop practical Industry 4.0 using the emerging applications

UNIT-I INTRODUCTION TO INDUSTRY 4.0 9

Overview of Industrial Revolutions, Historical Context, General framework, Introduction to Internet of Things (IoT) and Industrial Internet of Things (IIoT), Key Characteristics of Industry 4.0, Communication technologies (Wi-Fi, 5G, LPWAN, etc.), IoT platforms and protocols (MQTT, CoAP), IoT in smart manufacturing and logistics Application areas, Dissemination of Industry 4.0 and the disciplines that contribute to its development.

UNIT-II INDUSTRY 4.0 AND CYBER PHYSICAL SYSTEM 9

Introduction to Cyber Physical Systems (CPS), Components of CPS, Architecture and design principles of CPS, Differences between CPS and traditional embedded systems. Data science and technology for CPS, Emerging applications in CPS in different fields. Case study: Application of CPS in health care domain and Manufacturing.

UNIT-III SMART ENERGY SOURCES 9

Energy Storage for Mitigating the variability of Renewable Electricity Sources, Types of electric energy storage, Potential of Sodium-Sulfur Battery Energy Storage to Enable Integration of Wind-Case study. Electric Vehicles as Energy Storage: V2G Capacity Estimation. Smart grid definition and development Smart Grid, Understanding the Smart Grid, Smart grid solutions, Design challenges of smart grid and Industry 4.0.

UNIT-IV DESIGN OF SMART VEHICLE 9

Definition of Smart Vehicles, Evolution of Smart Vehicles, Components of Smart vehicle, Key Features of Smart Vehicles -Autonomous driving capabilities - Advanced driver-assistance systems (ADAS) - Vehicle-to-everything (V2X) communication - Real-time monitoring and data analysis - Enhanced fuel efficiency and environmental sustainability, Control systems, communication system, Energy Management. Software and Hardware and testing modules- Safety measures.

UNIT-V SMART APPLICATIONS 9

Applications of UAVs in Industries. Understanding Smart Appliances -Smart Operation-Smart Monitoring-Smart Energy Savings-Smart Maintenance, Case study-Smart Cars Case study - I : Milk Processing and Packaging Industries, Case study - II: Manufacturing Industries - Case study III - Virtual Reality Lab.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Understand the basic concepts of Industry 4.0 and the other related fields.
2. Understand cyber physical system and the emerging applications.
3. Analyze the different energy storage systems and smart grid system.
4. Implement the industry 4.0 to solve engineering problems.
5. Design of smart vehicle and analyze its performance

TEXT BOOKS:

1. Jean-Claude André, —Industry 4.0, Wiley- ISTE, July 2019, ISBN: 781786304827,2019.
2. Diego Galar Pascual, Pasquale Daponte, Uday Kumar, —Handbook of Industry 4.0 and SMART Systems,Taylor and Francis,2020.
3. Miller M, —The internet of things: How smart TVs, smart cars, smart homes, and smart cities are changing the world, Pearson Education, 2015, ISBN: 9780134021300.

REFERENCE BOOKS:

1. Pengwei Du and Ning Lu, —Energy storage for smart grids: planning and operation for renewable and variable energy resources VERs , Academic

Press, 2018, Reprint edition, ISBN-13: 978-0128100714.

2. Hossam A. Gabbar, —Smart Energy Grid Engineering, Academic Press, 2017, ISBN 978-0-12-805343-0.

3. Mini S. Thomas, John Douglas McDonald, —Power System SCADA and Smart Grids, CRC Press, 2017.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3		2		2							2	3		
2	3	2	2		2							2		3	
3	2	3	2				2					2		3	
4	3	2	2	3	3						2	2	2		3
5	2	2	3	2	3					2				2	3
Avg.	2.6	2.3	2.2	2.5	2.5	-	2.0	-	-	2.0	2.0	2.0	2.5	2.7	3.0

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

COURSE OBJECTIVES:

- To design simple IoT systems comprising sensors, edge devices, wireless network connections, data analytics capabilities and cloud storage.
- To acquire specific scripting knowledge to develop interactive applications.
- To understand the basics of android application development.
- To apply programming skills in developing applications pertaining to Industrial, medical, agricultural, etc.
- To familiarize the students to the basics of Internet of things and protocols.

UNIT-I FUNDAMENTALS OF IoT CONCEPTS 9

Introduction to IoT concept, Objective, IoT History, Introduction to IoT communication, Why IoT, IoT Architecture, Telemetry Vs IoT, IoT Technologies behind smart & Intelligence devices, Building blocks of an IoT device - Programming Inputs and outputs, Serial, SPI and I2C - Sensors and sensor Node and interfacing using any Embedded target boards (Raspberry Pi / Intel Galileo / ARM Cortex / Arduino).

UNIT-II SENSORS IN IoT 9

Introduction to IoT sensors, roles of IoT sensor, Types of IoT sensors – temperature sensor, proximity sensor, pressure sensor, water quality sensor, chemical sensor, gas sensor, infrared sensor, smoke sensor, image sensor, level sensor, motion sensor, humidity sensor, acceleration sensor, Gyroscopic sensor – Consideration in IoT sensors, Applications.

UNIT-III INTRODUCTION TO SENSORS AND TYPES 9

IoT Sensors/Actuators and IoT Challenges: IoT: Sensor Technology, Mobile Phone Based Sensors, Medical Sensors, Neural Sensors, Environmental and Chemical Sensors, Radio Frequency Identification, Actuators, IoT Challenges: Design challenges, Development challenges, Privacy and Security challenges, Data Management and Other challenges.

UNIT-IV DOMESTIC APPLICATION OF IoT 9

Smart Homes - Smart Appliances, Security and Safety. Smart Energy - Smart Meters, Automatic Meter Reading (AMR), Advanced Metering Infrastructure (AMI), Real Time Pricing, Smart grid, Smart Cities: Energy Consumption Monitoring, Smart Energy Meters, Home automation, Solar Energy Harvesting, Intelligent Parking, Data lake services scenarios. Smart Vehicles, Smart Lighting, etc.

UNIT-V IoT FOR FARMING AND HEALTHCARE 9

Smart Farming: Weather monitoring, Precision farming, Smart Greenhouse, Drones for pesticides - Architecture of IoT for Healthcare, Multiple views coalescence, SBC-ADL to construct the system architecture - Wearable devices for Remote monitoring of Physiological parameter, ECG, EEG, Diabetes and Blood Pressure.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will have

1. Ability to design simple IoT systems comprising sensors, edge devices, wireless network connections, data analytics capabilities and cloud storage.
2. Ability to solve the need for smart systems in a distributed environment.
3. Ability to understand the IoT architecture and building blocks for various domains.
4. Ability to explain the basics concepts of sensors used in IoT and its principles and various types used in its applications.
5. Ability to explain the need for smart systems in a distributed environment
6. Ability to implement multidisciplinary case to case modelling and execute wide range of application.

TEXT BOOKS:

1. Internet of Things by Rajkamal, Tata McGraw Hill publication.
2. Internet of things(A-Hand-on-Approach) By Vijay Madiseti and ArshdeepBahga1st Edition, Universal Press.
3. The Internet of Things: Connecting Objects By Hakima Chaouchi Wiley publication.

REFERENCE BOOKS:

1. Subhas Chandra Mukhopadhyay, "Intelligent Sensing, Instrumentation and Measurements (Smart Sensors, Measurement and Instrumentation Book 5)," Springer, 2013.
2. Manabendra Bhuyan, "Intelligent Instrumentation: Principles and Applications", CRC Press, 2017.
3. Fadi Al-Turjman, Intelligence in IoT- enabled Smart Cities, 2019, 1st edition, CRC Press, ISBN-10: 1138316849
4. Subhas Chandra Mukhopadhyay, Smart Sensing Technology for Agriculture and Environmental Monitoring, 2012, Springer, ISBN-10: 3642276377
5. Giacomo Veneri, and Antonio Capasso, Hands-on Industrial Internet of Things: Create a powerful industrial IoT infrastructure using Industry 4.0, 2018, Packt Publishing.
6. The Internet of Things – Key applications and Protocols By Olivier Hersent, David Boswarthick, Omar Elloumi,, Wiley, 2012.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	1	2									2	
2	1	2	2	1			1							2	
3					1										
4	1												1	2	
5	1						1								
6	1														1
Avg.	1.2	2	2	1	1.5	-	1	-	-	-	-	-	1	2	1

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

COURSE OBJECTIVES:

- To understand the basics of sensors used for various applications.
- To develop the concept of signal conditioning circuits and implementation.
- To study the role IoT sensors for automotive industries.
- To familiarize about the functioning of IoT based sensors in healthcare industry.
- To knowledge on unmanned Aerial vehicle.

UNIT-I SENSORS & TRANSDUCERS 9

Introduction to IoT Sensors- Temperature sensors, Proximity sensor, Pressure sensor, Water quality sensor, Chemical sensor, Gas sensor, Smoke sensor, IR sensors, Level sensors, Image sensors, motion sensor, Humidity sensor, Ultrasonic Sensor, MQ2 Sensor, Digital switch, Electro Mechanical switches.

UNIT-II SIGNAL CONDITION CIRCUITS 9

Design of Signal conditioning circuit – Wheatstone Bridge, Differential and Instrumentation amplifiers, Capacitive Sensors, Inductive Sensors, Electromagnetic Sensors, Thermocouples, Piezoelectric Sensors, Photovoltaic Sensors, Thermistor, RTD, Load cell, Torque, Strain gauge, Force Sensor, Accelerometer, Digital and Intelligent Sensors.

UNIT-III INTERNET OF THINGS IN AUTOMOTIVE INDUSTRIES 9

Role of IoT automotive industries, interfacing of digital and analog sensors in automotive industries, Biometric car door opening, accident monitoring, Engine management system, driver management system, real time vehicle tracking system, 5G advanced driver assistance systems (ADAS), Augmented road sign information, In-vehicle Infotainment and Telematics, Automotive Maintenance System, Truck's performance statistics like fuel and mileage, Tracking traffic conditions on the road.

UNIT-IV INTERNET OF THINGS FOR THE HEALTHCARE 9
INDUSTRY

Emerging Technologies in Smart Healthcare, Fog Computing in Healthcare, Technologies Used in Software Defined Networking (SDN) and HealthCare, WSN and IoT Based Smart Surveillance Systems for Patients, Security and Privacy Issues in Smart Healthcare System, IoMT- Based Smart Remote Monitoring System

UNIT-V IOT FOR UNMANNED AERIAL VEHICLES 9

Introduction, Battery and Energy Management, Energy Efficient Communication Methods, Unmanned Aerial Vehicle (UAV) for Security Intelligence, Gateways, Cloud Computers, Role of AI and Big Data Analytics in UAV, Blockchain-Based Solutions for Various Security Issues.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Categorize sensors and transducers used in industry.
2. Explain about signal conditioning circuits.
3. Apply IoT design concept on automotive industry.
4. Analyse used of IoT technology in health care industry.
5. Design unmanned aerial vehicles.

TEXT BOOKS:

1. A.K. Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai & Co. (P) Limited, 2015.
2. Ramon pallas-areny, John G. Webster, sensors and signal Conditioning, A Wiley- Interscience Publication, , 2001
3. IoT-Enabled Smart Healthcare Systems, Services and Applications by Shalli Rani, Maheswar Rajagopal, Neeraj Kumar, Syed Hassan Ahmed Shah, John.Wiley & Sons, Inc, 2022.

REFERENCE BOOKS:

1. Jerry Luecke, Analog and Digital Circuits for Electronic Control System Applications, Elsevier Inc., 2005
2. Chimata, Raghuveer, Singh, Rajesh, Singh, Bhupendra, Internet of Things in Automotive Industries and Road Safety, River Publishers, 2018.

3. IoT in Automotive Industry: <https://www.biz4intellia.com/blog/iot-applications-in-automotive-industry>

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	-	1	1	-	-	-	-	-	2	2	2
2	2	2	1	1	-	1	1	-	-	-	-	-	2	2	2
3	3	2	2	2	-	1	1	-	-	-	-	-	2	2	2
4	3	3	3	2	-	1	1	-	-	-	-	-	2	2	2
5	3	3	3	3	-	1	1	-	-	-	-	-	2	2	2
Avg.	2.8	2.6	2.4	2.2	-	1	1	-	-	-	-	-	2	2	2

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

COURSE OBJECTIVES:

- To understand the basic security terms in Internet of Things (IoT).
- To learn the fundamentals of security management and cryptography in IoT.
- To understand the cryptography of embedded devices in the IoT.
- To gain knowledge about the IoT protocols in security perspective.
- To realize security issues for various applications using case studies.

UNIT-I INTRODUCTION 9

Introduction to IoT Security – Attacks and Counter measures, Vulnerabilities, Information Assurance, Attack types, New security threats and vulnerabilities, Fault Trees and CPS. Threat Modeling. Attack, Defense, and Network Robustness of Internet of Things, A Solution-Based Analysis of Attack Vectors on Smart Home Systems.

UNIT-II SECURITY MANAGEMENT & CRYPTOLOGY 9

Building security into design and development, Safety and security design, Security Management & Cryptology- Security Controls, Access Control, Key Management, Communication and messaging Protocols, Cipher – Symmetric Key Algorithms, Public Private Key Cryptography; Attacks – Dictionary and Brute Force, Lookup Tables, Reverse Look Tables, Rainbow Tables, Hashing – MD5, SHA 256, SHA 512, Ripe MD, WI.

UNIT-III SECURITY IN EMBEDDED DEVICES 9

Attack Surface and Threat Assessment - Embedded Devices – UART, SPI, I2C, JTAG, Attacks– Software and cloud components, Firmware devices, Web and Mobile Applications.

UNIT-IV IoT PROTOCOLS 9

IoT Protocol Built-in Security Features – Transport Layer, COAP, UDP, TCP, MQTT, SSL/TLS, DTLS, LIGHT WEIGHT M2M, XMPP, Zigbee, LoRa, BLE, Kerberos, Cloud security for IoT.

UNIT-V IoT APPLICATIONS**9**

Case Studies and Discussion: Smart Agriculture, Cities, Grid, Healthcare, Smart Homes, smart street lighting, Smart building, Smart parking, smart irrigation, Supply Chain, and Transportation, Application of Security Concepts to Create IoT system.

TOTAL : 45 PERIODS**COURSE OUTCOMES:**

On completion of the course, the student will be able to:

1. Explain the security requirements in IoT Architecture.
2. Describe the different cryptographic techniques in IoT Security.
3. Classify various embedded devices related to IoT.
4. Analyze IoT protocols.
5. Interpret IoT applications in several fields.

TEXT BOOKS:

1. Russell, Brian, and Drew Van Duren. Practical Internet of Things Security: Design a security framework for an Internet connected ecosystem. Packt Publishing Ltd, 2016.
2. Hu, Fei. Security and privacy in Internet of things (IoTs): Models, Algorithms, and Implementations. Taylor & Francis Group, 2020.
3. Cheruvu, Sunil, Anil Kumar, Ned Smith, and David M. Wheeler. Demystifying internet of things security: successful IoT device/edge and platform security deployment. Springer Nature, 2020.

REFERENCE BOOKS:

1. Shancang Li and Li Da Xu, "Securing the Internet of Things", Elsevier, 2017.
2. Sridipta Misra, Muthucumaru Maheswaran, Salman Hashmi, "Security Challenges and Approaches in Internet of Things," Springer, 2017.
3. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A Hands-on approach," VPT Publishers, 2014.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	3	3	2	-	-	-	-	-	-	-	2	2	2
2	2	3	3	2	-	-	-	-	-	-	-	2	2	2
3	2	3	2	2	-	-	-	-	-	-	-	2	2	2
4	2	3	3	2	-	-	-	-	-	-	-	2	2	2
5	2	3	3	2	-	-	-	-	-	-	-	2	2	2
Avg.	2	3	3	2	-	-	-	-	-	-	-	2	2	2

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

PROFESSIONAL ELECTIVES
Vertical-II (Advanced Control)

PEI201	PROCESS MODELLING AND SIMULATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To develop mathematical model and dynamic simulator for chemical processes.
- To expose the students to various chemical production processes.
- To develop various processes and unit operations using numerical methods.
- To use the process simulation as a tool for understanding a chemical process.
- This course deals with understanding physical systems in chemical engineering and to develop their mathematical models

UNIT-I INTRODUCTION TO PROCESS MODELING 9

Introduction to process modeling - a systematic approach to model building, classification of models, Conservation principles, thermodynamic principles of process systems.

UNIT-II MODELLING PRINCIPLES FOR LUMPED PARAMETER SYSTEMS 9

Development of steady state and dynamic lumped and distributed parameter models based on first principles. Analysis of ill-conditioned systems, Models with stiff differential equations.

UNIT-III DEVELOPMENT AND VALIDATION OF GREY-BOX MODELS 9

Development of grey box models, Empirical model building, Statistical model calibration and validation, Introduction to population balance models, multi-scale modeling.

UNIT-IV SOLUTION STRATEGIES FOR LUMPED PARAMETER 9

MODELS AND STIFF DIFFERENTIAL EQUATIONS

Solution strategies for lumped parameter models and stiff differential equations, Solution methods for initial value and boundary value problems. Euler's method. R-K methods, shooting method, finite difference methods – predictor corrector methods.

UNIT-V METHODS OF SOLVING DISTRIBUTED PARAMETER 9 **MODELS**

Solution strategies for distributed parameter models. Solving parabolic, elliptic and hyperbolic partial differential equations. Introduction to finite element and finite volume methods.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Develop process models based on conservation principles and process data.
2. Apply computational techniques to solve the process models
3. Apply different methods for parameters estimation
4. Develop model equations for a given system.
5. Simulate process models using MATLAB/SCILAB

TEXT BOOKS:

1. K. M. Hargos and I. T. Cameron, Process Modeling and Model Analysis, Academic Press, 2001.
2. W.L. Luyben, Process Modeling, Simulation and Control for Chemical Engineers, 2 ndEdn., McGraw Hill Book Co., New York, 1990.
3. Singiresu S. Rao, Applied Numerical Methods for Engineers and Scientists Prentice Hall, Upper Saddle River, NJ, 2001.

REFERENCE BOOKS:

1. Bruce A. Finlayson, Introduction to Chemical Engineering Computing, Wiley, 2010.
2. W. F. Ramirez, Computational Methods for Process Simulation, 2nd ed., Butterworths, 1997.
3. Amiya K. Jana, Chemical Process Modelling and Computer Simulation, Prentice Hall of India, 2nd Edition, 2011.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2										2	3		
2	2	2		3	3							2		2	
3	2	3		3	2							2	2	2	
4	3	2	2	2									2	2	
5	2				3					2		2		3	2
Avg.	2.4	2.3	2.0	2.7	2.7	-	-	-	-	2.0	-	2.0	2.3	2.3	2.0

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

COURSE OBJECTIVES:

- To teach students to build and analyze models for time-varying systems and non-linear systems.
- To develop the skills needed to design adaptive controllers such as gain-scheduled adaptive controller, Model-reference adaptive controller and Self-tuning controller for various applications.
- To make the students learn to formulate optimal control schemes.
- To provide basic knowledge about Fractional-order systems and Fractional-order- controller and to lay the foundation for the systematic approach to Design controller for fractional order systems.
- To introduce FDI Techniques, such as Principal component Analysis, state observer to detect and diagnose faults in sensors and actuators.

UNIT-I REVIEW OF SYSTEMS 9

Review of first and higher order systems, closed and open loop response. Response to step, impulse and sinusoidal disturbances. Transient response. Block diagrams.

UNIT-II STABILITY ANALYSIS 9

Stability Analysis: Frequency response, design of control system, process identification. PI Controller tuning - Ziegler-Nichols and Cohen-Coon tuning methods, Bode and Nyquist stability criterion. Process identification.

UNIT-III COMPLEX CONTROL TECHNIQUES 9

Advanced control techniques, cascade, ratio, feed forward, adaptive control, Smith predictor, internal model control, model based control systems- Case studies: Power plant.

UNIT-IV MULTIVARIABLE CONTROL ANALYSIS 9

Introduction to state-space methods, Control degrees of freedom analysis and analysis, Interaction, Bristol arrays, Niederlinski index - design of controllers, Tuning of multivariable PI controllers, Design of multivariable DMC and MPC.

UNIT-V SAMPLE DATA CONTROLLERS**9**

Basic review of Z transforms, Response of discrete systems to various inputs. Open and closed loop response to step, impulse and sinusoidal inputs, closed loop response of discrete systems. Design of digital controllers.

TOTAL : 45 PERIODS**COURSE OUTCOMES:**

1. Apply knowledge of mathematics, science, and engineering to build and analyze models for time-varying systems and non-linear systems.
2. Ability to design and implement adaptive controllers such as gain-scheduled adaptive controller, Model-reference adaptive controller and Self-tuning controller
3. Ability to Identify, formulate, and solve optimal controller
4. Ability to Analyze Fractional-order systems, Fractional-order- controller and Design controller for fractional order systems
5. Ability to design and implement H2 and H-infinity Controllers.

TEXT BOOKS:

1. D.R. Coughanour, S.E. LeBlanc, Process Systems analysis and Control, McGraw-Hill, 2nd Edition, 2009.
2. D.E. Seborg, T.F. Edgar, and D.A. Millichamp, Process Dynamics and Control, John Wiley and Sons, 2nd Edition, 2004.
3. B.A.Ogunnaike and W.H.Ray, Process Dynamics, Modelling and Control, Oxford Press, 1994.

REFERENCE BOOKS:

1. B.W. Bequette, Process Control: Modeling, Design and Simulation, PHI, 2006.
2. S. Bhanot, Process Control: Principles and Applications, Oxford University Press, 2008.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	1	-	-	1	1	-	-	-	-	1	-	-	-
2	3	1	1	1	2	1	1	-	-	-		1	-	-	-
3	3	2	2	1	1	1	1	-	-	-	-	1	-	-	-
4	3	2	2	1	1	1	1	-	-	-	-	1	-	-	-
5	2	1	1	1	1	1	1	-	-	-	-	1	-	-	-
Avg.	2.8	1.4	1.4	1	1.3	1	1	-	-	-	-	1	-	-	-

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

COURSE OBJECTIVES:

- To introduce the concept of MIMO system.
- To impart knowledge in Model Predictive Control.
- To impart knowledge in characteristics and performance of Model Predictive Control Scheme.
- To teach a variety of classical methods and techniques for analysis and design of Model Predictive Control.
- To develop practical control systems using Adaptive Model Predictive Control Scheme.

UNIT-I INTRODUCTION TO MIMO CONTROL 9

Introduction to MIMO Systems-Multivariable control-Multiloop Control-Multivariable IMC-IMCPID-Case studies.

UNIT-II MODEL PREDICTIVE CONTROL SCHEMES 9

Introduction to Model Predictive Control – Model Predictive Control Elements – Generalized Predictive Control Scheme – Multivariable Generalized Predictive Control Scheme – Multiple Model based Model Predictive Control Scheme Case Studies.

UNIT-III STATE SPACE BASED MODEL PREDICTIVE CONTROL SCHEME 9

State Space Model Based Predictive Control Scheme – Review of Kalman Update based filters -State Observer Based Model Predictive Control Schemes – Case Studies.

UNIT-IV CONSTRAINED MODEL PREDICTIVE CONTROL SCHEME 9

Constraints Handling: Amplitude Constraints and Rate Constraints -Constraints and Optimization – Constrained Model Predictive Control Scheme – Case Studies.

UNIT-V ADAPTIVE CONTROL SCHEME**9**

Introduction to Adaptive Control-Gain Scheduling-Self tuning regulators-MARS-
Adaptive Model Predictive Control Scheme -Case Studies.

TOTAL : 45 PERIODS**COURSE OUTCOMES:**

1. Ability to apply engineering knowledge to understand the control schemes on MIMO systems.
2. Ability to design controller for MIMO system.
3. Ability to analyze the control schemes available in industries.
4. Ability to design MPC, Adaptive controllers for practical engineering problems.
5. Ability to choose suitable controllers for the given problems.

TEXT BOOKS:

1. Coleman Brosilow, Babu Joseph, Techniques of Model-Based Control, Prentice Hall PTR Pub 2002, 1st Edition.
2. E. F. Camacho, C. Bordons, Model Predictive Control, Springer-Verlag London Limited 2007, 2nd Edition.
3. K.J. Astrom and B. J. Wittenmark, Adaptive Control, Second Edition, Pearson Education Inc., second Edition 2013.

REFERENCE BOOKS:

1. Paul Serban Agachi, Zoltan K. Nagy, Mircea Vasile Cristea, and Arpad Imre-Lucaci, Model Based Control Case Studies in Process Engineering, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim 2007. 1st Edition.
2. Ridong Zhang, Anke Xue Furong Gao, Model Predictive Control Approaches Based on the Extended State Space Model and Extended Non-minimal State Space Model, Springer Nature Singapore Pte Ltd. 2019, 1st Edition.
3. J.A. ROSSITER, Model-Based Predictive Control A Practical Approach, Taylor & Francis eLibrary, 2005, 1st edition.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	2	-	1	3	-	-	-	-	2	-	1	-
2	3	1	2	1	-	-	-	-	-	-	-	-	-	-	-
3	3	2	2	1	-	-	-	-	-	-	-	-	-	-	-
4	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
5	2	2	3	2	1	-	1	-	-	-	-	2	-	1	-
Avg.	2.8	1.8	2.2	1.5	1	1	2	-	-	-	-	2	-	1	-

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

PEI204	SYSTEM IDENTIFICATION AND ADAPTIVE	L	T	P	C
	CONTROL	3	0	0	3

COURSE OBJECTIVES:

- To introduce process identification technique.
- To train the students in non-linear system identification techniques.
- To expose to the students, the system identification in discrete models.
- To learn adaptive control systems.
- To learn model reference adaptive system

UNIT-I PROCESS IDENTIFICATION 9

(Non-Parametric methods): Transient response analysis - frequency response analysis - correlation analysis - State space modeling of systems - nonlinear state space model and linearization of nonlinear models; modeling in state space - state space models – canonical state space forms- mechanical systems –electrical systems – liquid level systems- thermal systems. state estimation using kalman filter - kalman filter for parameter identification.

UNIT-II NONLINEAR SYSTEM IDENTIFICATION 9

Modeling of non-linear system using NARX, NNSS, NARMAX, Hammerstein models – Wiener model, ANN. Generation of training data – training feed-forward and recurrent neural networks- tsk model- adaptive neuro-fuzzy inference system(ANFIS). Practical aspects of System identification and control: Selection of input signals - offline and online identification; notion for persistent excitation, -drifts and de-trending-outliers and missing data-pre-filtering-robustness – comparison of parameter estimation methods – model order testing and verification- case studies.

UNIT-III DISCRETE TIME SYSTEM MODELS 9

ARX models - bilinear parametric models – ARMAX, Output Error (OE), Box Jenkins (B-J) models - –prediction error method and instrumental variable method. Selection of pseudo random binary sequence.

UNIT-IV ADAPTIVE CONTROL 9

Adaptive control theory. Applications. Situations when constant Gain feedback is insufficient. Robust control. The adaptive control problem. The model following problem. MRAS based on stability theory.

UNIT-V MODEL REFERENCE ADAPTIVE SYSTEM 9

Direct MRAS for general linear systems. Prior knowledge in MRAS. MRAS for partially known systems. Use of robust estimation methods in MRAS. The basic idea. Indirect self-tuning regulators. Direct Self-tuning regulators. Linear Quadratic STR. Adaptive Predictive control. Prior knowledge in STR.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Understand and explain about different model structures, parameterization, identifiability, structure determination and order estimation
2. Understand and explain about different model structures, parameterization, identifiability, structure determination and order estimation for nonlinear model
3. Understand and explain about different model structures, parameterization, identifiability, structure determination and order estimation for discrete model
4. Understand the effect of parameter variation and principle of adaptive control schemes
5. Understand the effect of parameter variation and principle of model reference adaptive system

TEXT BOOKS:

1. Torsten Soderstrom, Petre Stoica, System Identification, Prentice Hall International (UK) Ltd. 1989.
2. Karl J. Astrom & Bjorn Wittenmark, 'Adaptive Control', Pearson Education (Singapore), Second Edition, 2003.

REFERENCE BOOKS:

1. Arun K. Tangirala, Principles of System Identification: Theory and Practice, First Edition, CRC Press, 2014

2. Karel J. Keesman, System Identification: An Introduction, Springer-Verlag London, 2011
3. K.J. Astrom and B. Wittenmark, Adaptive Control, Second Edition, Dovers Publication.
4. L. Ljung, System Identification Theory for the User, Prentice-Hall, 2007

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	-	-	-	-	-	-	-	-	1	3	1	3
2	3	3	2	2	-	-	-	-	-	-	-	1	3	3	3
3	3	3	2	2	-	-	-	-	-	-	-	1	2	2	3
4	3	3	2	2	-	-	-	-	-	-	-	1	2	2	3
5	3	3	2	2	-	-	2	-	-	-	-	1	2	2	2
Avg.	3	3	2.2	2	-	-	2	-	-	-	-	1	2.4	2	2.8

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

COURSE OBJECTIVES:

- To provide knowledge on design in state variable form
- To provide knowledge in phase plane analysis.
- To give basic knowledge in describing function analysis.
- To study the design of optimal controller.
- To study the design of optimal estimator including Kalman Filter

UNIT-I STATE VARIABLE DESIGN 9

Introduction to state Model- effect of state Feedback- Necessary and Sufficient Condition for Arbitrary Pole-placement- pole placement Design- design of state Observers- separation principle- servo design: -State Feedback with integral control.

UNIT-II PHASE PLANE ANALYSIS 9

Features of linear and non-linear systems - Common physical non-linearities – Methods of linearization Concept of phase portraits – Singular points – Limit cycles – Construction of phase portraits – Phase plane analysis of linear and non-linear systems – Isocline method.

UNIT-III DESCRIBING FUNCTION ANALYSIS 9

Basic concepts, derivation of describing functions for common non-linearities – Describing function analysis of non-linear systems – limit cycles – Stability of oscillations.

UNIT-IV OPTIMAL CONTROL 9

Introduction - Time varying optimal control – LQR steady state optimal control – Solution of Ricatti's equation – Application examples.

UNIT-V OPTIMAL ESTIMATION 9

Optimal estimation – KalmanBucy Filter-Solution by duality principle-Discrete systems- Kalman Filter-Application examples.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Able to apply the knowledge gained on state feedback control and nonlinear control.
2. Ability to carryout analysis for common nonlinearities in a system.
3. Apply advanced control theory to practical engineering problems.
4. Design optimal controller.
5. Understand the basics and Importance of Kalman filter.

TEXT BOOKS:

1. G. J. Thaler, "Automatic Control Systems", Jaico Publishing House 1993.
2. M.Gopal, Modern Control System Theory, New Age International Publishers, 2002, 2nd Edition.
3. K. P. Mohandas, "Modern Control Engineering", Sanguine Technical Publishers, 2006, 1st Edition.

REFERENCE BOOKS:

1. Ashish Tewari, 'Modern Control Design with Matlab and Simulink', John Wiley, New Delhi, 2002, 1st Edition.
2. K. Ogata, 'Modern Control Engineering', 5th Edition, PHI, New Delhi, 2009.
3. T. Glad and L. Ljung,, "Control Theory –Multivariable and Non-Linear Methods", Taylor & Francis, 2002, 1st Edition.
4. D.S.Naidu, "Optimal Control Systems" First Indian Reprint, CRC Press, 2009, 1st Edition.
5. William S Levine, "Control System Fundamentals," The Control Handbook, CRC Press, Tayler and Francies Group, 2011, 2nd Edition.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	2	1	1	1	3	1	3	1	1	2	2	2
2	3	3	3	2	1	1	1	3	1	3	1	1	2	2	2
3	3	2	2	2	1	1	1	3	1	3	1	1	2	2	2
4	3	3	3	3	1	1	1	3	1	3	1	1	2	2	2
5	2	1	2	1	1	1	1	2	1	2	1	1	2	2	2
Avg.	2.8	2.2	2.4	2.0	1.0	1.0	1.0	2.8	1.0	2.8	1.0	1.0	2.0	2.0	2.0

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

COURSE OBJECTIVES:

- To provide an exposure to different type of optimal control problems such as time- optimal, fuel optimal, energy optimal control problems.
- To impart knowledge and skills needed to design Linear Quadratic Regulator for Time- invariant and Time-varying Linear system (Continuous time and Discrete-time systems).
- To introduce concepts needed to design optimal controller using Dynamic Programming Approach and H-J-B equation.
- To provide an exposure to various types of fault tolerant control schemes such as Passive and active approaches.
- To introduce concepts needed to design optimal controller in the presence of state constraints and time optimal controller.

UNIT-I CALCULUS OF VARIATIONS AND OPTIMAL CONTROL 9

Introduction – Performance Index- Constraints – Formal statement of optimal control system– Calculus of variations – Function, Functional, Increment, Differential and variation and optimum of function and functional – The basic variation problem
Extrema of functions and functional with conditions – variational approach to optimal control system

UNIT-II LINEAR QUADRATIC OPTIMAL CONTROL SYSTEM 9

Problem formulation – Finite time Linear Quadratic regulator – Infinite time LQR system: Time Varying case- Time-invariant case – Stability issues of Time-invariant regulator – Linear Quadratic Tracking system: Finite time case and Infinite time case.

UNIT-III DISCRETE TIME OPTIMAL CONTROL SYSTEMS 9

Variational calculus for Discrete time systems – Discrete time optimal control systems:- Fixed final state and open-loop optimal control and Free-final state and open-loop optimal control - Discrete time linear state regulator system – Steady state regulator system.

Pontryagin Minimum Principle – Dynamic Programming:- Principle of optimality, optimal control using Dynamic Programming – Optimal Control of Continuous time and Discrete-time systems – Hamilton-Jacobi-Bellman Equation – LQR system using H-J-B equation.

Time optimal control systems – Fuel Optimal Control Systems- Energy Optimal Control Systems – Optimal Control Systems with State Constraints.

COURSE OUTCOMES:

1. Explain different type of optimal control problems such as time-optimal, fuel optimal, energy optimal control problems.
2. Design Linear Quadratic Regulator for Time-invariant and Time-varying Linear system (Continuous time and Discrete-time systems)
3. Design optimal controller using Dynamic Programming Approach and H-J-B equation.
4. Explain the Pontryagin Minimum Principle.
5. Design optimal controller in the presence of state constraints and time optimal controller.

1. Donald E. Kirk, Optimal Control Theory – An Introduction, Dover Publications, Inc. Mineola, New York. 2012. 10th Edition.

1. D. Subbaram Naidu, Optimal Control Systems, CRC Press, New York, 2003, 1st Edition.
2. Frank L. Lewis, Draguna Vrabie, Vassilis L. Syrmos, Optimal Control, 3rd Edition, Wiley Publication, 2012, 3rd Edition.
3. Yan Wang, Cheng-Lin Liu, Zhi-Cheng Ji, Quantitative Analysis and Optimal Control of Energy Efficiency in Discrete Manufacturing System, Springer, 2020, 1st Edition.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	-	1	1	-	-	-	-	-	2	2	2
2	2	2	1	1	-	1	1	-	-	-	-	-	2	2	2
3	3	2	2	2	-	1	1	-	-	-	-	-	2	2	2
4	3	3	3	2	-	1	1	-	-	-	-	-	2	2	2
5	3	3	3	3	-	1	1	-	-	-	-	-	2	2	2
Avg.	2.8	2.6	2.4	2.2	-	1	1	-	-	-	-	-	2	2	2

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

PROFESSIONAL ELECTIVES
Vertical-III (Applied Instrumentation)

PEI301	ANALYTICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the theory and operational principles of instrumental methods for identification and quantitative analysis of chemical substances by different types of spectroscopy.
- To impart fundamental knowledge on gas chromatography and liquid chromatography.
- To integrate a fundamental understanding of the underlining principles of physics as they relate to specific instrumentation used for gas analyzers and pollution monitoring instruments.
- To impart knowledge on the important measurement in many chemical processes and laboratories handling liquids or solutions.
- To understand the working principle, types and applications of NMR and Mass spectroscopy.

UNIT-I SPECTROPHOTOMETRY 9

Spectral methods of analysis – Beer-Lambert law – UV-Visible spectroscopy – IR Spectrophotometry - FTIR spectrophotometry – Atomic absorption spectrophotometry - Flame emission and atomic emission photometry – Construction, working principle, sources detectors and applications.

UNIT-II CHROMATOGRAPHY 9

General principles – classification – chromatographic behaviour of solutes – quantitative determination – Gas chromatography – Liquid chromatography - High-pressure liquid chromatography – Applications.

UNIT-III INDUSTRIAL GAS ANALYZERS AND POLLUTION 9
MONITORING INSTRUMENTS

Gas analyzers – Oxygen, NO₂ and H₂S types, IR analyzers, thermal conductivity

detectors, analysis based on ionization of gases. Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation - Dust and smoke measurements.

UNIT-IV pH METERS AND DISSOLVED COMPONENT ANALYZERS 9

Selective ion electrodes - Principle of pH and conductivity measurement - dissolved oxygen analyzer – Sodium analyzer – Silicon analyzer – Water quality Analyzers.

UNIT-V NUCLEAR MAGNETIC RESONANCE AND MASS SPECTROMETRY 9

NMR – Basic principles – Continuous and Pulsed Fourier Transform NMR spectrometer – Mass Spectrometry – Sample system – Ionization methods – Mass analyzers – Types of mass spectrometry.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Understand the basic concept of qualitative and quantitative analysis of a given sample.
2. Explain the working knowledge of analytical instrumentation typically employed in chemical/biochemical research and industry laboratories.
3. Apply the fundamental principles of selective analytical instruments for separation, identification and quantitative analysis of chemical substances.
4. Differentiate between online and offline process and identify suitable instruments for analysis.
5. Describe the relative strengths and limitations of different instrumental based analysis methods.
6. Identify and suggest a suitable analytical method for a specific application.

TEXT BOOKS:

1. Braun, R.D., "Introduction to Instrumental Analysis", Pharma Book Syndicate, Singapore, 2nd edition 2016.
2. Willard, H.H., Merritt, L.L., Dean, J.A., Settle, F.A., "Instrumental methods of analysis", CBS publishing & distribution, 7th Edition, 2012.

3. Robert E. Sherman., "Analytical Instrumentation, Instruments", Society of America, 1996.

REFERENCE BOOKS:

1. Khandpur, R.S., "Handbook of Analytical Instruments", Tata McGraw Hill publishing Co. Ltd., 5th edition 2018.
2. Ewing, G.W., "Instrumental Methods of Chemical Analysis", McGraw Hill, 5th edition reprint 1985. Digitized in May 2013.
3. Liptak, B.G., "Process Measurement and Analysis", CRC Press, 5th Edition, 2016.
4. NPTEL lecture notes on, "Modern Instrumental methods of Analysis" by Dr.J.R. Mudakavi, IISC, Bangalore.
5. R.K.Jain, Mechanical and Industrial Measurements, Khanna Publishers, New Delhi, 1999

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	-	1	1	-	-	-	-	-	2	-	-
2	2	2	2	2	-	1	1	-	-	-	-	-	2	-	-
3	3	3	3	2	-	1	1	-	-	-	-	-	2	-	-
4	3	3	3	2	-	1	1	-	-	-	-	-	2	-	-
5	2	2	2	2	-	1	1	-	-	-	-	-	2	-	-
6	1	1	1	1	-	1	1	-	-	-	-	-	2	-	-
Avg.	2.2	2.2	2.2	1.8	-	1	1	-	-	-	-	-	2	-	-

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

COURSE OBJECTIVES:

- To make the students familiarize about various power generation methods.
- To identify various parameters in thermal power plant
- To impart knowledge about different types of control loops in furnace control.
- To impart knowledge about different types of control loops in boiler control.
- To familiarize the student with the methods of monitoring different parameters like speed, vibration of turbines and their control.

UNIT-I POWER GENERATION METHODS 9

Brief survey of methods of power generation: hydro, thermal, nuclear, solar and wind power – importance of instrumentation in power generation – thermal power plants: building blocks, details of boiler processes P&I diagram of boiler – cogeneration.

UNIT-II MEASUREMENTS IN POWER PLANTS 9

Metal temperature measurement in boilers, impulse-piping system for pressure measuring devices, Thermal analysers, flame monitoring. Introduction to turbine supervising system, pedestal vibration, shaft vibration, eccentricity measurement. Installation of non-contracting transducers for speed measurement, rotor and casing movement and expansion measurement.

UNIT-III BOILER CONTROL - I 9

Draught plant: Introduction, natural draught, forced draught, induced draught, balanced draught, power requirements for draught systems. Fan drives and control, control of airflow. Combustion control: Fuel/Air ratio, oxygen, CO and CO₂ trimming, combustion efficiency, excess air, parallel and cross limited combustion control, control of large systems.

UNIT-IV BOILER CONTROL - II 9

Boiler drum level measurement methods, feedwater control, soot-blowing operation, steam temperature control, coordinated control, boiler following mode operation,

turbine following mode operation, constant / sliding pressure operation, selection between boiler and turbine following modes. Distributed control system in power plants-interlocks in boiler operation

UNIT-V TURBINE CONTROL

9

Speed measurement, rotor and casing movement- vibration - shell temperature monitoring and control - steam pressure control - lubricant oil temperature - cooling system.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Understanding various power generation process.
2. Identify important parameter to be monitored and controlled in thermal power plant.
3. Knowledge about various building blocks and instruments involved in boiler control.
4. Knowledge about Major control systems involved in the thermal power plant.
5. Knowledge about various methods of monitoring different parameters in turbine and their control.

TEXT BOOKS:

1. Sam. G.Dukelow, The Control of Boilers, ISA Press, New York, 2nd Edition, 1991
2. Gill A.B, Power Plant Performance, Butterworth, London, 1984.
3. P.C Martin, I.W Hannah, Modern Power Station Practice, British Electricity International Vol.1 & VI, Pergamon Press, London, 1992.

REFERENCE BOOKS:

1. David Lindsley, Power-plant Control and Instrumentation: The Control of Boilers and HRSG Systems, IET, London, 2000
2. Jervis M.J, Power Station Instrumentation, Butterworth Heinemann, Oxford, 1993.
3. Swapan Basu Ajay Debnath, Power Plant Instrumentation and Control Handbook, 1ST Edition, Academic Press, 2014.

4. G. F. Gilman, Jerry Gilman, Boiler Control Systems Engineering, ISA, 2010.
5. Elonka, S.M.and Kohal A.L, Standard Boiler Operations, McGraw-Hill, New Delhi, 1994.
6. Philip Kiameh, Power Plant Instrumentation and Controls, McGraw-Hill Professional, 2014.
7. Dipak.K. Sarkar, Thermal Power Plant, Design and Operation, Elsevier, ISBN: 978-0-12-801575-9,2015
8. Tamilmani.P, "Power Plant Instrumentation", SAMS Publications, April 2018.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	1	1				1					1	1	1
2	2	3	1	2					1	1			2	2	3
3	2	3	2	3		3	2	1	2	1		1	2	2	1
4	2	1			1										1
5	2	1	3	1	3	2	2	1			2	2	1	2	1
Avg.	2.2	1.8	1.8	1.8	2.0	2.5	2.0	1.0	1.5	1.0	2.0	1.5	1.5	1.8	1.4

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

PEI303	INSTRUMENTATION AND CONTROL IN	L	T	P	C
	PETROCHEMICAL INDUSTRIES	3	0	0	3

COURSE OBJECTIVES:

- To expose the students to various petroleum production processes.
- To impart knowledge on various processes involved in petroleum refinery.
- To introduce students the terminology, concepts and practices of atmospheric and vacuum distillation units.
- To impart knowledgeable in the design of steam and condensate control for processes.
- To provide knowledge on specific measurement techniques practiced, control systems and automation involved in petrochemical industry.

UNIT-I INTRODUCTION TO PETROLEUM REFINING AND FORMATION PROCESS 9

Brief survey of petroleum formation, petroleum exploration, Petroleum production, Petroleum refining and its methods, refining capacity and consumption in India, constituents of Crude Oil, Recovery techniques – Oil – Gas separation, Processing wet gases.

UNIT-II ATMOSPHERIC AND VACUUM DISTILLATION UNITS 9

P & I diagram of petroleum refinery, Atmospheric distillation process, Vacuum distillation process, Thermal cracking, Catalytic cracking, Catalytic reforming, and Utility plants – Air, N₂, and cooling water.

UNIT-III INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES 9

Basics of field instruments, Parameters to be measured in Petrochemical industry, Distillation Column control, Selection of instruments, Basics of intrinsic safety of instruments, Area classification.

UNIT-IV STEAM AND CONDENSATE CONTROL 9

Control of furnace, Reboiler Control, Reflux Control, Control of catalytic crackers, Control of heat exchanger, Control of cooling tower.

UNIT-V BOILER SAFETY AND PROCESS INTERLOCKS 9

Basics of PLC, and Safety interlocks in furnace, separator, pump, and compressor.
Basics of SIL, Introduction to Standards.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Various petrochemical process and important parameters to be monitored and controlled.
2. Various instruments involved in and the control of petrochemical process.
3. The automation and safety standards of a petrochemical industry.
4. To identify the type of process and instrumentation in petrochemical industries.
5. To understand different control strategies and control loops in atmospheric and distillation column and boilers.

TEXT BOOKS:

1. Waddams A.L, .Chemical from petroleum, Butter and Janner Ltd., 1968.
2. Balchan.J.G. and Mumme K.I., Process Control Structures and Applications, Van Nostrand Reinhold Company, New York, 1988

REFERENCE BOOKS:

1. Liptak B.G., Instrument Engineers' Handbook, CRC PRESS, 4th Edition, 2003.
2. Austin G.T.Shreeves, Chemical Process Industries, McGraw Hill International student edition, singapore, 1985.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	1	1	-	-	-	-	-	-	-	1	-	1
2	3	2	2	1	1	-	-		-	-	-	-	-	-	2
3	3	2	2	1	1	-	2		-	-	-	-	1	-	-
4	3	2	2	1	1	1	-		-	-	-	1	2	1	2
5	3	2	2	1	1	1	-		2	-	-	1	2	1	2
Avg.	3	2	2	1	1	1	2	-	2	-	-	1	1.5	1	1.8

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

PEI304	AUTOMOTIVE INSTRUMENTATION AND	L	T	P	C
	CONTROL	3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on automobile system, its subsystems and components.
- To expose the students to the concepts of various sensors used in automobile systems.
- To teach the basic and advanced controls in automotive systems.
- To impart knowledge about the electronics and software involved in automotive systems.
- To impart the basic knowledge about active and passive safety system.

UNIT-I AUTOMOBILE FUNDAMENTALS 9

Introduction, Electronics in automotive and its evolution, Automotive physical configuration, Engine block, Cylinder head, Piston, Crankshaft, Camshaft, Connecting rod, Valve, 4-stroke cycle, Engine control, Ignition system, Spark plug, High voltage circuit and distribution, Spark pulse generation, Ignition timing, Drivetrain, Transmission, Drive shaft, Differential, Suspension, Brakes, Steering system.

UNIT-II ELECTRONIC ENGINE CONTROL 9

Motivation, Exhaust emission, Fuel economy, Concept of electronic engine control, Performance parameters and variables, Torque, Power, BSFC, Fuel consumption, Efficiency, Calibration, Engine mapping, Effect of air-fuel ratio, Spark timing, EGR on engine performance, Exhaust Catalytic converter, Oxidizing catalytic and Three-way type, Electronic fuel control, Open and Close Loop, EGO concentration, Intake manifold pressure, Speed density method, EGR, Electronic ignition.

UNIT-III SENSORS AND ACTUATORS 9

Automotive variable, Air flow rate sensor, Pressure measurement, Strain gauge MAP sensor, Engine crankshaft angular position sensor, Magnetic reluctance position sensor, Engine angular speed sensor, Timing sensor for ignition and fuel

delivery, Hall effect and optical position sensor, Optical crankshaft position sensor, Throttle angle sensor, temperature sensor, coolant sensor, Exhaust gas oxygen (EGO) sensor, Desirable and switching characteristics, Knock sensor, Angular rate sensor, LIDAR, Flex fuel sensor, Acceleration sensor, Fuel injection, Exhaust gas recirculation actuator, Variable valve timing, Electric motor actuator, Ignition system.

UNIT-IV VEHICLE POWER TRAIN AND MOTION CONTROL 9

Electronic transmission control, adaptive power Steering, adaptive cruise control, safety and comfort systems, anti-lock braking, traction control and electronic stability, active suspension control.

UNIT-V ACTIVE AND PASSIVE SAFETY SYSTEM 9

Body electronics including lighting control, remote keyless entry, immobilizers etc., electronic instrument clusters and dashboard electronics, aspects of hardware design for automotive including electro-magnetic interference suppression, electromagnetic compatibility etc., (ABS) antilock braking system, (ESP) electronic stability program, air bags. Automotive standards and protocols: Automotive standards like CAN protocol, LIN protocol, FLEX RAY, Head-Up Display (HUD), OBD-II, CAN FD, automotive Ethernet etc. Automotive standards like MISRA, functional safety standards (ISO 26262).

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Identify the automotive system and its components.
2. Attain knowledge of various sensors and conditioning circuit used in automotive systems.
3. Gain knowledge about various control strategies, the electronics and software used in automotive application.
4. Gain the basic ideas about the standards and protocols and energy management.
5. Gain the basic knowledge about active and passive safety system.

TEXT BOOKS:

1. William B. Ribbens, Understanding Automotive Electronics, Butterworth-Heinemann publications, 7 th Edition, 2012

REFERENCE BOOKS:

1. Young A.P., Griffiths L., Automotive Electrical Equipment, ELBS & New Press, 2010.
2. Tom Weather Jr., Cland C. Hunter, Automotive computers and control system, Prentice Hall Inc., New Jersey, 2009.
3. Crouse W.H., Automobile Electrical Equipment, McGraw Hill Co. Inc., New York, 2005.
4. Bechtold, Understanding Automotive Electronic, SAE, 2010.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	1	-	1	2	3	-	1	-	1	2	3	2	-
2	3	1	2	1	1	2	1	-	1	1	2	2	2	1	-
3	2	2	2	1	1	3	1	1	2	1	2	1	2	2	-
4	3	2	2	2	3	2	2	1	2	1	3	2	2	2	3
5	1	3	3	2	3	3	3	3	-	2	2	3	2	2	-
Avg.	2.2	1.8	2	1.5	1.8	2.4	2	1.7	1.5	1.3	2	2	2.2	1.8	3

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

COURSE OBJECTIVES:

- To make the students aware of basic concepts of safety instrumented system, standards and risk analysis techniques.
- To make the students understand different layers of protection.
- To make student conscious about safety instrumentation applications.
- To make the students aware of potential events and impact of failures.
- To make students aware of design, installation and maintenance procedures.

UNIT-I	INTRODUCTION	9
---------------	---------------------	----------

Safety Instrumented System (SIS): need, features, components, difference between basic process control system and SIS - Risk: how to measure risk, risk tolerance, Safety integrity level, safety instrumented functions - Standards and Regulation – HSE-PES, AICHE-CCPS, IEC-61508, ANSI/ISA-84.00.01-2004 (IEC 61511 Mod) & ANSI/ISA – 84.01-1996, NFPA 85, API RP 556, API RP 14C, OSHA (29 CFR 1910.119 – Process Safety Management of Highly Hazardous Chemicals – SIS design cycle - Process Control vs Safety Control.

UNIT-II	PROTECTION LAYERS AND SAFETY REQUIREMENT SPECIFICATIONS	9
----------------	--	----------

Prevention Layers: Process Plant Design, Process Control System, Alarm Systems, Procedures, Shutdown/Interlock/Instrumented Systems (Safety Instrumented Systems – SIS), Physical Protection - Mitigation Layers: Containment Systems, Scrubbers and Flares, Fire and Gas (F&G) Systems, Evacuation Procedures - Safety specification requirements as per standards, causes for deviation from the standards.

UNIT-III	SAFETY INTEGRITY LEVEL (SIL)	9
-----------------	-------------------------------------	----------

Evaluating Risk, Safety Integrity Levels, SIL Determination Method : As Low As Reasonably Practical (ALARP), Risk matrix, Risk Graph, Layers Of Protection Analysis (LOPA) – Issues related to system size and complexity –Issues related to

field device safety – Functional Testing.

UNIT-IV SYSTEM EVALUATION 9

Failure Modes, Safe/Dangerous Failures, Detected/Undetected Failures, Metrics: Failure Rate, MTBF, and Life, Degree of Modeling Accuracy, Modeling Methods: Reliability Block Diagrams, Fault Trees, Markov Models - Consequence analysis: Characterization of potential events, dispersion, impacts, occupancy considerations, consequence analysis tools - Quantitative layer of protection analysis: multiple initiating events, estimating initiating event frequencies and IPL failure probabilities.

UNIT-V CASE STUDY 9

SIS Design check list - Case Description: Furnace/Fired Heater Safety Shutdown System: Scope of Analysis, Define Target SILs, Develop Safety Requirement Specification (SRS), SIS Conceptual Design, Lifecycle Cost Analysis, Verify that the Conceptual Design Meets the SIL, Detailed Design, Installation, Commissioning and Pre-startup Tests, Operation and Maintenance Procedures.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Ability to be aware of basic concepts of safety instrumented system, standards and risk analysis techniques.
2. Ability to understand different layers of protection.
3. Ability to understand and analyse safety instrumentation applications.
4. Ability to aware of potential events and impact of failures.
5. Ability to apply the design, installation and maintenance procedures for SIS applied to industrial processes.

TEXT BOOKS:

1. Paul Gruhn and Harry L. Cheddie,” Safety Instrumented systems: Design, Analysis and Justification”, ISA, 2nd edition, 2018.
2. Eric W. Scharpf, Heidi J. Hartmann, Harlod W. Thomas, “Practical SIL target selection: Risk analysis per the IEC 61511 safety Lifecycle”, exida2nd Edition 2016.

REFERENCE BOOKS:

1. William M. Goble and Harry Cheddie, "Safety Instrumented Systems Verification: Practical Probabilistic Calculations" ISA, 2005.
2. Edward Marszal, Eric W. Scharpf, "Safety Integrity Level Selection: Systematic Methods Including Layer of Protection Analysis", ISA, 2002.
3. Standard - ANSI/ISA-84.00.01-2004 Part 1 (IEC 61511-1 Mod) "Functional Safety: Safety Instrumented Systems for the Process Industry Sector - Part 1: Framework, Definitions, System, Hardware and Software Requirements", ISA, 2004.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2		1			1	3	2			3	1	2
2	1	1		1			1	1		1			1	3	1
3	3	1	1	2		2		3				3	1	3	2
4						2	1	3				3	2	2	3
5		1	3		3			3		1	3	3	1	1	3
Avg.	2.3	1.5	2	1.5	2	2	1	2.2	3	1.3	3	3	1.6	2	2.2

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

COURSE OBJECTIVES:

- To impart about the basic concepts of optical fibres and their properties.
- To provide adequate knowledge about the Industrial applications of optical fibres.
- To familiarize about Industrial application of lasers.
- To enhance the students knowledge in Laser fundamentals.
- To illustrate about holography and Medical applications of Lasers.

UNIT-I OPTICAL FIBRES AND THEIR PROPERTIES 9

Construction of optical fiber cable: Guiding mechanism in optical fiber and Basic component of optical fiber communication, –Principles of light propagation through a fibre: Total internal reflection, Acceptance angle (θ_a), Numerical aperture and Skew mode, –Different types of fibres and their properties: Single and multimode fibers and Step index and graded index fibers,– fibre characteristics: Mechanical characteristics and Transmission characteristics, – Absorption losses – Scattering losses – Dispersion – Connectors and splicers –Fibre termination – Optical sources: Light Emitting Diode (LED), – Optical detectors: PIN Diode.

UNIT-II INDUSTRIAL APPLICATION OF OPTICAL FIBRES 9

Fibre optic sensors: Types of fiber optics sensor, Intrinsic sensor- Temperature/ Pressure sensor, Extrinsic sensors, Phase Modulated Fibre Optic Sensor and Displacement sensor (Extrinsic Sensor) – Fibre optic instrumentation system: Measurement of attenuation (by cut back method), Optical domain reflectometers, Fiber Scattering loss Measurement, Fiber Absorption Measurement, Fiber dispersion measurements, End reflection method and Near field scanning techniques – Different types of modulators: Electro-optic modulator (EOM) – Interferometric method of measurement of length – Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain.

UNIT-III LASER FUNDAMENTALS 9

Fundamental characteristics of lasers – Level Lasers: Two-Level Laser, Three Level Laser, Quasi Three and four level lasers – Properties of laser: Monochromaticity, Coherence, Divergence and Directionality and Brightness – Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping – Types of lasers; – Gas lasers, solid lasers, liquid lasers and semiconductor lasers.

UNIT-IV INDUSTRIAL APPLICATIONS OF LASER 9

Laser for measurement of distance, Laser for measurement of length, Laser for measurement of velocity, Laser for measurement of acceleration, Laser for measurement of current, voltage and Laser for measurement of Atmospheric Effect: Types of LIDAR, Construction And Working, and LIDAR Applications – Material processing: Laser instrumentation for material processing, Powder Feeder, Laser Heating, Laser Welding, Laser Melting, Conduction Limited Melting and Key Hole Melting – Laser trimming of material: Process Of Laser Trimming, Types Of Trim, Construction And Working Advantages – Material Removal and vaporization: Process Of Material Removal

UNIT-V HOLOGRAM AND MEDICAL APPLICATIONS 9

Holography: Basic Principle, Holography vs. photography, Principle Of Hologram Recording, Condition For Recording A Hologram, Reconstructing and viewing the holographic image–Holography for non-destructive testing – Holographic components – Medical applications of lasers, laser-Tissue Interactions Photochemical reactions, Thermalisation, collisional relaxation, Types of Interactions and Selecting an Interaction Mechanism – Laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynaecology and oncology.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Ability to be aware of basic concepts of safety instrumented system, standards and risk analysis techniques.
2. Ability to understand different layers of protection.
3. Ability to understand and analyse safety instrumentation applications.

4. Ability to aware of potential events and impact of failures.
5. Ability to apply the design, installation and maintenance procedures for SIS applied to industrial processes.

TEXT BOOKS:

1. J.M. Senior, Optical Fibre Communication – Principles and Practice, Prentice Hall of India, 1985.
2. J. Wilson and J.F.B. Hawkes, Introduction to Opto Electronics, Prentice Hall of India, 2001.
3. Eric Udd, William B., and Spillman, Jr., Fiber Optic Sensors: An Introduction for Engineers and Scientists, John Wiley and Sons, 2011

REFERENCE BOOKS:

1. G. Keiser, Optical Fibre Communication, McGraw Hill, 1995.
2. M. Arumugam, Optical Fibre Communication and Sensors, Anuradha Agencies, 2002.
3. John F. Ready, Industrial Applications of Lasers, Academic Press, Digitized in 2008.
4. Monte Ross, Laser Applications, McGraw Hill, 1968.
5. John and Harry, Industrial lasers and their application, McGraw-Hill, 2002.
6. Keiser, G., Optical Fiber Communication, McGraw-Hill, 3rd Edition, 2000.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2		1										2		
2	3		2	3	2								2	2	
3	2		2	3									2	2	
4	1			3	1								2		
5	3	2	2	3	2								2	2	
Avg.	2.2	2	1.8	3	1.7	-	-	-	-	-	-	-	2	2	-

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

PROFESSIONAL ELECTIVES
Vertical-IV (Health Care Instrumentation)

PEI401	BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To Introduce Fundamentals of Biomedical Engineering.
- To study the communication mechanics in a biomedical system with few examples.
- To study measurement of certain important electrical and non-electrical parameters.
- To understand the basic principles in imaging techniques.
- To have a basic knowledge in life assisting and therapeutic devices.

UNIT-I FUNDAMENTALS OF BIOMEDICAL ENGINEERING 9

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Basic components of a biomedical system- Cardiovascular systems- Respiratory systems – Kidney and blood flow - Biomechanics of bone - Biomechanics of soft tissues -Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors.

UNIT-II NON ELECTRICAL PARAMETERS MEASUREMENT AND 9
DIAGNOSTIC PROCEDURES

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography –Blood Gas analysers, pH of blood –measurement of blood pCO₂, pO₂, finger-tip oxymeter - ESR, GSR measurements.

UNIT-III ELECTRICAL PARAMETERS ACQUISITION AND 9
ANALYSIS

Electrodes – Limb electrodes –floating electrodes – pregelled disposable electrodes

- Micro,needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipment.

UNIT-IV IMAGING MODALITIES AND ANALYSIS 9

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging – Imaging application in Biometric systems.

UNIT-V LIFE ASSISTING, THERAPEUTIC AND ROBOTIC 9
DEVICES

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system – Nano Robots - Robotic surgery –Orthopedic prostheses fixation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course students will have the

1. Ability to understand the philosophy of the heart, lung, blood circulation and respiration system.
2. Ability to provide latest ideas on devices of non-electrical devices..
3. Ability to gain knowledge on various sensing and measurement devices of electrical origin.
4. Ability to understand the analysis systems of various organ types.
5. Ability to bring out the important and modern methods of imaging techniques and their analysis.
6. Ability to explain the medical assistance/techniques, robotic and therapeutic equipments.

TEXT BOOKS:

1. Leslie Cromwell, Fred J.Weibell , Erich A.Pfeiffer , Biomedical Instrumentation and Measurement, 2nd edition by Cromwell, Pearson India, 2015.
2. Joseph J.carr and John M. Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th Edition, 2012.
3. Khandpur R.S, Handbook of Biomedical Instrumentation,, Tata McGraw-Hill, New Delhi, 3rd Edition, 2014.Sensors: An Introduction for Engineers and Scientists , John Wiley and Sons, 2011.

REFERENCE BOOKS:

1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 4th edition, 2016.
2. Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2012.
3. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2014.
4. Ed. Joseph D. Bronzino, Donald R.Peterson The Biomedical Engineering Hand Book, fourth edition , Boca Raton, CRC Press , 2014.
5. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Publications, 2017.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2		2						1			2		
2	2		1		2						1			2	
3	3	2	2										3	3	
4	3	1	2	2									3	2	
5	3	2		2	3								2		1
6	2	1	2	2						1	2		2	2	3
AVG.	2.7	1.6	1.8	2.0	2.5					1.0	1.5		2.4	2.3	2.0

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

COURSE OBJECTIVES:

- To understand about the digital image fundamentals.
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To analyze the restoration function and its techniques.
- To learn the image segmentation techniques.
- To become familiar with image compression methods.
- To explore the image 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, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band pass Filters – Band reject 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. Boundary representation and description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student will be able to

1. Know the basics of digital image processing, such as digitization, sampling.
2. Operate on images using the techniques of smoothing, sharpening and enhancement.
3. Understand the restoration concepts and filtering techniques.
4. Apply the methods to segmentation of gray scale or RGB images.
5. Comprehend image compression concepts.
6. Assess the image recognition methods.

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.

REFERENCE BOOKS:

1. Milan Sonka et al 'Image processing, analysis and machine vision', Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.
2. William K. Pratt, 'Digital Image Processing', John Wiley, New York, 2002.
3. Kenneth R. Castleman, 'Digital Image Processing', Pearson, 2006.
4. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, 'Digital Image Processing using MATLAB', Pearson Education, Inc., 2011

CO - PO and CO - PSO MAPPING:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	1	2	1	3	-	-	-	2	2	-	3	3	-
2	2	1	3	2	3	-	-	-	2	2	-	2	3	-
3	2	1	3	2	3	-	-	-	2	2	-	2	3	-
4	2	2	3	2	3	-	-	-	1	2	-	2	3	3
5	2	2	3	1	3	-	-	-	2	2	-	2	3	3
6	2	2	3	2	3	-	-	-	2	2	-	2	3	3
AVG.	2.2	1.5	2.8	1.7	3	-	-	-	1.8	2	-	2.2	3	3

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

COURSE OBJECTIVES:

- To learn the concepts of bio signals and its spectral characteristics.
- To understand the concepts of linear and non-linear filtering techniques to extract desired information.
- To analyze the principle of adaptive filtering and wavelet detection of bio signals.
- To explore the various techniques for automated classification and decision making to aid diagnosis.
- To acquire knowledge of time, frequency and multivariate analysis

UNIT-I BIOSIGNAL AND SPECTRAL CHARACTERISTICS 9

Characteristics of some dynamic biomedical signals, Noises- random, structured and physiological noises. Filters- IIR and FIR filters. Spectrum – power spectral density function, cross-spectral density and coherence function, cepstrum and homomorphic filtering. Estimation of mean of finite time signals.

UNIT-II TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION 9

Time series analysis – linear prediction models, process order estimation, lattice representation, non-stationary process, fixed segmentation, adaptive segmentation, application in EEG, PCG signals, Time varying analysis of Heart-rate variability, model based ECG simulator. Spectral estimation –Blackman Tukey method, periodogram, and model based estimation. Application in Heart rate variability, PCG signals.

UNIT-III ADAPTIVE FILTERING AND WAVELET DETECTION 9

Filtering – LMS adaptive filter, adaptive noise canceling in ECG, improved adaptive filtering in ECG, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.

UNIT-IV BIOSIGNAL CLASSIFICATION AND RECOGNITION 9

Signal classification and recognition – Statistical signal classification, linear

discriminant function, direct feature selection and ordering, Back propagation neural network based classification. Application in Normal versus Ectopic ECG beats.

UNIT-V TIME FREQUENCY AND MULTIVARIATE ANALYSIS 9

Time frequency representation, spectrogram, Wigner distribution, Time-scale representation, scalogram, wavelet analysis – Data reduction techniques, ECG data compression, ECG characterization, Feature extraction- Wavelet packets, Multivariate component analysis-PCA, ICA.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student will be able to

1. Preprocess the Bio signals.
2. Analyze bio signals in time domain & to estimate the spectrum.
3. Apply wavelet detection techniques for bio signal processing.
4. Classify Bio signals using neural networks and statistical classifiers.
5. Extract the features using multivariate component analysis.

TEXT BOOKS:

1. Rangaraj M. Rangayyan, "Biomedical Signal Analysis-A case study approach", Wiley, 2nd Edition, 2016.
2. Willis J. Tompkins, "Biomedical Digital Signal Processing", Prentice Hall of India, New Delhi, 2003.
3. Arnon Cohen, "Bio-Medical Signal Processing Vol I and Vol II", CRC Press Inc., Boca Raton, Florida, 1999.

REFERENCE BOOKS:

1. Kayvan Najarian and Robert Splesthor, "Biomedical signals and Image processing", CRC – Taylor and Francis, New York, 2nd Edition, 2012.
2. K.P.Soman, K.Ramachandran, "Insight into wavelet from theory to practice", PHI, New Delhi, 3rd Edition, 2010.
3. D.C.Reddy, "Biomedical Signal Processing – Principles and Techniques", Tata McGraw-Hill Publishing Co. Ltd, 2005.
4. John L.Semmlow, "Biosignal and Biomedical Image Processing Matlab Based applications", Taylor & Francis Inc, 2004

CO - PO and CO - PSO MAPPING:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	1	1	1	1	-	-	1	2	2	-	-	1	2
2	3	1	1	1	1	-	-	1	2	2	-	-	1	2
3	3	1	1	1	1	-	-	1	2	2	-	-	1	2
4	3	1	1	1	1	-	-	1	2	2	-	-	1	2
5	3	1	1	1	1	-	-	1	2	2	-	-	1	2
6	3	1	1	1	1	-	-	1	2	2	-	-	1	2
AVG.	3	1	1	1	1	-	-	1	2	2	-	-	1	2

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

COURSE OBJECTIVES:

- To understand the concepts on Radiography, Fluoroscopy, and Angiography.
- To examine the principles and applications of Computed Tomography.
- To obtain knowledge on the principle and construction of MRI and spectroscopy.
- To comprehend the application of radioisotopes and
- To analyse infrared imaging methods in the field of medicine.
- To assess the working principle of ultrasound in imaging the body

UNIT-I RADIOGRAPHY AND FLUOROSCOPY 9

Nature of X-rays- X-Ray absorption – Tissue contrast. X- Ray Equipment – X-Ray Tube, the collimator, Bucky Grid, Digital Radiography- discrete digital detectors, storage phosphor and film scanning, – Fluoroscopy – X-ray Image Intensifier -Digital Fluoroscopy. Angiography, cine Angiography. Digital subtraction Angiography. Mammography.

UNIT-II COMPUTED TOMOGRAPHY 9

Principles of sectional imaging, Principles of computed Tomographic Imaging - Scan motions, X-ray sources. Influences of Images quality: Unsharpness- contrast - Image Noise-2-D image reconstruction techniques-Back projection and iterative.

UNIT-III MAGNETIC RESONANCE IMAGING AND SPECTROSCOPY 9

Fundamentals of magnetic resonance- overview - Relaxation processes T1 and T2. Block Diagram approach of MRI system- system Magnet (Permanent, Electromagnet and Super conductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, contrast agents- tissue contrast in MRI- MR angiography, MR spectroscopy.

UNIT-IV RADIO ISOTOPIC IMAGING AND INFRARED IMAGING 9

Radio nuclides for imaging -Rectilinear scanners – linear scanners – Gamma

camera –Emission computed tomography- SPECT, PET- Physics of thermography – imaging systems – pyroelectric vidicon camera clinical, thermography – liquid crystal thermography.

UNIT-V ULTRASOUND IMAGING

9

Ultrasound: Wave propagation and interaction in Biological tissues. -Transducers and imaging systems- Imaging modes- Time required to obtain Images- System components, signal processing -dynamic Range- Ultrasound Image Artifacts.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student will be able to

1. Gain knowledge on medical imaging methods such as X-Ray and fluoroscopy.
2. Apply a detailed understanding of Computed Tomography.
3. Understand the principles of MRI and spectroscopy.
4. Outline the application of radioisotopes and
5. Diagnosis of infrared imaging methods in healthcare.
6. Analyze the difference between normal ultrasound images and artifacts.

TEXT BOOKS:

1. Steve Webb, "The Physics of Medical Imaging", First Edition, Adam Hilger, Philadelphia, 1988.
2. Jerry L. Prince and Jnathan M.Links, "Medical Imaging Signals and Systems", Second Edition, Pearson Education Inc., 2014.

REFERENCE BOOKS:

1. William R. Hendee, E. Russell Ritenour, "Medical Imaging Physics", Fourth Edition, A John Wiley & sons, Inc., 2002.
2. Z.H. Cho., J-oie, P. Jones and Manbir Singh, "Foundations of Medical Imaging", First Edition, John Wiley and sons Inc, 1993.
3. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw – Hill, New Delhi, 2003.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	1	1	-	-	-	-	-	-	-	-	1	-
2	3	2	1	1	-	-	-	-	-	-	-	-	1	-
3	3	2	1	1	-	-	-	-	-	-	-	-	1	-
4	3	2	1	1	-	-	-	-	-	-	-	-	1	-
5	3	2	1	1	-	-	-	-	-	-	-	-	1	-
6	3	2	1	1	-	-	-	-	-	-	-	-	1	-
AVG.	3	2	1	1	-	-	-	-	-	-	-	-	1	-

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

COURSE OBJECTIVES:

- To understand the robot structure medical field.
- To understand the robot fundamentals in medical field.
- To understand the concept of medical imaging and navigation.
- To understand various techniques involved in robot surgery.
- To introduce role of artificial intelligence role in medical robots

UNIT-I INTRODUCTION TO MEDICAL ROBOTICS 9

About Robots and why, Robotics terminology, Surgical robots, Telepresence robots, The Exoskeleton Devices, Role in Modern Medicine, Mechanical Robots, Robots in Clinical Diagnosis and Epidemic Control, Types of Medical Robots, Main Type of Robotic Operating System, Microbots, Cosmobot, CODY, and RP-VITA.

UNIT-II FUNDAMENTAL OF ROBOTS IN MEDICINE 9

Parts of a Robot, Robot Characteristics, Advantage Vs Disadvantage of Robots, Robotics Kinematics, Role in Precise Medical Procedures, Economics in Medical Robotics Design, MIS Robot.

UNIT-III MEDICAL IMAGING AND NAVIGATIONS 9

Medical Imaging Timeline, Electromagnetic Spectrum, Contrast, X-Ray Modalities, X-Ray Contrast, Image Basic Production, Radiography, X-Ray Computed Tomography (CT), CT Scanner & CT Slice Images, Magnetic Resonance Imaging (MRI), Ultrasound (US) Imaging, Role of The Physicist in Diagnostic Radiology, Medical Physicist Skill, Robotic Technology in Medical Imaging, Image Guided Surgery (IGS).

UNIT-IV ROBOTICS SURGERY 9

Robotic Gynecologic Surgery, Robotic Prostate Surgery, Robotic Kidney Surgery, Robotic Colorectal Surgery, Single- Site Robotic Gallbladder Surgery, Why Robotic Surgery is a Better Option, Simulation in Robotic Surgery.

UNIT-V ARTIFICIAL INTELLIGENCE IN HEALTHCARE AND 9

FUTURE TRENDS

Artificial Intelligence in Healthcare, Diagnosis and Treatment Applications, Challenges for Artificial Intelligence in Healthcare, Future of Artificial Intelligence in Healthcare, Emerging Trends, Ultrasound Imaging, Custom Design Robots, Commercial Robots Autonomous Systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Understand different robot structures in medical field.
2. Understand robot fundamental in medical field.
3. Understand the concept of medical imaging and navigation.
4. Understand the techniques involved in robot surgery.
5. Understand the role of artificial intelligence in medical robots.

TEXT BOOKS:

1. Daniel R. Faust, Medical Robots, The Rosen Publishing Group, Inc, 2016.
2. Jocelyne Troccaz, Medical Robots, John Wiley & Sons, 2013 - Technology & Engineering.

REFERENCE BOOKS:

1. Vanja Bozovic, Medical Robotics, IntechOpen, 2008.
2. Paula Gomes, Medical Robotics: Minimally Invasive Surgery, Elsevier, 18 Oct 2012, Woodhead Publishing Limited.
3. Achim Schweikard, Floris Ernst, Medical Robotics, 2015, Springer.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	3	3					2		1	3	1		
2	3	3	2	2	3					2		1	3	3		
3	3	3	3	2	3					2		1	2	2		
4	3	3	3	2	3					2		1	2	2		
5	3	3	2	2			2			2		1	2	2		
Avg.	3	3	2.6	2.2	3	-	2	-	-	2	-	1	2.4	2	-	-

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

COURSE OBJECTIVES:

- To understand the concept behind feedback and continuum in various systems and subsystems
- To analyse the systems in time and frequency domain and to understand the concept of stability
- To apply mathematical modelling principles in understanding the various fundamental biological systems.
- To analyse biological system models using MATLAB.

UNIT-I INTRODUCTION 9

Preliminary Considerations- Historical Background -- Systems Analysis- Fundamental Concepts - Physiological Control Systems Analysis- Differences between Engineering and Physiological Control Systems - The Science (and Art) of Modeling

UNIT-II MATHEMATICAL MODELLING 9

Generalized System Properties - Models with Combinations of System Elements - Linear Models of Physiological Systems-Distributed-Parameter versus Lumped-Parameter Models - Linear Systems and the Superposition Principle - Laplace Transforms and Transfer Functions -The Impulse Response and Linear Convolution

UNIT-III STATIC ANALYSIS OF PHYSIOLOGICAL SYSTEMS 9

Introduction - Open-Loop versus Closed-Loop Systems- Determination of the Steady-State Operating Point -Steady-State Analysis Using SIMULINK - Regulation of Cardiac Output- The Cardiac Output Curve - The Venous Return Curve - Closed-Loop Analysis: Heart and Systemic Circulation Combined - Regulation of Glucose - Chemical Regulation of Ventilation - The Gas Exchanger.

UNIT-IV IDENTIFICATION OF PHYSIOLOGICAL CONTROL SYSTEMS 9

Basic Problems in Physiological System Analysis -Nonparametric and Parametric

Identification Methods- Structural Identifiability - Sensitivity Analysis - Input Design
- Identification of Closed-Loop Systems: "Opening the Loop" -The Starling Heart-
Lung Preparation -Kao's Cross-Circulation Experiments - Artificial Brain Perfusion
for Partitioning Central and Peripheral Chemoreflexes

UNIT-V OPTIMIZATION IN OF PHYSIOLOGICAL CONTROL 9
SYSTEMS

Optimization in Systems with Negative Feedback-Single-Parameter Optimization-
Control of Respiratory Frequency- Constrained Optimization- Airflow Pattern
Regulation - Lagrange Multiplier Method -Optimal Control of Airflow Pattern -
Constrained Optimization: Control of Aortic Flow.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Understand the need for mathematical modeling of various systems, representation of systems in block diagrams and signal flow graphs and are introduced to biological control systems.
2. Analyze the time response of various systems and discuss the concept of system stability.
3. Analyze the frequency response characteristics of various systems using different charts.
4. Understand the concept of modeling basic physiological systems.
5. Comprehend the application aspects of time and frequency response analysis in physiological control systems.

TEXT BOOKS:

1. Michael C K Khoo, "Physiological Control Systems", IEEE Press, Prentice Hall of India, 2005
2. I.J. Nagarath and M. Gopal "Control Systems Engineering", Fifth Edition, Anshan Publishers, 2008..

REFERENCE BOOKS:

1. Michael C. K. Khoo, Physiological Control Systems Analysis, Simulation, and Estimation Theory and Practice, IEEE Press Series In Biomedical

Engineering, A Johnwiley & Sons, Inc.,Publication,2018.

2. Marmarelis, “Nonlinear Dynamic Modelling of Physiological Systems”, Wiley-IEEE Press, 2004.
3. John H Milsum , “Biological control systems”, McGraw Hill 1966.
4. David.T Westwick, Robert E. Kearney, Identification of Nonlinear Physiological Systems, Wiley-IEEE Press, 2003
5. MinruiFei, Shiwei Ma, Xin Li, Xin Sun, Li Jia and Zhou Su,“ Advanced Computational Methods in Life System Modelling and Simulation”, Springer,2017.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	3					2		1	3	1	
2	3	3	2	2	3					2		1	3	3	
3	3	3	3	2	3					2		1	2	2	
4	3	3	3	2	3					2		1	2	2	
5	3	3	2	2			2			2		1	2	2	
Avg.	3	3	2.6	2.2	3	-	2	-	-	2	-	1	2.4	2	-

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

PROFESSIONAL ELECTIVES
Vertical – V (Semiconductor / Communication)

PEI501	POWER ELECTRONICS AND DRIVES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Have an overview of different types of power semi-conductor devices and their switching characteristics.
- Understand the operation, characteristics and performance parameters of controlled rectifiers.
- Study the operation, switching techniques of various DC to DC Converters.
- Study the operation, switching techniques of various DC to AC Converters.
- Learn the different speed control techniques of Converter fed drives.

UNIT-I POWER SEMICONDUCTOR DEVICES 9

Constructional Features, Operating Principle, Characteristics and Specification of Power Semiconductor Diode – Power Bipolar Junction Transistor (BJT) –Thyristors and Triacs, Gate Turn Off Thyristor (GTO) – Metal Oxide Semiconductor Field Effect Transistor (MOSFET) – Insulated Gate Bipolar Transistor (IGBT) – Hard and Soft Switching of Power Semiconductors.

UNIT-II AC to DC CONVERTERS 9

Operation and Analysis of Single Phase (1 ϕ) Half Controlled and Fully controlled Bridge Converter with R, RL & RLE load - Three Phase (3 ϕ) Half Controlled and Fully controlled Bridge Converter with RLE load –Effect of source inductance on the Performance of AC to DC Converters – Power Factor Improvement, Harmonic Reduction, Filter. Introduction to Cyclo Converters and AC voltage controllers.

UNIT-III DC to DC CONVERTERS 9

Types of Basic DC-DC Converters – Analysis of Buck Converter (DC – DC) Circuit – Commutation of Thyristor Based Circuits – Introduction to Switched Mode Supply (SMPS) Circuits – Fly Back Type Converters – Cuk, Sepic and Zeta Converter –

Design of Transformer for SMPS circuits.

UNIT-IV DC to AC CONVERTERS 9

Introduction to Voltage Source Inverters – Analysis of 1-phase, Square Wave Voltage Source Inverter, 3 – Phase Voltage Source Inverter with Square Wave output – 3 – Phase Pulse Width Modulated (PWM) Inverter – Sine PWM and its Realization – Other Popular PWM Techniques – Current Source Inverter – Load Commutated Current Source Inverter (CSI).

UNIT-V ELECTRIC DRIVES 9

Fundamentals of dynamics and control of electric drives– separately excited dc motor drives using controlled rectifiers — chopper controlled dc drives – ac voltage controllers – three phase induction motor speed control – VSI and CSI fed induction motor drives – synchronous motor drives – Introduction to BLDC Drives and SR Drives.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Ability to explain various devices and their structure, operating characteristics in the field of electronics.
- Ability to get exposure to various topologies, working principle and analysis of controlled rectifiers, cycloconverters and ac controllers.
- Ability to gain knowledge on Classifications, structure, operating principle of various dc to dc converters.
- Ability to gain knowledge on Classifications, structure, operating principle of various dc to ac converters.
- Ability to gain knowledge about control of DC drives.

TEXT BOOKS:

1. Rashid, M.H., “Power Electronics – Circuits, Devices and Applications”, PHI, 4th Edition, 2017.
2. Mohan, Udeland and Robbins., “Power Electronics :Converters, Applications, and Design”, John Wiley and Sons, New York, 3rd Edition, 2002.

REFERENCE BOOKS:

1. Prof. D.Prasad, Prof. N.K. De, Dr. D.Kastha, Prof. Sabyasachi Sengupta, "Power Electronics – NPTEL Lecture Series", IIT Kharagpur.
2. Singh, M.D., and Khanchandani, K.B., "Power Electronics", 2nd Edition., Tata McGraw-Hill, 2017.
3. Bose, B.K., "Modern Power Electronics and AC Drives", 1st Edition, Pearson Education, 2002.
4. Bimbira, P.S., "Power Electronics", 5th Edition, Khanna Publishers, 2006.
5. Moorthi, V.R., "Power Electronics - Devices, Circuits and Industrial Applications", Oxford University Press, 2005.
6. Dubey G. K. "Power semiconductor control drives" Prentice Hall, Englewood Cliffs, New Jersey, 1989.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	1	2	1		1						1		1
2	2	1	1	2	2		1						1		2
3	2	1	1	1	1		1						1		2
4	2	1	1	1	2		1						1		2
5	2	1	1	2	2		1						1		1
Avg.	2	1	1	1.6	1.6		1						1		1.6

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

COURSE OBJECTIVES:

- To provide wide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the rudiments of Micro fabrication techniques.
- To provide knowledge on MEMS sensors and actuators.
- To provide wide information dealing with nano material and its necessity
- To understand and apply the various instrumentation techniques for characterization of nano materials.

UNIT-I OVERVIEW OF MEMS AND MICROSYSTEMS 9

Introduction to MEMS and Microsystems, Need for Miniaturization, MEMS and Microsystem products: Micro gears - Micro turbines - Micromotors - Micro optical devices. Microsystems and Microelectronics, Application of MEMS and Microsystems in Automotive Industry, Aerospace Industry, Biomedical Industry, Consumer Products, Telecommunication Industry.

UNIT-II MEMS FABRICATION PROCESS 9

Photolithography, Ion Implantation, Diffusion, Oxidation, Chemical Vapour Deposition, Physical Vapour Deposition: Sputtering, Etching: Chemical-Plasma, Micromachining: Bulk Micromachining, Surface Micromachining and LIGA.

UNIT-III MEMS SENSORS AND ACTUATORS 9

MEMS Sensors: Design of Acoustic wave sensors, Vibratory gyroscope, Capacitive Pressure sensors.

MEMS Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces.

UNIT-IV INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY 9

Nano scale Science and Technology - Implications for Physics, Chemistry, Biology and Engineering - Classifications of nano structured materials - nano particles -

quantum dots, Nano wires - ultrathin films - multilayered materials. Bottom up Synthesis - Top down Approach.

UNIT-V INSTRUMENTS FOR CHARACTERIZATION OF 9
NANOMATERIALS

X- Ray Diffraction technique - Scanning Electron Microscopy - Transmission Electron Microscopy - Atomic Force Microscope - Scanning Tunneling Microscope - Nano indentation system.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Ability to understand the operation of micro devices, micro systems and their applications.
- Ability to design the micro devices, micro systems using the MEMS fabrication process.
- Analyze the key performance aspects of electromechanical sensors and illustrate the design of micro actuators using various actuations.
- Ability to utilize the principles of nano science along with the properties of nano materials for the design of novel systems.
- Ability to apply and utilize the instrumentation systems for characterization of nano materials.

TEXT BOOKS:

1. Tai Ran Hsu, "MEMS and Microsystems Design : Manufacture and Nano Scale Engineering", John Wiley & Sons, INC., 2nd Edition, 2008.
2. A.S. Edelstein and R.C. Cammearata, eds., Nanomaterials: Synthesis, Properties and Applications, Institute of Physics Publishing, Bristol and Philadelphia, 1996.

REFERENCE BOOKS:

1. Chang Liu, "Foundations of MEMS", Pearson Education Inc., 2012.
2. Mohamed Gad-el-Hak, editor, "The MEMS Handbook", CRC press Boca Raton, 2001.
3. Nadim Maluf, "An Introduction to Micro Electro Mechanical System Design",

ArtechHouse, 2000.

4. G Timp (Editor), Nanotechnology, AIP press/Springer, 1999.
5. N John Dinardo, Nanoscale charecterisation of surfaces & Interfaces, Second edition, Weinheim Cambridge, Wiley-VCH, 2000.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3		3									1	3	2		
2	3		3		2	2					2	1	1			
3	3		3		2	1						1	2	1		
4	3		3	3	3							1	3	2		
5	3		3		2	2					2	1	3			
Avg.	3	-	3	3	2.3	1.7	-	-	-	-	2	1	2.4	1.7	-	-

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

COURSE OBJECTIVES:

- To understand the fundamental components and their characteristics of IC technology.
- To understand the design principles of the combinational logic circuits.
- To understand sequential logic circuits and clocking strategies
- To understand Interconnect parameters and Memory Architecture.
- To understand the design of arithmetic building blocks.

UNIT-I MOS TRANSISTOR PRINCIPLES 9

MOS logic families (NMOS and CMOS), Ideal and Non Ideal I-V Characteristics, CMOS devices. MOSFET - DC transfer characteristics, Small signal analysis.

UNIT-II COMBINATIONAL LOGIC CIRCUITS 9

Propagation Delays, Stick diagram, Layout diagrams, Examples of combinational logic design, Elmore's constant, Static Logic Gates, Dynamic Logic Gates, Pass Transistor Logic, Power Dissipation.

UNIT-III SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES 9

Static Latches and Registers, Dynamic Latches and Registers, Pipelines, Timing classification of Digital Systems, Synchronous Design, Self-Timed Circuit Design.

UNIT-IV INTERCONNECT, MEMORY ARCHITECTURE 9

Interconnect Parameters – Capacitance, Resistance, and Inductance, Logic Implementation using Programmable Devices (ROM, PLA, FPGA), Memory Architecture and Building Blocks.

UNIT-V DESIGN OF ARITHMETIC BUILDING BLOCKS 9

Arithmetic Building Blocks: Data Paths, Adders-Ripple Carry Adder, Carry-Bypass Adder, Carry Select Adder, Carry-Look Ahead Adder, Multipliers, Barrel Shifter, power and speed tradeoffs.

COURSE OUTCOMES:

On completion of the course, the student will be able to:

1. Understand the basic characteristics and working principle of MOSFET.
2. Explain Combinational Logic Circuits.
3. Describe about Sequential Logic Circuits and Clocking systems.
4. Understand Memory architecture and interconnects.
5. Discuss about an arithmetic building blocks.

TEXT BOOKS:

1. Jan M. Rabaey, Anantha P. Chandrakasan, Borivoje Nikolic, "Digital Integrated Circuits: A Design Perspective", Pearson Education, Limited, 2017.
2. Neil H E Weste, Kamran Eshraghian, "Principles of CMOS VLSI Design: A System Perspective," Addison Wesley, 2009.

REFERENCE BOOKS:

1. D.A. Hodges, H.G. Jackson and Resve A. Saleh, Analysis and Design of Digital Integrated Circuits, International Student Edition, McGraw Hill, 2005.
2. P. Rashinkar, Paterson and L. Singh, "System-on-a-Chip Verification-Methodology and Techniques", Springer US, 2013.
3. Samiha Mourad and Yervant Zorian, "Principles of Testing Electronic Systems", Wiley 2000.
4. M. Bushnell and V. D. Agarwal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Springer US, 2013.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	2	2	1	-	-	-	-	-	-	-	3	3
2	3	3	2	2	1	-	-	-	-	-	-	-	3	3
3	3	-	3	2	1	-	-	-	-	-	-	-	2	3
4	3	3	2	2	2	-	-	-	-	-	-	-	3	2
5	2	-	3	2	2	-	-	-	-	-	-	-	2	2
Avg.	2.8	3	2.4	2	1.4	-	-	-	-	-	-	-	2.6	2.6

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

PEC504	WIRELESS SENSOR NETWORK DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the principles and architecture of wireless sensor networks (WSNs).
- To gain insight into the MAC and Routing protocols used in WSNs.
- To explore the 6LOWPAN technology.
- To acquire understanding of the protocols essential for developing real-time applications using WSNs and 6LOWPAN.
- To gain knowledge about operating systems related to WSNs and 6LOWPAN.
- To familiarise the tools involved in WSN design.

UNIT-I INTRODUCTION 9

Principles of Wireless Sensor Network - 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 – low duty cycle protocols and wakeup concepts, contention and Schedule-based protocols - SMAC, BMAC, TRAMA, Routing protocols – Requirements, SPIN, Directed Diffusion, COUGAR, ACQUIRE, LEACH, PEGASIS.

UNIT-III APPLICATION LAYER PROTOCOL 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-IV 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-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 : 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student will be able to

1. Understand the principles and architectures of wireless sensor networks (WSNs).
2. Illustrate the MAC and Routing protocols used in WSNs.
3. Explore the 6LOWPAN technology.
4. Analyse the protocols essential for developing real-time applications using WSNs and 6LOWPAN.
5. Assess the operating systems related to WSNs and 6LOWPAN.
6. Design and develop the WSN using different tools.

TEXT BOOKS:

1. Shelby, Zach., Bormann, Carsten. 6LoWPAN: The Wireless Embedded Internet. Germany: Wiley, 2011.
2. Yang, Shuang-Hua. Wireless Sensor Networks: Principles, Design and Applications. United Kingdom: Springer London, 2013.
3. Wireless Sensor Networks: Design, Deployment and Applications. United Kingdom: IntechOpen, 2021.
4. Levis, Philip., Gay, DavidE. TinyOS Programming. United Kingdom, Cambridge University Press, 2014.

REFERENCE BOOKS:

1. F. Zhao and L. Guibas, “Wireless Sensor Networks: An Information Processing Approach”, Morgan Kaufmann, 1st Indian reprint, 2013.

2. YingshuLi, MyT. Thai, Weili Wu, “Wireless sensor Network and Applications”, Springer series on signals and communication technology, 2008.
3. Ian F. Akyildiz , By (author) Mehmet Can Vuran, “Wireless Sensor Networks“, John Wiley & Sons Inc, 2011.
4. Kazem Sohraby , Daniel Minoli , Taieb Znati , “Wireless Sensor Networks : Technology, Protocols, and Applications “, John Wiley & Sons Inc, 2010.
5. Shuang-Hua Yang ,” Wireless Sensor Networks: Principles, Design and Applications “, Springer London Ltd, 2013.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	2	2	2	1	-	-	-	-	2	2	3	1
2	3	3	2	2	2	1	-	-	-	-	-	2	3	2
3	3	3	3	2	2	1	-	-	-	-	-	3	3	2
4	3	3	3	3	2	2	-	-	-	-	-	2	2	1
5	2	-	1	1	3	2	-	-	-	-	-	2	2	2
6	-	1	-	1	1	-	-	-	-	-	-	-	1	1
Avg.	3	3	2	2	2	1	-	-	-	-	2	2	3	2

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

COURSE OBJECTIVES:

- To expose the glossary related to vehicle electrical and electronic system
- To impart the need for starter batteries, starter motor and alternator in the vehicle.
- To differentiate the conventional and modern vehicle architecture and the data transfer among the different electronic control unit using different communication protocols
- To impart common types of sensor and actuators used in vehicles.
- To expose the understanding of networking in vehicles.

UNIT-I	INTRODUCTION AND AUTOMOTIVE BATTERIES	9
	MANAGEMENT SYSTEM	

Introduction - Overview of vehicle electrical systems- Electrical circuits - Electrical power supply in conventional vehicle- Dimensioning of wires- Circuit diagrams and symbols - Electromagnetic Compatibility and interference suppression. Batteries – Battery design – Method of operation – Lead acid battery construction – Battery ratings and testing- Maintenance -free batteries – Lithium Batteries – Substitute, versions, special cases.

UNIT-II	STARTING AND CHARGING SYSTEM	9
----------------	-------------------------------------	----------

Alternators – Generation of electrical energy in vehicle- physical principles- Alternator and voltage regulations versions – power losses – characteristics curve- Alternator operation in the vehicle- Alternator circuitry. Starter Motors – Development and Starting requirements in the IC engines starter motor design – Starter motor design variations – starter motor control and power Circuits.

UNIT-III	IGNITION, LIGHTING AND AUXILLARY SYSTEM	9
-----------------	--	----------

Ignitions System - Ignition fundamentals- Electronic ignition- Programmed ignition- Distributor less ignition -Direct ignition - Spark plugs. Automotive lighting Technology – Technical demands – Development of lighting technology- Light sources – physical principles – Front and rear lighting system- Interior lighting system – Special

purpose lamps – Adaptive Lighting system - Instrument clusters - Wiper and Washer systems- electric horns.

UNIT-IV AUTOMOTIVE ELECTRONICS AND SENSORS AND 9 **ACTUATORS**

Automotive Electronics- overview and demands- Basic principles of semiconductor technology - Electronic Components- semiconductor components- Microcontrollers - Sensor-Signal Processing - Data Processing in the vehicle - Glossary for automotive microelectronics. Automotive Sensors – Basics – Sensors: Position, speed, acceleration/ Vibrational, Force/Torque, Flow meters, Gas/ Concentration, Temperature- Measured Quantities, Measuring Principles and automotive applications Automotive Actuators - Electromechanical actuators- Fluid-mechanical actuators- Electrical machines- Direct-current machines- Three-phase machines- Single-phase alternating- current Machines - Duty-type ratings for electrical machines, Automatic controller with networking.

UNIT-V VEHICLE NETWORKING 9

Data transfer between automotive Electronics systems - Basic principles of networking- Network topology- Network organization- OSI reference model- Control mechanisms - communication protocols in embedded systems- - Vehicle Communication Protocols – Cross-system functions - Requirements for bus systems- Classification of bus systems- Applications in the vehicle -Coupling of networks- Examples of networked Vehicles - Bus system- CAN, LIN, Flexray – MOST etc.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Define the glossary related to vehicle electrical and electronic system
2. Explain the need for starter batteries, starter motor and alternator in the vehicle.
3. Differentiate the conventional and modern vehicle architecture and the data transfer among the different electronic control unit using different communication protocols
4. List common types of sensor and actuators used in vehicles

5. Understand networking in vehicles.

TEXT BOOKS:

1. Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th Edition, 2007, ISBN No: 978-3-658-01783-5

REFERENCE BOOKS:

1. Barry Holembeak, "Automotive Electrical and Electronics" , Delmar Publishers, Clifton Park,USA,2010
2. James D Halderman, "Automotive Electrical and Electronics", Prentice Hall, USA, 2013
3. Tom Denton, "Automotive Electrical and Electronics Systems," Third Edition, 2004,SAE International
4. William Ribbens, "Understanding Automotive Electronics - An Engineering Perspective," 7th Edition, Elsevier Butterworth-Heinemann Publishers, 2012

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	1	1	-	-	1	1	-	1	-	-	1	2	1	-	-
2	2	1	-	-	-	2	3	1	1	-	1	2	2	1	-	-
3	2	2	1	1	-	2	2	-	1	-	-	2	1	1	-	-
4	2	2	1	-	-	1	2	-	1	-	2	2	2	1	1	-
5	2	3	2	2	2	1	2	-	1	-	2	2	1	2	2	-
Avg.	2.0	1.8	1.3	1.5	2.0	1.4	2.0	1.0	1.0	-	1.7	1.8	1.6	1.2	1.5	-

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

COURSE OBJECTIVES:

- To various solar PV and solar thermal technologies.
- To know the basic parameters of solar PV panels and systems.
- To familiarize the standard test conditions under which the parameters are measured.
- To design of solar PV system for electrical energy requirements, sizing of PV modules, battery, electronics, etc.
- To design of solar thermal system for given thermal energy requirements.

UNIT-I OVERVIEW OF SEMICONDUCTOR 9

Review of Semiconductor Physics, Charge carrier generation and recombination, p-n junction model and depletion capacitance, Current voltage characteristics in dark and light, Equivalent Circuits of Solar Cells, Fill Factor, Fabrication Process of Semiconductor Grade Silicon.

UNIT-II SOLAR PV TECHNOLOGY 9

Device Physics of Solar Cells, Principle of solar energy conversion, Conversion efficiency, Single, Tandem multi-junction solar cells, Numerical solar cell modelling Principle of cell design, Crystalline silicon and III-V solar cells, Thin film solar cells: Amorphous silicon, Quantum Dot solar cells.

UNIT-III DESIGN OF SOLAR PV SYSTEM 9

Design of solar hot water system: solar thermal system components, use of thermosyphon effect, estimation of the energy required for heating water, collector area, typical losses in conversion, efficiency equation of solar thermal system, solar PV system components, block diagram of simple (no storage, no electronics) and complicated systems (grid tied with diesel and wind generators), sizing solar PV, battery and power conditioning units required in solar system, configuration of battery and panels, fixing input and output parameters of all system components.

UNIT-IV FABRICATION OF ORGANIC AND PEROVSKITE SOLAR 9

CELLS

Introduction to Dye Sensitized Solar Cells, Perovskite Solar Cells, Fabrication of Dye Sensitized Solar Cells and perovskite solar cells. Design of novel dye, Design of solid electrolytes materials, Counter electrode engineering Introduction to Organic Solar Cells, Physics of Bulk Hetero junction (BHJ) Solar Cells, Morphology and charge separation in BHJ, Design of low band gap polymers, Novel architecture in BHJ. Photo physics in perovskite solar cells Stability in perovskite solar cells, Lead free perovskite solar cells.

UNIT-V APPLICATIONS FOR DC-DC CONVERTERS 9

Photovoltaics modules, system and application-Buck, Boost, Buck-Boost converters- Maximum Power Point Tracking (MPPT) techniques and implementation using DC-DC converters, Standalone PV system Configurations, Hybrid PV Systems, Grid-Connected PV Systems, Building Integrated PV system, Photovoltaic system engineering, Thermo- Photovoltaic generation of electricity, Concentration and storage of electrical energy, green energy building.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Understand various solar energy technologies, how sun light can be converted in electrical and heat energy.
2. Discuss the efficiency of technologies measured.
3. Relate various components of solar PV system to fulfill given electricity requirements.
4. Relate organic solar system to fulfill given organic energy requirements
5. Relate perovskite solar system to fulfill given perovskite energy requirements.

TEXT BOOKS:

1. Jasprit Singh, "Semiconductor Devices, Basic Principles", Wiley,2001
2. Jenny Nelson, "The Physics of Solar Cells", Imperial College Press, 2003

REFERENCE BOOKS:

1. A Luque and S. Hegedus, Handbook of Photovoltaic Science & Engineering",

Wiley Tsakalakos, L.; "Nanotechnology for Photovoltaics", CRC Solar Photovoltaics: Fundamentals Technologies and Applications, Chetan Singh Solanki, PHI Learning, July 2015.

2. C. S. Solanki, Solar Photovoltaics – Fundamentals, Technologies and Applications, 3rd Ed. Prentice Hall of India, 2016.
3. C. S. Solanki, Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers and Engineers, Prentice Hall of India, 2013.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	-	3	1	1	-	-	-	-	-	2	2	2
2	2	2	1	-	3	1	1	-	-	-	-	-	2	2	2
3	3	2	2	-	3	1	1	-	-	-	-	-	2	2	2
4	3	3	3	-	3	1	1	-	-	-	-	-	2	2	2
5	3	3	3	-	3	1	1	-	-	-	-	-	2	2	2
Avg.	2.8	2.6	2.4	-	3	1	1	-	-	-	-	-	2	2	2

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

PROFESSIONAL ELECTIVES
Verticals – VI (Computing Techniques)

PEI601	SOFT COMPUTING TECHNIQUES FOR	L	T	P	C
	PROCESS CONTROL	3	0	0	3

COURSE OBJECTIVES:

- To Understand Soft Computing concepts, technologies, and applications.
- To Understand the underlying principle of soft computing with its usage in various application.
- To Understand different soft computing tools to solve real life problems.
- Be familiar with the design of neural networks, fuzzy logic and fuzzy systems.
- Classify the various soft computing frame works.

UNIT-I INTRODUCTION TO SOFT COMPUTING 9

Introduction of soft computing- soft computing vs. hard computing-various types of soft computing techniques- Fuzzy Computing-Neural Computing, Genetic Algorithms, Associative Memory- Adaptive Resonance Theory-Classification-Clustering- Bayesian Networks- Probabilistic reasoning.

UNIT-II INTRODUCTION TO ARTIFICIAL NEURAL NETWORK 9

Artificial Neural Network: Fundamental concept, Evolution of Neural Networks, Basic Models, McCulloch-Pitts Neuron, Linear Separability, Hebb Network. Supervised Learning Network: Perceptron Networks, Adaptive Linear Neuron, Multiple Adaptive Linear Neurons, Backpropagation Network, Radial Basis Function, Time Delay Network, Functional Link Networks, Tree Neural Network. Associative Memory Networks: Training algorithm for pattern Association, Autoassociative memory network, heteroassociative memory network, bi-directional associative memory, Hopfield networks, iterative autoassociative memory networks.

UNIT-III NETWORK LEARNING 9

UnSupervised Learning Networks: Fixed weight competitive nets, Kohonen self-organizing feature maps, learning vectors quantization, counter propagation

networks, adaptive resonance theory networks. Special Networks: Simulated annealing, Boltzman machine, Gaussian Machine, Cauchy Machine, Probabilistic neural net, cascade correlation network, cognition network, neo-cognition network, cellular neural network, optical neural network Third Generation Neural Networks: Spiking Neural networks, convolutional neural networks, deep learning neural networks, extreme learning machine model.

UNIT-IV INTRODUCTION TO FUZZY LOGIC AND FUZZY 9

Introduction to Fuzzy Logic, Classical Sets and Fuzzy sets: Classical sets, Fuzzy sets. Classical Relations and Fuzzy Relations: Cartesian Product of relation, classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets. Membership Function: features of the membership functions, fuzzification, methods of membership value assignments. Defuzzification: Lambda-cuts for fuzzy sets, Lambda-cuts for fuzzy relations, Defuzzification methods. Fuzzy Arithmetic and Fuzzy measures: fuzzy arithmetic, fuzzy measures, measures of fuzziness, fuzzy integrals.

UNIT-V SOFT COMPUTING APPLICATIONS IN PROCESS 9
CONTROL

Case study: Gas Turbine Speed Control Systems-Direct Torque control of Induction Motor-Intelligent Control of DC Servomotor-Tuning Alogrithm for PID controller using Soft Computing Techniques.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Apply various soft computing concepts for practical applications.
2. Choose and design suitable neural network for real time problems.
3. Use fuzzy rules and reasoning to develop decision making and expert system.
4. Explain the importance of optimization techniques and genetic programming.
5. Review the various hybrid soft computing techniques and apply in real time problems.

TEXT BOOKS:

1. J.S.R.Jang, C.T. Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI / Pearson Education 2004.
2. R. Rajasekaran and G. A and Vijayalakshmi Pa, Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications, Prentice Hall of India.
3. T. Ross, Fuzzy Logic with Engineering Applications, Tata McGraw Hill.

REFERENCE BOOKS:

1. R. Rajasekaran and G. A and Vijayalakshmi Pa, Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications, Prentice Hall of India.
2. D. E. Goldberg, Genetic Algorithms in Search, Optimisation, and Machine Learning, Addison-Wesley.
3. T. Ross, Fuzzy Logic with Engineering Applications, Tata McGraw Hill.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	2	3	1	2	2		1	1		2		1	3
2	1	1	2	3	1	2	2		1	1		2		1	3
3	1	1	2	3	1	2	2		1	1		2		1	3
4	1	1	2	3	1	2	2		1	1		2		1	3
5	1	1	2	3	1	2	2		1	1		2		1	3
Avg.	1	1	2	3	1	2	2	-	1	1	-	2	-	1	3

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

COURSE OBJECTIVES:

- To represent the linear time invariant System in discrete State Space form
- To introduce system identification techniques
- To educate direct discrete design techniques
- To introduce multi-loop regulatory control
- To introduce multivariable regulatory control

UNIT-I DISCRETE STATE-VARIABLE TECHNIQUE 9

State equation of discrete data system with sample and hold – State transition equation – Methods of computing the state transition matrix – Decomposition of discrete data transfer functions – State diagrams of discrete data systems – System with zero-order hold – Controllability and observability of linear time invariant discrete data system–Stability tests of discrete-data system – State Observer - State Feedback Control.

UNIT-II SYSTEM IDENTIFICATION 9

Non Parametric methods:-Transient analysis–Frequency analysis–correlation analysis– Spectral analysis – Parametric methods- Least square method – Recursive least square method.

UNIT-III DIGITAL CONTROLLER DESIGN 9

Review of z-transform – Modified of z-transform – Pulse transfer function – Digital PID controller – Dead-beat control and Dahlin's control – Smith predictor – Digital Feed-forward controller – IMC State Feedback Controller - LQG Control

UNIT-IV MULTI-LOOP REGULATORY CONTROL 9

Multi-loop Control - Introduction – Process Interaction – Pairing of Inputs and Outputs -The Relative Gain Array (RGA) – Properties and Application of RGA – Multi – loop PID Controller– Biggest Log Modulus Tuning Method – De coupler.

UNIT-V MULTIVARIABLE REGULATORY CONTROL 9

Introduction to Multivariable control –Multivariable PID Controller -Multivariable IMC– multivariable Dynamic Matrix Controller – Multivariable Model Predictive Control – Generalized Predictive Controller – Implementation Issues.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Ability to analyze the discrete time systems
2. Ability to build models from input-output data.
3. Ability to design a digital controller.
4. Ability to design multi-loop controller and multivariable controller for multi-variable systems.
5. Ability to design multivariable controller for multi-variable systems.

TEXT BOOKS:

1. Stephanopoulos, G., “Chemical Process Control -An Introduction to Theory and Practice”, Prentice Hall of India, 2005.
2. Sigurd Skogestad, Ian Postlethwaite, “Multivariable Feedback Control: Analysis and Design”, John Wiley and Sons, 2005.

REFERENCE BOOKS:

1. Gopal, M., “Digital Control and State Variable Methods”, Tata Mc Graw Hill, 2003.
2. Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, “Process Dynamics and Control”, Wiley John and Sons, 3rd Edition, 2010..
3. P. Albertos and A. Sala, “Multivariable Control Systems An Engineering Approach”, Springer Verlag, 2006.
4. Bequette, B.W., “Process Control Modeling, Design and Simulation”, Prentice Hall of India, 2008.
5. Thomas E. Marlin, Process Control – Designing Processes and Control systems for Dynamic Performance, Mc-Graw-Hill,2000.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2				2		2		3		2	3	2	
2	2		2						1	3	1	2	3	2	1
3	3	2				1									2
4	3	2	2			1				2	1	1		2	2
5	3	3		1		1	1			2				2	
Avg.	2.8	2.3	2.0	1.0	-	1.3	1.0	2.0	1.0	2.5	1.0	1.7	3.0	2.0	1.7

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

COURSE OBJECTIVES:

- To infer knowledge in problem formulation with AI.
- To exemplify the uninformed and informed search technique procedures for real world problems.
- To understand the adversarial search methods, constraint satisfaction problems and intelligent agents.
- To demonstrate various knowledge representation techniques.
- To infer knowledge about expert systems.

UNIT-I	INTRODUCTION TO AI	9
---------------	---------------------------	----------

AI techniques, Problem solving with AI, AI Models, Data acquisition and learning aspects in AI, Problem solving- Problem solving process, formulating problems, Problem types and characteristics, Problem space and search, Toy Problems – Tic-tac-toe problems, Missionaries and Cannibals Problem, Real World Problem – Travelling Salesman Problem.

UNIT-II	BASIC INTRODUCTION TO DATA STRUCTURE AND SEARCH ALGORITHMS	9
----------------	---	----------

Basic Introduction to Data Structure and Search Algorithms 9 Hour Basic introduction to stacks, queues, trees and graphs - General Search Algorithms – Searching for solutions – Problem-solving agents – Control Strategies – Uninformed Search Methods – Breadth First Search – Uniform Cost Search - Depth First Search -Depth Limited Search – Informed search - Generate and test - Best First search - A* Algorithm.

UNIT-III ADVERSARIAL SEARCH PROBLEMS AND INTELLIGENT AGENT 9

Adversarial Search Methods (Game Theory) - Mini max algorithm - Alpha beta pruning - Constraint satisfactory problems – Constraints – Crypt Arithmetic Puzzles – Constraint Domain – CSP as a search problem (Room colouring). Intelligent Agent – Rationality and Rational Agent – Performance Measures – Rationality and

Performance – Flexibility and Intelligent Agents – Task environment and its properties – Types of agents.

UNIT-IV KNOWLEDGE REPRESENTATION 9

Knowledge Representation -Knowledge based agents – The Wumpus world – Propositional Logic - syntax, semantics and knowledge base building - inferences – reasoning patterns in propositional logic – predicate logic – representing facts in logic: Syntax and semantics – Unification – Unification Algorithm - Knowledge representation using rules - Knowledge representation using semantic nets - Knowledge representation using frames inferences - Uncertain Knowledge and reasoning Methods.

UNIT-V PLANNING AND EXPERT SYSTEM 9

Planning and Expert System 9 Hour Planning – planning problem – Simple planning agent – Blocks world problem – Mean Ends analysis Learning - Machine learning - Learning concepts, methods and models Introduction to expert system – architecture of expert systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

1. Formulate a problem as a state space search method and its solution using various AI techniques.
2. Apply appropriate searching techniques to solve a real-world problem.
3. Develop various game playing strategies to solve real world adversarial search problems.
4. Represent various knowledge representation techniques to solve complex AI problems.
5. Design an expert system to implement advance techniques in Artificial Intelligence.

TEXT BOOKS:

1. Deepak Kemhani, First course in Artificial Intelligence, McGraw Hill Pvt Ltd, 2013.
2. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition, Pearson Education, 2020.

REFERENCE BOOKS:

1. Parag Kulkarni, Prachi Joshi, Artificial Intelligence –Building Intelligent Systems, 1st ed., PHI learning, 2015.
2. Data Structures Schaum's Outlines Series, Seymour, Lipschutz, 2014.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	1	-	2	-	-	-	-	2	-	-	-	2	-	-	-
2	-	2	-	-	2	-	-	-	-	-	-	-	-	2	-	-
3	-	-	3	-	-	-	3	-	-	-	2	-	-	-	1	-
4	-	-	-	2	-	2	2	1	-	2	-	-	-	-	2	-
5	-	2	-	-	-	-	2	-	2	-	-	-	-	2	-	2
Avg.	2	1.7	3	2	2	2	2.3	1	2	2	2	-	2	2	1.5	2

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

COURSE OBJECTIVES:

- To understand the principles of cloud architecture, models and infrastructure.
- To explore and experiment with various Cloud deployment environments.
- To understand edge routing and networking layers.
- To describe the fog topologies in IoT.
- To discuss the security issues of protocols in IoT

UNIT-I	CLOUD ARCHITECTURE MODELS AND INFRASTRUCTURE	9
---------------	---	----------

Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud deployment models – Cloud service models; Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Design Challenges.

UNIT-II	CLOUD DEPLOYMENT ENVIRONMENT	9
----------------	-------------------------------------	----------

Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus – OpenStack.

UNIT-III	EDGE COMPUTING	9
-----------------	-----------------------	----------

Edge purpose and definition, Edge hardware architectures, Operating systems, Edge platforms Edge Routing and Networking, Edge to Cloud Protocols.

UNIT-IV	CLOUD AND FOG TOPOLOGIES	9
----------------	---------------------------------	----------

Cloud services model, Public, private, and hybrid cloud, Constraints of cloud architectures for IoT, Fog computing- Open Fog reference architecture, Fog topologies, Data Analytics and Machine Learning- Basic data analytics, Machine learning- Convolutional neural networks, Recurrent neural networks, IoT data analytics and machine learning comparison.

UNIT-V	IOT AND EDGE SECURITY	9
---------------	------------------------------	----------

Cybersecurity- Attack and threat terms, definitions of different cyber defense mechanisms and technologies, Anatomy of IoT cyber-attacks, Physical and hardware security, Cryptography, Blockchain and cryptocurrencies in IoT, Consortiums and Communities.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

1. Understand the design challenges in the cloud.
2. Develop and deploy services on the cloud and set up a cloud environment.
3. Practice the concept of edge computing protocols.
4. Analyze the purpose of machine learning in IoT.
5. Construct hardware security for IoT applications.

TEXT BOOKS:

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012. (Unit 1 & 2).
2. Perry Lea, IoT and Edge Computing for Architects Implementing edge and IoT systems from sensors to clouds with communication systems, analytics, and security, 2nd Edition ,Packt Publishing, 2020. (Unit 3, 4 & 5).

REFERENCE BOOKS:

1. K. Anitha Kumari, G. Sudha Sadasivam, D. Dharani, M. Niranjnamurthy, Edge Computing Fundamentals, Advances and Applications,CRC Press, 2021.
2. Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy: an enterprise perspective on risks and compliance", O'Reilly Media, Inc.,2009.
3. Li, H., Ota, K., & Dong, M. Learning IoT in edge: Deep learning for the Internet of Things with edge computing, 2018.

List of Open Source Software/ Learning website:

1. <https://www.udemy.com/course/introduction-to-edge-computing>
2. [https://www.coursera.org/lecture/iot-wireless-cloud-computing/5-10-edge-computing pOK8T](https://www.coursera.org/lecture/iot-wireless-cloud-computing/5-10-edge-computing-pOK8T)
3. <https://www.cognixia.com/course/edge-computing-training/>
4. Edge Computing Platforms: Alef Private Edge, Azure IoT Edge, ClearBlade, Eclipse ioFog, ESF Edge Computing Platform, Google Distributed Cloud Edge, HPE Edgeline, Infiot ZETO, Mutable Public Edge Cloud, Vapor IO Kinetic Grid, StarlingX

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	1	1	-	-	-	-	3	-	-	2	1	3
2	1	2	3	2	3	-	-	-	-	3	-	-	1	3	3
3	3	2	2	2	-	-	-	-	-	-	-	-	1	2	2
4	3	2	3	2	-	-	-	-	-	-	-	-	1	2	2
5	3	3	3	2	-	-	-	-	-	-	-	-	1	2	2
Avg	2.6	2.2	2.6	1.8	2.0	-	-	-	-	3	-	-	1.2	2	2.4

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

PIT602	DEEP AND REINFORCEMENT LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand complexity of Deep Learning algorithms and their limitations
- Understand the theoretical foundations, algorithms, methodologies, and applications of neural networks and deep learning.
- It will help to design and develop an application-specific deep learning models.
- Be capable of confidently applying common Deep Learning algorithms in practice and implementing their own.
- Be capable of performing experiments in Deep Learning using real-world data.

UNIT-I MACHINE LEARNING BASICS 9

Learning algorithms, Maximum likelihood estimation, Building machine learning algorithm, Neural Networks Multilayer Perceptron, Back-propagation algorithm and its variants Stochastic gradient decent, Curse of Dimensionality.

UNIT-II INTRODUCTION TO DEEP LEARNING & ARCHITECTURES 9

Machine Learning Vs. Deep Learning, Representation Learning, Width Vs. Depth of Neural Networks, Activation Functions: RELU, LRELU, ERELU, Unsupervised Training of Neural Networks, Restricted Boltzmann Machines, Auto Encoders.

UNIT-III CONVOLUTIONAL NEURAL NETWORKS 9

Architectural Overview – Motivation - Layers – Filters – Parameter sharing – Regularization, Popular CNN Architectures: ResNet, AlexNet.

UNIT-IV SEQUENCE MODELLING – RECURRENT AND RECURSIVE NETS 9

Recurrent Neural Networks, Bidirectional RNNs – Encoder-decoder sequence to sequence architectures - BPTT for training RNN, Long Short Term Memory Networks.

UNIT-V AUTO ENCODERS AND DEEP GENERATIVE MODELS 9

Deep Belief networks – Boltzmann Machines – Deep Boltzmann Machine – Generative Adversarial Networks.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

1. Have a good understanding of the fundamental issues and basics of machine learning.
2. Ability to differentiate the concept of machine learning with deep learning techniques.
3. Understand the concept of CNN and transfer learning techniques, to apply it in the classification problems.
4. Understand the concept of Recurrent Neural Networks Model.
5. Use autoencoder and deep generative models to solve problems with high dimensional data including text, image and speech.

TEXT BOOKS:

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, 2017. (Unit 1,2,3,4,5)
2. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017. (Unit 2)

REFERENCE BOOKS:

1. Umberto Michelucci "Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks" Apress, 2018. (Unit 2)
2. Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Press, 2012.(Unit 1)
3. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Prentice Hall of India, Third Edition 2014. (Unit 1,2)
4. Giancarlo Zaccane, Md. Rezaul Karim, Ahmed Menshawy "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017.(Unit 3,4)

List of Open Source Software/ Learning website:

1. <https://www.techtarget.com/searchenterpriseai/definition/machine-learning-ML>
2. <https://www.techtarget.com/searchenterpriseai/definition/deep-learning-deep-neuralnetwork>
3. <https://www.simplilearn.com/tutorials/deep-learning-tutorial/rnn>
4. <https://machinelearningmastery.com/what-are-generative-adversarial-networks-gans/>

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	-	-	-	-	-	-	-	-	-	-	2	2	2
2	3	2	2	-	-	-	-	-	-	2	-	-	2	2	2
3	2	3	2	-	-	-	-	-	-	-	-	-	2	2	2
4	1	2	3	2	2	-	-	-	-	-	-	-	2	2	2
5	2	2	2	3	3	-	-	-	-	2	-	-	2	2	2
Avg	2.2	2.2	2.25	2.5	2.5	-	-	-	-	2	-	-	2	2	2

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

PIT603	AUGMENTED REALITY AND VIRTUAL REALITY	L	T	P	C
	TECHNOLOGIES	3	0	0	3

COURSE OBJECTIVES:

- To impart the fundamental aspects and principles of AR and VR technologies.
- To know the internals of the hardware and software components involved in the development of AR and VR enabled applications.
- To learn about the graphical processing units and their architectures.
- To gain knowledge about AR and VR application development.
- To know the technologies involved in the development of AR and VR based applications.

UNIT-I AUGMENTED REALITY 9

Introduction to Augmented Reality - Examples and Related Fields - Displays - Multimodal Displays - Visual Perception - Spatial Display Model - Visual Displays - Tracking, Calibration, and Registration - Coordinate Systems - Characteristics of Tracking Technology - Stationary Tracking Systems - Mobile Sensors - Optical Tracking - Sensor Fusion.

UNIT-II AUGMENTED REALITY IN COMPUTER VISION 9

Computer Vision for AR -Interaction - Visual Coherence - Modelling and Annotation – Navigation - Wearable devices – AR Smart Glasses – AR Headsets – AR Contact Lenses – AR Wristbands and Rings - Applications of Computer Vision in AR.

UNIT-III VIRTUAL REALITY 9

Introduction to Virtual Reality-Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management.

UNIT-IV VR PROGRAMMING 9

VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D- VR hardware: Headsets, motion tracking, controllers - VR software: Game engines (Unity, Unreal Engine) - VR display technologies: FOV, resolution, latency- Spatial audio in VR - Creating immersive environments.

UNIT-V APPLICATIONS 9

Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education..

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

1. Understand the basic concepts of AR and VR.
2. Understand the tools and technologies related to AR and VR.
3. Know the working principle of AR and VR related Sensor devices.
4. Design of various models using modeling techniques.
5. Develop AR and VR applications in different domains.

TEXT BOOKS:

1. Charles Palmer, John Williamson, “Virtual Reality Blueprints: Create compelling VR experiences for mobile”, Packt Publisher, 2018.
2. Dieter Schmalstieg, Tobias Hollerer, “Augmented Reality: Principles & Practice”, Addison Wesley, 2016.

REFERENCE BOOKS:

1. John Vince, “Introduction to Virtual Reality”, Springer-Verlag, 2004.
2. William R. Sherman, Alan B. Craig: Understanding Virtual Reality – Interface, Application, Design”, Morgan Kaufmann, 2003.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	-	-	-	-	-	-	-	-	1	-	-	2	1	2
2	3	-	3	2	-	-	-	-	-	1	-	-	3	1	2
3	2	-	3	-	-	-	-	-	-	1	-	-	3	2	2
4	3	-	3	2	2	-	-	-	-	1	-	-	3	2	2
5	3	2	2	2	-	-	-	-	-	1	-	-	3	3	3
Avg	2.8	2	2.7	2	2	-	-	-	-	1	-	-	2.8	1.8	2.2

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

ELECTIVE – MANAGEMENT COURSES

S.No	Course Code	Course Title	Category	Contact Periods				Credits
				L	T	P	Total	C
1.	MAN101	Principles of Management	HSMC	2	0	0	2	2
2.	MAN102	Total Quality Management	HSMC	2	0	0	2	2
3.	MAN103	Human Resource Management	HSMC	2	0	0	2	2
4.	MAN104	Entrepreneurship Development	HSMC	2	0	0	2	2

OBJECTIVES:

1. To study the principles of management, functions and their application in an organization.
2. To educate the students on the concept of planning and decision-making.
3. To understand the dynamics of human relations in organisations.
4. To learn about motivation, communication and leadership aspects.
5. To study the process of controlling and the various techniques involved in controlling.

UNIT I: INTRODUCTION TO MANAGEMENT**6**

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. Current trends and issues in Management.

UNIT II: PLANNING**6**

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management –types of strategies.

UNIT III: ORGANISING**6**

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.

UNIT IV: DIRECTING**6**

Motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – the process of communication – barrier in communication.

UNIT V: CONTROLLING**6**

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Quality control and Inventory Control - Productivity problems and management.

TOTAL HOURS: 30**OUTCOMES:**

1. Students will be able to have a clear understanding of managerial functions.
2. Students would have the knowledge to apply planning techniques and decision-making.
3. Understand the concept of Human Resource Management.

4. Students would be able to understand motivation, leadership and communication principles.
5. Students would be able to apply control techniques in the organization.

Textbooks:

1. Stephen P. Robbins & Mary Coulter, "Management", 14th Edition, Pearson, 2017
2. AF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6th Edition, Pearson, 2004.

REFERENCES:

1. R.S.N. Pillai, S.Kala, Principles of Management, S. Chand Publishing, 2013.
2. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management" 10th Edition, Pearson Education, 2016.
3. Robert Kreitner & Mamata Mohapatra, "Management", Biztantra, 2008.
4. Harold Koontz & Heinz Weihrich "Essentials of management" Tata Mc Graw Hill, 2006.
5. Tripathy PC & Reddy PN, "Principles of Management", Tata McGraw Hill, 6th edition 2017.

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1							
CO2		2						
CO3					1			
CO4			1					
CO5		1						
AVG	1	2	1	-	1	-	-	-

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

OBJECTIVES:

1. To understand the Total Quality Management Concepts and Dimensions of Customers quality.
2. To familiarise the various contributions of Quality Gurus.
3. To understand the Framework of Quality Management.
4. To educate about tools and techniques in Quality Management.
5. To impart knowledge to implement the Quality Management System.

UNIT – I: INTRODUCTION**6**

Introduction - Need for quality - Evolution of quality - Definition of quality, Benefits & Obstacles, Quality – vision, mission and policy statements - Attitude and involvement of top management, Customer Focus – customer perception - Customer retention. Introduction to SERVQUAL.

UNIT – II: OVERVIEW OF THE CONTRIBUTIONS**6**

Philosophies of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa - Concept of Quality circle

UNIT – III: TQM FRAMEWORK**6**

Culture, Leadership – Quality Council, Employee Involvement, Motivation, Empowerment, Recognition and Rewards, International/National Quality Awards.

UNIT – IV: TOOLS AND TECHNIQUES**6**

Six Sigma, Kaizen, 5S, 7QC Tools, Quality function deployment (QFD) – Benefits, Voice of customer, Information Organization, Building a House of Quality (HOQ), Bench marking and Poka-Yoke.

UNIT – V: QUALITY MANAGEMENT**6**

Quality Audits – Quality Council. ISO 9001:2015 (Quality Management) AS9100 (Aerospace), ISO 14001 (Environment), ISO/TS 16949 (Automotive), ISO 17025 (Testing/FDA), TL 9000 (Telecommunication), ISO 13485 (Medical Devices), ISO 27001 (Information Security), ISO 29001 (Oil / Gas).

Total Hours : 30

OUTCOMES:

1. Students will have an understanding of Quality Management concepts and Customers
2. Students will be able to apply Quality principles provided by the authors and implement.
3. Students will have an understanding of Framework of Quality Management.
4. Students will be able to apply tools and techniques to improve business process.
5. Students will be able to understand Quality System available.

REFERENCES:

1. James R. Evans, William M.Lindsay, "Total Quality Mangement"10 th Edition, Cengage, Phillippine Edition, 2019.
2. Ray Tricker, Quality Management Systems: A Practical Guide to Standards Implementation, Routledge; 1st edition, 2019
- 3.Poornima M. Charantimath, Total Quality Management, Pearson Education, 2 nd Edition,2017.
4. Dale H. Besterfield, Carol Besterfield, Michna, Glen H. Besterfield, Mary Besterfield, Sacre, Hermant, Urdhwareshe, Rashmi Urdhwareshe, Total Quality Management, Revised 4 th Edition, Pearson Education, 2013.
5. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, 2 nd Edition 2010.
- 6.Douglas C. Montgomery, Introduction to Statistical Quality Control, Wiley Student Edition, 7 th Edition, Wiley India Pvt Limited, 2012.
7. Indian Standards – Quality management systems – Guidelines for performance improvement (Fifth Revision), Bureau of Indian standards, New Delhi.

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1				1				
CO2	1							
CO3				1				
CO4		2						
CO5				1				
AVG	1	2	-	1	-	-	-	-

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

OBJECTIVES:

1. To enable students to gain knowledge on Human resource management concepts and principles.
2. To familiarise students about HRP process and Job Analysis.
3. To illustrate the techniques and tools for Training and Development and Performance appraisal.
4. Students will be able to illustrate the techniques and tools for compensation.
5. To understand concepts of Performance evaluation, Industrial Relations System and Grievance redressal mechanism.

UNIT – I: INTRODUCTION TO HUMAN RESOURCE MANAGEMENT**6**

Meaning – Definition – Nature – Scope and significance – Evolutionary growth of HRM – Functions of HRM - Role of Human resource manager – Personnel Management vs HRM

UNIT – II: TALENT MANAGEMENT**6**

Job Analysis – Job description & specification - Human Resource Planning – Forecasting human resource requirement – Recruitment - Selection – Induction

UNIT – III: TRAINING AND DEVELOPMENT**6**

Need for Training – Process -Types of Training methods – On the job & Off the job - Purpose – Benefits – Management development programmes – Training vs Development -Effectiveness of training

UNIT – IV: COMPENSATION MANAGEMENT**6**

Introduction – Compensation – Forms & Types of compensation – Determinants of compensation – Components of Pay structure – Significance in Employee morale

UNIT – V: PERFORMANCE MANAGEMENT AND CONTROL PROCESS**6**

Performance Management System – Process – Appraisal methods – Evaluation of managerial Implications – Control process – Importance – Methods – Requirement of effective control systems

OUTCOMES:

1. Students will be able to gain knowledge on Human resource management concepts and principles.
2. Students will be able to do human forecasting and handle HRM issues in the context of outsourcing.
3. Students will be able to design and implement appropriate Training and Development programmes.
4. Students will be able to develop relevant Compensation system to meet individual and organisational strategic needs.
5. Students can develop Performance appraisal system and effectively handle Disciplinary and grievance mechanisms.

REFERENCES:

1. Gary Dezzler & Biju Vaarkey, Human Resource Management, Pearson 16th edition 2020
2. S S Khanka, Human Resource Management (Text and Cases), S. Chand Publishing, 2019.
3. Decenzo and Robbins, Fundamentals of Human Resource Management, Wiley, 11th Edition, 2013.
4. Luis R. Gomez-Mejia, David B. Balkin, Robert L Cardy, Managing Human Resource, PHI Learning, 2012.
5. Bernadin, Human Resource Management, Tata Mc Graw Hill, 8th Edition 2012.
6. Wayne Cascio, Managing Human Resource, Mc Graw Hill, 9th Edition, 2012.
7. Ivancevich, Human Resource Management, Mc Graw Hill, 2012.
8. Uday Kumar Haldar, Juthika Sarkar. Human Resource Management, Oxford 2012.

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1				1				
CO2		1						
CO3				1				
CO4		1						
CO5				1				
AVG	-	1	-	1	-	-	-	-

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

OBJECTIVES:

1. Develop and strengthen entrepreneurial qualities and entrepreneur's role in economic growth
2. Impart understanding on Entrepreneurial Training and Development Programs.
3. Develop understanding on the business environment and to manage projects.
4. Create an understanding on project finance and accounting principles.
5. Create awareness on entrepreneurial support offered through government agencies and schemes.

UNIT – I: INTRODUCTION**6**

Entrepreneur – Types of Entrepreneurs – Entrepreneurship as a Career – Entrepreneurial Personality - women entrepreneurship, rural and urban entrepreneurship, Entrepreneur – Knowledge and Skills of Entrepreneur. Difference between Entrepreneur and Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT – II: ENTREPRENEURIAL MOTIVATION**6**

Major Motives Influencing an Entrepreneur, motivation theories-Maslow's Need Hierarchy Theory – Achievement Motivation Training, Self-Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT – III: BUSINESS ENVIRONMENT AND PROJECT MANAGEMENT**6**

Business Environment - Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT – IV: FINANCING AND ACCOUNTING**6**

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, and Management of working Capital. Accounting – Double Entry system of accounting.

UNIT – V: SUPPORT TO ENTREPRENEURS**6**

Entrepreneur Support Organizations - Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

TOTAL HOURS : 30

OUTCOMES:

1. Gain knowledge and skills needed to run a business.
2. Understanding the concept on entrepreneurial motivation.
3. Formulate project proposals based on understanding on business environment.
4. Evaluate accounting and financial aspects of business.
5. Understanding on project funding and support agencies.

TEXT BOOKS:

1. Khanka. S.S"Entrepreneurial Development" S.Chand&Co. Ltd., Ram Nagar, New Delhi, 2013.
2. Donald F Kuratko, "Entrepreneurship – Theory, Process and Practice", 10th Edition, Cengage Learning, 2017

REFERENCE BOOKS:

- 1.Hisrich R D, Peters M P, "Entrepreneurship" 10th Edition, Tata McGraw-Hill, 2017.
- 2.Mathew J Manimala, "Entrepreneurship theory at cross roads: paradigms and praxis" 2nd Edition Dream tech, 2005.
- 3.Rajeev Roy, "Entrepreneurship" 2nd Edition, Oxford University Press, 2011.
- 4.EDII "Faculty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986.

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1							
CO2				1				
CO3				1				
CO4		2						
CO5				1				
AVG	1	2	-	1	-	-	-	-

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

MANDATORY COURSES - I

S.No	Course Code	Course Title	Category	Contact Periods				Credits
				L	T	P	Total	C
1.	MBA101	Introduction to Gender Studies	MC	3	0	0	3	0
2.	MBA102	Patent drafting for Beginners	MC	3	0	0	3	0
3.	MBA103	Industrial Psychology	MC	3	0	0	3	0
4.	MBA104	Indian Constitution	MC	3	0	0	3	0
5.	MEN101	Elements of Literature	MC	3	0	0	3	0

OBJECTIVES:

1. To provide awareness on how gender operates on Institutional and cultural context.
2. To understand about gender roles in society.
3. To understand the institutions of family and its influence on women's status.
4. To educate students on the gender issues.
5. To familiarize students with women development with gender perspective.

UNIT – I: INTRODUCTION TO WOMEN STUDIES**9**

Women & Gender Studies Perspectives & Practices - Need, Scope and challenges of Women's Studies – Need for Gender Sensitization - Women's Movements – global and local - National Committees and Commissions for Women.

UNIT-II: FEMINIST THINKERS AND THEORIES**9**

Liberal Feminism, Marxist Feminism, Radical Feminism, Socialist Feminism, Indian Feminism, Black Feminism, Eco-Feminism - New Feminist Debates- Contemporary Contestations - Feminist thinkers in 18th, 19th, 20th and 21st Century

UNIT - III: WOMEN, WORK AND EMPLOYMENT**9**

Concept of Work – Productive and non – productive work – Use value and market value - Gender Division of Labour – Mode of Production – Women in organized and unorganized sector - New Economic Policy and its impact on Women's Employment – Globalization – Structural Adjustment Programs.

UNIT - IV: GENDER AND ENTREPRENEURSHIP**9**

Concept and meaning, Importance of Entrepreneurship, Entrepreneurial traits, Factors contributing to Entrepreneurship, enabling environment, small Enterprises, women in agri-business - Gender and emerging Technology – Impact -Self-help Groups and Micro Credit.

UNIT - V: WOMEN DEVELOPMENT**9**

Theories of Development, Alternative approaches – Women in Development (WID), Women and Development (WAD) and Gender and Development (GAD) - Empowerment- Concept and indices: Gender Development Index (GDI), Gender Inequality Index (GII), Global Gender Gap Index (GGGI) - Women Development approaches in Indian Five –

Year Plans - Women and leadership– Panchayati Raj and Role of NGOs and Women Development - Sustainable Development Goals, Policies and Programmes.

TOTAL HOURS : 45

OUTCOMES:

1. Students will have an understanding on gender and its operations on Institutional and cultural context.
2. Students will be able to understand about gender roles in society.
3. Students will be able to understand the institutions of family and its influence on women's status.
4. Students will be educated on the gender issues.
5. Students will be familiarized on women development with gender perspective.

REFERENCES:

1. Susan Shaw and Janet Lee, Women's Voices, Feminist Visions, McGraw Hill Pub, 6 th edition, 2014
2. Rege, Sharmila (ed), Sociology of Gender: The Challenge of Feminist Sociological
3. Knowledge, Sage, New Delhi, 2003.
4. Bonnie G. Smith, 2013 Women's Studies: the Basics, Routledge
5. Uma Chakravarti. Gendering Caste: Through a Feminist Lens. Sage, 2018.

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1							1	
CO2							1	
CO3				1				
CO4							1	
CO5							1	
AVG.	-	-	-	1	-	-	1	-

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

OBJECTIVES:

1. To recognize the importance of IP and to educate the pupils on basic concepts of Intellectual Property Rights.
2. To identify the significance of practice and procedure of Patents.
3. To make the students to understand the statutory provisions of different forms of IPRs in simple forms.
4. To learn the procedure of obtaining Patents, Copyrights, Trade Marks & Industrial Design
5. To enable the students to keep their IP rights alive.

Unit – I Understanding and Over view of the IPR Regime**9**

Introduction, types of intellectual property- Industrial property, Artistic and literary Property, Need for intellectual property rights, Rationale for protection of IPR, Impact of IPR on development, health, agriculture, and genetic resources, IPR in India- Genesis and development, IPR in abroad- some important examples of IPR, International organizations, agencies, and treaties.

Unit- II Patents**9**

Need for patent, Macro-economic impact of the patent system, Classification of patents in India, Classification of patents by WIPO, Categories of Patent, Special Patents, Patenting Biological products, Patent document, Granting of patent, Rights of a patent, Patent Searching, Patent Drafting, filing of a patent, different layers of the international patent system, Utility models, Case Study.

Unit-III Copyright**9**

Rights and protection covered by copy right- law of copy rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copyright ownership issues, obtaining copyright registration, notice of copy rights, international copyright law, infringement of copy right under copyright Act.

Unit- IV Trademarks and Trade Secret**9**

Overview of Trademarks & Trade Secret, Importance of Trademarks & Trade secret, Rights of Trademark & Trade Secret, Types of Trademarks, Registration process for Trademark & Trade Secret, Duration of Trademark and trade secret, Case Study.

Unit -V Geographical Indications and Trade Secrets

9

Overview of Geographical Indications, Importance of Geographical Indication Protection.

Geographical Indication of Goods- Type, why and how GI need protection and GI Laws. Indian GI Act. Trade secret law, determination of trade secret status, liability for misappropriations of trade secrets, protection for submission, trade secret litigations.

TOTAL HOURS: 45

OUTCOMES:

1. Student will be able to define need and importance of intellectual property rights.
2. Rules and process for IPR registration.
3. Patent Searching, Patent Drafting, filing, Protection and duration of a patent in India and abroad.
4. Legal concepts in Science, Engineering, Technology and Creative Design.
5. Clarity on the influence of Geographical Indications on Trade Secrets.

REFERENCES:

1. Watal, Jayashree, Intellectual Property Rights In The WTO And Developing Countries, Oxford University Press
2. R. Anita Rao & Bhanoji Rao, Intellectual Property Rights- A Primer, Eastern Book Co.
3. Shiv Sahai Singh, The Law Of Intellectual Property Rights, Eastern Book Co.
4. Deepa Goel and Shomini Parashar, IPR, Biosafety and Bioethics, Pearson publisher
5. Pandey, Neeraj, Dharni, Khushdeep, Intellectual Property Rights, PHI, 2020.
6. Sople, Vinod V. Managing Intellectual Property: The Strategic Imperative, PHI, 2020.

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1				1				
CO2	1							
CO3				1				
CO4		2						
CO5				1				
AVG.	1	2	-	1	-	-	-	-

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

OBJECTIVES:

1. To understand the core concepts, history, and significance of Industrial Psychology
2. To analyze factors influencing employee attitudes, behaviors, and well-being.
3. To apply principles of ergonomics and human factors to improve workplace design and safety.
4. To evaluate different theories of motivation and their practical applications in organizational settings.
5. To assess team dynamics, cultural diversity, and organizational change processes in modern workplaces.

UNIT I: FOUNDATIONS OF INDUSTRIAL PSYCHOLOGY AND JOB ANALYSIS**9**

Definition, Characteristics, Goals, and Importance of Industrial Psychology - Brief History of Industrial Psychology - Major Fields in Industrial Psychology - Research Methods in Industrial Psychology - Job Analysis: Methods and Techniques - Performance Measurement: Concepts and Practices - Performance Rating and Evaluation - The Social Context of Performance Evaluation

UNIT II: EMPLOYEE ATTITUDES, BEHAVIOUR, AND WELL-BEING**9**

Work Attitudes and Employee Engagement - Job Satisfaction and Organizational Commitment - Positive Employee Behaviors - Worker Stress: Sources, Consequences, and Coping Strategies

UNIT III: ERGONOMICS AND ENGINEERING PSYCHOLOGY**9**

Principles of Ergonomics and Human Factors - Work Design for Productivity and Well-being - Psychological Aspects of Workplace Safety - Human-Technology Interaction.

UNIT IV: MOTIVATION IN THE WORKPLACE**9**

Defining and Theories of Motivation - Need-Based Theories of Motivation (e.g., Maslow's Hierarchy of Needs, Alderfer's ERG Theory) - Behaviour-Based Theories of Motivation (e.g., Skinner's Reinforcement Theory) - Job Design Theories of Motivation (e.g., Hackman and Oldham's Job Characteristics Model) - Motivation and Performance - Practical Techniques to Enhance Motivation

UNIT V: GROUP DYNAMICS AND ORGANIZATIONAL CULTURE

9

Defining Work Groups and Teams - Types of Teams and Team Processes - Group Decision- Making and Effectiveness - Diversity and Multiculturalism in Teams - Organizational Culture and Development - Social Dynamics and Change Management.

TOTAL HOURS: 45

COURSE OUTCOMES

1. Students will be able to understand Industrial Psychology by practicing Management theories in solving Industrial relations problems.
2. Students can apply critical thinking with regard to human attitudes and behavior for better decision making.
3. The managerial competencies among students can be enhanced by employing human factor with suitable ergonomics in workplace.
4. To inculcate value based leadership abilities amongst students in achieving individual as well as organizational goals.
5. Students can withhold cultural diversity in globalized business and engage in lifelong learning.

REFERENCES

1. Aamodt, M. G. (2016). Industrial/Organizational Psychology: An Applied Approach (6th Edition), Cengage Learning.
2. Landy, F. J., & Conte, J. M. (2016). Work in the 21st Century: An Introduction to Industrial and Organizational Psychology (4th Edition), Wiley.
3. Riggio, R. E. (2017). Introduction to Industrial and Organizational Psychology (6th Edition), Routledge.
4. Salvendy, G. (2006). Handbook of human factors and ergonomics (3rd ed.). New York: Wiley.
5. Levy, P. E. (2017). Industrial/Organizational Psychology: Understanding the Workplace (5th Edition), Macmillan Learning
6. Culbertson, S. S., & Muchinsky, P. M. (2022). Psychology Applied to Work (13th Edition), Hypergraphic Press.
7. Spector, P. E. (2017). Industrial and Organizational Psychology: Research and Practice (7th Edition), Wiley.
8. Truxillo, D. M., Bauer, T. N., & Erdogan, B. (2016). Psychology and Work: Perspectives on Industrial and Organizational Psychology (1st Edition), Routledge.

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3			1				1
CO2		3	2		1		1	
CO3	1					1		
CO4	2		2		1		1	
CO5				3				2
AVG.	2	3	2	2	1	1	1	2

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

OBJECTIVES:

1. To create an awareness on the constitution of India and its amendments.
2. To educate the students with fundamental duties and rights of the citizens.
3. To equip with the functions of central government and its' structure.
4. To learn the state government structure and its' functions.
5. To understand the judiciary structure and its functions in India.

UNIT I: INTRODUCTION 09

Introduction to constitution of India – Philosophical Foundations and Historical Background – Preamble – Schedule – 42nd Amendment - 44th Amendment – 73rd Amendment - 74th Amendment – Articles Related to Amendments.

UNIT II: FUNDAMENTAL DUTIES AND RIGHTS OF CITIZENS 09

Citizenship – Citizenship Amendment Act (CAA) – Union of States - Union Territories - Fundamental Rights – Directive Principles of State Policy (DPSP) – Fundamental Duties - Reference of Articles for Granting of Special Status to Various States in the Country.

UNIT III: CENTRAL GOVERNMENT STRUCTURE AND FUNCTIONS 09

Government at Central Level – President of India – Powers of President of India – Structure of Central Government – Functions of Central Government – Vice President – Powers of Vice President – Powers of Prime Minister – Powers of Cabinet Ministers – Powers of Parliament.

UNIT IV: STATE GOVERNMENT STRUCTURE AND FUNCTIONIONS 09

Government at State Level – Structure of State Government – Functions of State Government – Governor – Powers of Governor – Chief Minister – Powers of Chief Minister – State Legislature – Powers of Cabinet Ministers in State Legislature – Cabinet Ministers Responsibilities in State Government.

UNIT V: JUDICIARY STRUCTURE AND FUNCTIONS 09

Supreme Court of India – Judiciary System in Indian Constitution – Judicial Systems Central Government Level – Judiciary System in State Government Level – High Courts

and Subordinate Courts – Election Commission of India – Case Studies of Major Disputes.

TOTAL HOURS: 45

OUTCOMES:

1. Students will be able to understand the constitution of India and its' amendments.
2. Students will be able to analyze the fundamental duties and rights of citizens.
3. Students will be able to narrate the central government structure and its functions.
4. Students will be able to discuss the state government structure and its functions.
5. Students will be able to derive judiciary structure and its functions.

REFERENCES:

1. Basu, D. D. (1966). Introduction to the Constitution of India. LexisNexis, India.
2. Khosla, Madhav (2012). The Indian Constitution. Oxford University Press, India.
3. R.C.Agarwal (1997). Indian Political System. SChand Company Ltd., India.
4. Bakshi, P. (2023). The Constitution of India. LexisNexis, India.
5. V. N. Shukla (2017). Constitution of India, 13th Ed., Eastern Book Company.

PO-CO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2			1				1
CO2	2		3	2	3	3	1	1
CO3	2	3	2	1		1		
CO4	2		2	1		1		
CO5	2		2	1	2	1	1	
Avg.	2	3	1.8	1.2	2.5	1.5	1	1

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

OBJECTIVE

- To make the students aware of the finer sensibilities of human existence through an art form
- To enable students to appreciate different forms of literature
- To help students understand that literature is an expression of life's experience.
- To improve the aesthetic sense of the students by exposing them to various forms of literature
- To improve the creative abilities of students by giving them opportunities to review forms of literature

UNIT – I: Introduction to Elements of Literature**9**

- Reading, thinking, discussing and writing skills
- Finer sensibility for better human relationship
- Understanding of the problem of humanity without bias
- Space to reconcile and get a cathartic effect

Assessment- Declamation /Solioquy**UNIT – II: Elements of fiction****9**

- Plot, character and perspective
- Analysing works of literature
- Character analysis
- Short story reading

Assessment- Short Story Analysis**UNIT – III: Elements of poetry****9**

- Emotions and imaginations
- Figurative language
- Simile, metaphor, conceit, symbol, pun and irony
- Personification and animation

Assessment – Appreciation Poetry**UNIT – IV: Elements of drama****9**

- Drama as representational art
- Content, mode and elements
- Features of tragedy, comedy and satire

Assessment – Presenting a play/Skit/ Street Play**UNIT – V: Impact of literature on Society****9**

- Translation of original literature in English
- Comparative literature

- Expression of finer feelings in different forms of literature.
- Influence of literature in society

Assessment- Project: Under the guidance of the teachers, the students will take a volume of poetry, fiction or drama and write a term paper to show their understanding of it in a given context (sociological, psychological, historical, autobiographical etc).

COURSE OUTCOMES

At the end of the course, learners will be able

- CO1: To understand the relevance of literature in human life.
- CO2: To appreciate the aspects of literature in developing finer sensibilities.
- CO3: To enhance reading, thinking, discussing opinions and to understand finer feelings.
- CO4: To identify the creative uses of language in literary texts.
- CO5: To write reviews and comments about forms of literature.

Reference Book

1. Seasons of Life: A Poetic Anthology (Literary Classics) by Nigel Collins, Jim Herrick, John Pearce (ISBN: 9781573927710)
2. Web Link :<https://www.amazon.co.uk/Seasons-Life-Anthology-Literary-Classics/dp/1573927716>
3. New One-Act Plays for Acting Students: A New Anthology of Complete One-Act Plays for One, Two or Three Actors Paperback – by Norman Bert (Author), Deb Bert (Editor)
4. Web Link : <https://www.amazon.in/New-One-Act-Plays-Acting-Students/dp/1566080843>
5. Student Text (Drama Essentials: An Anthology of Plays) Paperback – by Matthew C. Roudane (Editor) Web Link : <https://www.amazon.in/Drama-Essentials-Student-Anthology-Plays/dp/0618474773>
6. Famous Novels and Short stories in English.(to be recommended by teachers to individual students)
7. Collection of poems by Robert Frost, William Wordsworth, Rabindranath Tagore, Walt Whitman , Maya Angelou, Rudyard Kipling (to be recommended by teachers to individual students)

MANDATORY COURSES II

S.No	Course Code	Course Title	Category	Contact Periods				Credits
				L	T	P	Total	C
1.	MGE201	Well-Being With Traditional Practices-Yoga, Ayurveda and Siddha	MC	3	0	0	3	0
2.	MGE202	History of Science and Technology in India	MC	3	0	0	3	0
3.	MCY201	Awareness of Cyber Security and Cyber Law	MC	3	0	0	3	0
4.	MME201	Industrial Safety	MC	3	0	0	3	0

MGE201	WELL-BEING WITH TRADITIONAL	L	T	P	C
	PRACTICES - YOGA, AYURVEDA AND	3	0	0	0
	SIDDHA				

COURSE OBJECTIVES:

- To enjoy life happily with fun filled new style activities that help to maintain health.
- To adopt a few lifestyle changes that will prevent many health disorders.
- To be cool and handbill every emotion very smoothly in every walk of life.
- To learn to eat cost-effective but healthy foods that are rich in essential nutrients.
- To develop immunity naturally that will improve resistance against many health disorders.

UNIT-I HEALTH AND ITS IMPORTANCE 2+4

Health: Definition - Importance of maintaining health - More importance on prevention than treatment - Ten types of health one has to maintain - Physical health - Mental health - Social health – Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health – Environmental health. Occupational/Professional 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 to be taken.

UNIT-II DIET 4+6

Role of diet in maintaining health - energy one needs to keep active throughout the day – nutrients one needs for growth and repair - helps one to stay strong and

healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong.

Balanced Diet and its 7 Components - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water.

Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions.

Definition of BMI and maintaining it with diet Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM.

Common cooking mistakes-Different cooking methods, merits and demerits of each method.

UNIT-III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN 4+4 **MAINTAINING HEALTH**

AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy. **Secrets of traditional healthy living** - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.

Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Panchekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (TriDosha Theory) - Udal Thathukkal.

Prevention of illness with our traditional system of medicine-Primary Prevention - To decrease the number of new cases of a disorder or illness – Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention – To decrease the amount of disability associated with an existing disorder.

UNIT-IV MENTAL WELLNESS 3+4

Emotional health - Definition and types - Three key elements: the subjective experience – the physiological response - the behavioural response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances – Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions.

Stress management - Stress definition - Stress in daily life - How stress affects one's life -Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement.

Sleep - Sleep and its importance for mental wellness - Sleep and digestion.

Immunity - Types and importance - Ways to develop immunity.

UNIT-V YOGA

2+12

Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for Individuals according to the Age - The Eight Limbs of Yoga - Simple yoga asanas for cure and prevention of health disorders - What yoga can bring to our life.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Learn the importance of different components of health.
2. Gain confidence to lead a healthy life.
3. Learn new techniques to prevent lifestyle health disorders.
4. Understand the importance of diet and workouts in maintaining health.
5. Understand the practice of yoga.

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.
3. Yoga and Empowerment, WCSC-VISION for Wisdom, 3rd Edition 2018, Vethathiri Publications, Erode

4. SIDDHA MEDICINE HANDBOOK OF TRADITIONAL REMEDIES
Kindle Edition by Paul Joseph Thottam (Author) 2012.
5. The Ayurvedic Pharmacopoeia of India Part-I Volume-VII First Edition
[Minerals & Metals] by Central Council for Research in Ayurveda and Siddha,
2008.

REFERENCE BOOKS:

1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects
Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner,
Gerald Matthews, and Richard D. Roberts A Bradford Book, The MIT Press,
Cambridge, Massachusetts, London, England.
2. D 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. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/>
4. Simple lifestyle modifications to maintain health
<https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-betterhealth#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time%20to%20cook.>
5. Read more: <https://www.legit.ng/1163909-classes-food-examples-functions.html>
6. <https://www.yaclass.in/p/science-state-board/class-9/nutrition-and-health-5926>
7. Benefits of healthy eating <https://www.cdc.gov/nutrition/resources-publications/benefitsof-healthy-eating.html>
8. Food additives
<https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/foodadditives>
9. BMI <https://www.hsph.harvard.edu/nutritionsource/healthy-weight/>
<https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle---whorecommendations>
10. Yoga <https://www.healthifyme.com/blog/types-of-yoga/>
<https://yogamedicine.com/guide-types-yoga-styles/>

Ayurveda : <https://vikaspedia.in/health/ayush/ayurveda-1/concept-of-healthy-living-in-ayurveda>

11. Siddha: http://www.tkdI.res.in/tkdI/langdefault/Siddha/Sid_Siddha_Concepts.asp

12. CAM : <https://www.hindawi.com/journals/ecam/2013/376327/>

13. Preventive herbs : <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3847409/>

COURSE OBJECTIVES:

- To know the contributions of the scientists for the development of society over a period of time.
- To understand the Science and Technological developments that lead to human welfare.
- To appreciate the Science and Technological contributions for the development of various sectors of the country.
- To identify the technical transfer versus economic progress of the countries.
- To know the students get a holistic view of the development of science and technology as a historical and cultural phenomenon.

UNIT-I	HISTORICAL PERSPECTIVE OF SCIENCE AND TECHNOLOGY	9
---------------	---	----------

The nature of science and technology, Roots of science and technology in India, Science and society, Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Indian contribution to science and technology (from Ancient to Modern). Aryabhata, Charaka, Bhaskara II, Sushruta, J C Bose, C V Raman, Homi J Bhaba, Dr APJ Abdul kalam.

UNIT-II	SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA	9
----------------	---	----------

Scientific and Technological Developments in Medieval India; Influence of the Islamic world and Europe; The role of makhtabs, madrasas and karkhanas set up. Developments in the fields of Mathematics, Chemistry, Astronomy and Medicine. Innovations in the field of agriculture - new crops introduced new techniques of irrigation etc.

UNIT-III	SCIENCE AND TECHNOLOGY IN COLONIAL INDIA	9
-----------------	---	----------

Early European Scientists in Colonial India- Surveyors, Botanists, Doctors, under the Company's Service- Indian Response to new Scientific Knowledge, Science and Technology in Modern India- Development of research organizations like CSIR and

DRDO; Establishment of Atomic Energy Commission; Launching of the space satellites.

UNIT-IV IMPACT OF SCIENCE AND TECHNOLOGY IN MAJOR 9 **AREAS**

Space – Objectives of space programs, Geostationary Satellite Services – INSAT system and INSAT services remote sensing applications, Launch Vehicle Technology Ocean Development – Objectives of ocean development, Biological and mineral resources, Marine research and capacity building. Defence Research – Spin-off technologies for civilian use, Biotechnology – Applications of biotechnology in medicine, Biocatalysts, Agriculture, Food, Fuel and Fodder, Development of biosensors and animal husbandry Energy – Research and development in conservation of energy, India's nuclear energy program, technology spin-offs.

UNIT-V NEXUS BETWEEN TECHNOLOGY TRANSFER AND 9 **DEVELOPMENT**

Transfer of Technology – Types, Methods, Mechanisms, Process, Channels and Techniques, Appropriate technology- Criteria and selection of Appropriate technology: Technology assessment, Technological forecasting, Technological innovations and barriers of technological change. Social implications of new technologies like the Information Technology and Biotechnology.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

1. The origins of scientific knowledge, Names, major milestones in the life and work of prominent scientists and engineers.
2. Periodization of the history of science and technology.
3. Major events, dates of the most significant achievements in the development of science and technology at different stages of history.
4. Features of the network of scientific and technical institutions, the history of formation and development of leading research centers, in particular higher education institutions as centers of basic and applied research.

5. Features of science and technology and its development.

TEXT BOOKS:

1. Kalpana Rajaram, Science and Technology in India, Published and Distributed by Spectrum Books (P) Ltd., New Delhi – 58.
2. Srinivasan, M., Management of Science and Technology (Problems & Prospects), East-West Press (P) Ltd., New Delhi.

REFERENCE BOOKS:

1. Ramasamy, K.A., and Seshagiri Rao, K., (Eds), Science, Technology and education for Development, K., Nayudamma Memorial Science Foundation, Chennai – 8.
2. Kohli, G.R., The Role and Impact of Science and Technology in the Development of India, Surjeet Publications.
3. Government of India, Five Year Plans, Planning Commission, New Delhi.
4. Sharma K.D., and Quresh M.A., Science, Technology and Development, Sterling Publications (P) Ltd., New Delhi.

ONLINE LINK

Swayam online course History of Science and Technology:

https://onlinecourses.swayam2.ac.in/arp19_ap87/preview

ASSESSMENT:

- Quizzes
- Assignment,
- Case Study / Presentation
- Continuous Assessment Test

MCY201	AWARENESS OF CYBER SECURITY AND CYBER LAW	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES:

- To understand the basics of cyber security and cyber law,
- To understand the problems and issues associated with it,
- To understand the various act or regulations,
- To understand the various approaches for incident analysis and response.
- To understand the ethical laws of computer for different countries.

UNIT-I INTRODUCTION TO CYBER SECURITY AND CYBER CRIME 9

Introduction–Cyber Crime: Definition and origins– Cyber crime and information Security– Cyber criminals– Classification of Cyber crimes.

UNIT-II LEGAL PERSPECTIVES 9

Introduction to the Legal Perspectives of Cybercrimes and Cyber security, Cybercrime and the Legal Landscape around the World, Why Do We Need Cyber laws, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India.

UNIT-III CYBER ACT 9

Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Cybercrime and Punishment, Cyber law, Technology and Students: Indian Scenario.

UNIT-IV CYBER LIABILITY 9

Private ordering solutions, Regulation and Jurisdiction for global Cyber security, Copy Right–source of risks, Pirates, Internet Infringement, Fair Use, postings, criminal liability, First Amendments, Data Losing.

UNIT-V CYBER CHANGES 9

Ethics, Legal Developments, Cyber security in Society, Security in cyber laws case studies, General law and Cyber Law–a Swift Analysis.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

1. Understand key terms and concepts in cyber security and cyber law, intellectual property and cyber– crimes, trademarks and domain theft.
2. Determine computer technologies, digital evidence collection.
3. Determine evidentiary reporting in forensic acquisition.
4. Secure both clean and corrupted systems, protecting personal data, securing simple computer networks, and safe Internet usage.
5. Incorporate approaches for incident analysis and response.

TEXT BOOKS:

1. Richard S. Grimes, "Cyber Law and Cyber Security: Legal and Ethical Issues," CRC Press, 1st Edition, 2019.
2. Sunit Belapure and Nina Godbole, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, WileyIndia Pvt. Ltd, 2011.
3. Jonathan Rosenoer, "Cyber Law: The law of the Internet", Springer–Verla.

REFERENCE BOOKS:

1. Pavan Duggal, "Cyber Security and Cyber Laws," LexisNexis, 4th Edition, 2020.
2. Mark F Grady, Fransesco Parisi, "The Law and Economics of Cyber Security", Cambridge University Press, 2006.
3. Dr. Farooq Ahmad, Cyber Law in India, Allahbad Law Agency– Faridabad.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2											2	1			
2		2		2		2									2	2
3								2					1			
4		3	2					2				2			2	1
5	2					2								2		
AVG.	2	2.5	2	2	-	2	-	2	-	-	-	2	1	2	2	1.5

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

COURSE OBJECTIVES:

- To discuss the basic approaches of the organizations and safety management.
- To discuss the concept of Work design and facility planning.
- To comprehend the accident investigation process and accident reports.
- To discuss the principles of safety performance monitoring.
- To elaborate the methods of safety education and training.

UNIT-I BASICS OF SAFETY ENGINEERING & ACTS 9

Evolution of modern safety concept – Safety audit – Acts: Factories act – 1948 – Statutory authorities – Tamil Nadu factories Rules 1950 under safety and health – Environment act – 1986 – Air act 1981, Water act 1974 – other acts; Safety in industries – General safety concepts, machine guarding, hazards in metal removing process, welding process, cold and hot working process. Introduction to Electrical Acts.

UNIT-II SAFETY MANAGEMENT 9

History of Safety movement – Evolution of modern safety concept General concepts of management – Planning for safety for optimization of productivity, quality and safety line and staff functions for safety, budgeting for safety policy. Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of performance of supervisors on safety.

UNIT-III ACCIDENT INVESTIGATION AND REPORTING 9

Concept of an accident, reportable and non-reportable accidents, unsafe act and condition – Principles of accident prevention, Supervisory role - Role of safety committee – Accident causation models Cost of accident. Overall accident investigation process Response to accidents, India reporting requirement, Planning document, Planning matrix, Investigators Kit, Functions of investigator, Four types of evidences, Records of accidents, Accident reports Class exercise with case study.

UNIT-IV SAFETY PERFORMANCE MONITORING 9

Reactive and proactive monitoring techniques, Permanent total disabilities, Permanent partial disabilities, Temporary total disabilities - Calculation of accident indices, Frequency rate, Severity rate, Frequency severity incidence, Incident rate, Accident rate, Safety “t” score, Safety activity rate problems.

UNIT-V SAFETY EDUCATION AND TRAINING 9

Importance of training identification of training needs training methods – programme, seminars, conferences, competitions – method of promoting safe practice motivation – communication role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

6. Learn the basic approaches of the organizations and safety management.
7. Perform work design and facility planning.
8. Study the accident investigation process and accident reports.
9. Learn the principles of safety performance monitoring.
10. Study the methods of safety education and training.

TEXT BOOKS:

4. L M Deshmukh, Industrial safety management, TATA McGraw Hill, 2017.
5. Heinrich H.W., Industrial Accident Prevention, McGraw Hill Company, New York, 2001.

REFERENCE BOOKS:

4. Garg, HP, Maintenance Engineering, S. Chand Publishing, 2012.
5. J Maiti, Pradip Kumar Ray, Industrial Safety Management: 21st Century Perspectives of Asia, Springer, 2017.

CO's	PO's												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3		1			2			1			2	1	
CO2		1		2				2			1		1	
CO3	2			2			1			2		2	1	
CO4	2		3			2			2		1		1	
CO5		2			2			1				1	1	
Average	3	1	1	1	1	1		1	1	1	1	1	1	

(1-LOW, 2-MEDIUM, 3-HIGH)

OPEN ELECTIVE (VII SEMESTER)

OAG101	ENVIRONMENT AND AGRICULTURAL	L	T	P	C
	ENGINEERING	3	0	0	3

COURSE OBJECTIVES:

The Course prepares the students

- To emphasize on the importance of environment and agriculture on changing global scenario and the emerging issues connected to it.
- To understand the ecological context of agriculture and its concerns.
- To study the context of climate change and emerging global issues.
- To introduce the students about the importance of the land and water resources in India.
- To study the importance of sustainable agriculture for the growing population, various resources required and their sustainability.

UNIT-I INTRODUCTION 9

Scope and importance of environmental studies. Natural resources: Renewable and renewable resources. Ecosystems: Definition, concept, structure and functions. Producers, consumers and decomposers of an ecosystem. Energy flow in the ecosystem. Types of ecosystems. Bio-diversity: Definition, classification, threats to biodiversity and its conservation.

UNIT-II ENVIRONMENTAL CONCERNS 9

Environmental pollution: Causes, effects and control of air, water, soil, thermal, noise and marine pollution. Disaster management. Floods, earthquakes, cyclones and landslides. Social issues and the environment, unsustainable to sustainable development. The Environment Protections Act, The Air Act, The water Act, The Wildlife Protection.

UNIT-III CLIMATE CHANGE AND ECOLOGICAL DIVERSITY 9

Global warming and changing environment – Ecosystem changes – Changing blue green-grey water cycles – Water scarcity and water shortages – Desertification- Ecological diversity, wild life and agriculture – GM crops and their impacts on the environment – Insects and agriculture – Pollination crisis – Ecological farming principles – Forest fragmentation and agriculture – Agricultural biotechnology concerns.

UNIT-IV AGRICULTURAL IMPACTS 9

Irrigation development and watersheds – mechanized agriculture and soil cover impacts – Erosion and problems of deposition in irrigation systems – Agricultural drainage and downstream impacts – Agriculture versus urban impacts.

UNIT-V SUSTAINABLE AGRICULTURE 9

Sustainable agriculture-problems and its impact on agriculture, conservation agriculture strategies, HEIA, LELA and LEISA and its techniques for sustainability, Integrated farming system components of IFS and its advantages, farming system and environment.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

- To know how the environment and agriculture are related and the changes in the environmental due to agriculture.
- To gather idea on about how the mechanization helps and impacts of soil erosion due to agricultural activities.
- To gain knowledge on the need for sustainable agriculture.
- To demonstrate how ecological balance is required for sustainability of agriculture.
- To know the ecological diversity in agriculture and different technologies used in farming activities.

TEXT BOOKS:

1. M.Lakshmi Narasaiah, Environment and Agriculture, Discovery Pub. House, 2006.
2. N.P.Singh,Mhesh Kumar,N.V.Singh,Climate Resilient Agriculture for Sustainable Production, TTTP, 2023.
3. B.K.Desai and Pujari, B.T., "Sustainable Agriculture: A vision for future", New India Publishing Agency, New Delhi, 2007.
4. Saroja Raman, "Agricultural Sustainability – Principles, Processes and Prospects", CRC Press, 2013.

5. Prof Johannes S. C. Wiskerke, Dr Nevin Cohen, Dr Laine Young, Prof Alison Blay-Palmer, Achieving sustainable urban agriculture, 2020.

REFERENCE BOOKS:

1. T.C. Byerly, Environment and Agriculture, United States Dept. of Agriculture, Economic Research Service, 2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 3rd edition, Pearson Education, 2023.
3. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.38 . Edition 2010.
4. Nem Raj Sunda"A Competitive Book of Agriculture (14th Edition)" Surahee Publications (2024)
5. 5.M.H. Chavda, Y.B. Vala, C.K. Patel, P.P. Chaudhari, D.K. Patel "Sustainable Agriculture: A Vision for Resilience Future" KD Publications (2024).

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	2	-	-	-	1	1	-	-	1	-	-	2	2	1	1
2	2	3	1	-	2	3	-	-	1	-	1	1	1	1	1	2
3	1	3	-	-	-	1	2	-	-	-	-	2	2	2	2	1
4	3	3	3	2	3	-	3	2	1	-	2	3	2	1	1	-
5	-	3	2	2	3	-	3	3	-	-	2	3	2	2	3	1
AVG.	2.0	3.0	2.0	2.0	3.0	2.0	2.0	3.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	1.0

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

OAG102	ORGANIC FARMING FOR SUSTAINABLE	L	T	P	C
	AGRICULTURAL PRODUCTION	3	0	0	3

COURSE OBJECTIVES:

- To quantify the organic resources of integrated organic farming system (IOFS) components.
- To assess the total productivity of the system.
- To work out the economics of organic farming system.
- To gain knowledge on Organic Farming for Sustainable agriculture.
- To expose the students to the concept of Organic Farming.

UNIT-I INTRODUCTION TO ORGANIC FARMING 9

Concept of organic farming, Significance of organic farming for Indian farmers, Terminologies used in organic farming, Objectives of organic farming, Characteristics of organic farming, often debated issues in organic farming, Area under OF and size of organic food market. Status of organic farming in India.

UNIT-II SOIL HEALTH MANAGEMENT IN ORGANIC FARMING 9

Organic manures- Biofertilizers- Green manures- Crop rotation - Classification of Biofertilizers. Organic production requirements, Components. Nutrient requirements, Limiting nutrient losses, Farm Yard Manure (FYM), Enrichment of FYM.

UNIT-III MICROBIAL INOCULATIONS IN ORGANIC FARMING 9

Importance, benefits, Methods of vermicomposting, Preparation and management of vermicompost unit. Recycling of organic residues, Classification of organic residues Biofertilizers, Importance, classification and benefits of biofertilizers (Azospirillum, Azotobacter, Rhizobium, PSB, VAM etc.,).

UNIT-IV GOOD HARVESTING PRACTICES 9

Crop harvesting, signs of maturity in different field crops; physiological and crop Maturity- Methods of threshing crops, cleaning, drying and storage of field crops- Rainfed agriculture: Introduction, types, History of rainfed agriculture and watershed in India- Problems and prospects of rainfed agriculture in India.

UNIT-V ORGANIC REGULATION AND CERTIFICATION 9
PROCEDURE, BRANDING, PACKAGING AND
MARKETING OF ORGANIC PRODUCTS

Organic Certification-process-Requirements for Organic Certification Systems in India - Basic standards for Livestock Certification - NPOP - Marketing of Organic Produce - Integrated Farming System models for Sustainable Agriculture.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To the completion of the course, the students will be able to understand the concepts of Organic farming and sustainable agriculture.
2. To the Students will gain knowledge on organic farming and Overview of Organic Farming in India.
3. To the students will be able to understand Microbial Inoculations in Organic Farming.
4. To the students can design Sustainable agriculture.
5. To the students will be understand Organic Regulation and Certification Procedure.

TEXT BOOKS:

1. S.P. Palaniappan & K. Annadurai "Organic Farming: Theory and Practice", Scientific Publishers (India) 2nd Edition (1 January 2022)
2. Dilip Nandwani Organic Farming for Sustainable Agriculture, 2016.
3. Jeyabalan Sangeetha, Kasem Soyong, Devarajan Thangadurai, Abdel Rahman Mohammad Al-Tawaha, Organic Farming for Sustainable Development, 2023.
4. Rahul Kumar, Jitendra Kumar, Dr. Uma, Mahesh Kumar Singh and Monu Kumar "Manual on Organic Farming", Integrated Publications, 2021.
5. P.L.Maliwal "Principles Of Organic Farming" Scientific Publishers, 2022.

REFERENCE BOOKS:

1. Khalid Rehman Hakeem, Gowhar Hamid Dar, Mohammad Aneesul Mehmood, Rouf Ahmad Bhat, "Microbiota and Biofertilizers A Sustainable Continuum for Plant and Soil Health", Springer, 2021.
2. S. Krishnaprabu , "Organic Farming and Farming Systems for Sustainable Agriculture", Satish Serial Publishing House ,2020
3. Latha, E , "Organic Farming for Sustainable Agriculture" Narendra Publishing House, 2022.
4. S.P. Palaniappan & K. Annadurai, "Organic Farming Theory and Practice" 2nd Edition, Scientific Publishers, 2022.
5. R. Sathya Priya, N. Jagathjothi, M. Yuvaraj, N. Suganthi Satish, "Organic Farming Principles & Practices", Satish Serial Publishing House, 2024.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	-	-	-	-	3	2	-	-	2	-	1	3	-	2	-
2	1	3	-	2	-	2	2	2	-	-	-	3	2	3	-	2
3	3	-	-	2	-	-	3	-	-	2	-	1	2	3	-	-
4	3	2	-	-	3	2	-	-	-	-	-	3	2	-	-	3
5	-	-	-	2	-	-	3	3	-	-	2	-	-	2	-	3
AVG.	2.0	3.0	0.0	2.0	3.0	2.0	3.0	3.0	0.0	2.0	2.0	2.0	2.0	3.0	2.0	3.0

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

OAG103	SUSTAINABLE DEVELOPMENT THROUGH	L	T	P	C
	INDIAN KNOWLEDGE SYSTEM	3	0	0	3

COURSE OBJECTIVES:

- To understand the structure and methods of ancient Indian education, focusing on holistic development through indigenous learning systems like Gurukuls, Pathshalas, and ancient universities.
- To explore how ancient Indian architecture, as seen in landmarks like the Ajanta Caves, Konark Sun Temple, and Brihadishvara Temple, embodies principles of sustainability and energy efficiency.
- To study traditional Indian farming techniques such as organic farming, rainfed Agriculture, and agroforestry to promote biodiversity and environmental stewardship.
- To understand the holistic approach of Ayurveda, focusing on the Interconnection of physical, mental, and spiritual health through individualized treatments based on one's Prakriti (constitution).
- To explore the moral responsibility humans have toward nature, focusing on the interconnectedness of life, environmental ethics, and wildlife conservation.

UNIT-I ANCIENT EDUCATION SYSTEM IN INDIA 9

Indigenous education systems (Home, Temples, Pathshalas, Tols, Chatuspadis and Gurukuls)-methods- multi design learning Shastra, Kala, Vidya- Prominent Universities Nalaandha and Takshashila - Vocational Training and Focus on Ethics and Values National Logic and Reasoning, Artistic Education, Astronomy and Mathematics.

UNIT-II VASTU SHASTRA AND SUSTAINABLE ARCHITECTURE 9

Historical Architecture Models (Ajanta Caves (Aurangabad) Brihadishvara Temple (Tanjore) Qutb Minar (Delhi) Konark Sun Temple (Odisha) Shore Temple (Mahabalipuram)-Vastu Shastra and Ancient Indian Architecture- Natural Forces (wind, water, sunlight, earth) - Energy Efficiency and Sustainable Materials - Eco-Friendly Construction- Communal Space and Architectural Carvings-Human Well-Being-Modern Integration of Vastu..

Organic Farming and Rainfed Agriculture - Agroforestry and Biodiversity - Soil Science - Soil Erosion Prevention- Chemical free Farming and Environmental Stewardship-Water Management and Ancient Indian Techniques - Water Storage and Groundwater Recharge- Drought-Prone Areas and Reviving Traditional Practices-Human and Animal Powered Devices-Biodiversity Support and Ecosystem Preservation-Modern Water Scarcity Solutions and Cultural Heritage in Water Management.

Ayurveda and Holistic Health-Prakriti (Individual Constitution)- Personalized Health- Locally Sourced Remedies and Seasonal Foods- Sustainable Diet and Whole, Unprocessed Foods - Herbal Medicine and Natural Remedies - Yoga, Meditation, and Pranayama - Mental and Spiritual Well-Being- Resource Efficiency and Environmental Health- Non-Synthetic Healthcare and Home Remedies- Eco-Friendly Health Practices- Modern Healthcare Integration and Sustainable Wellness.

Moral Responsibility and Interconnectedness of Life- Cosmic Order and Ethical Living- Environmental Ethics and Wildlife Conservation- Sustainable Resource Use- Traditional Indian Festivals and Agricultural Cycle- Sustainability Movements and Ethical Responsibility- Social Equity and Spiritual Well-Being- Intergenerational Sustainability- Cultural and Environmental Preservation.

TOTAL : 45 PERIODS

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

1. Analyze the traditional learning methods, institutions, and disciplines such as Shastra, Kala, and Vidya.
2. Understand natural forces and energy efficiency in ancient Indian architecture. Explore the modern integration of Vastu principles for human well-being.

3. Understand traditional water management systems and their relevance to modern water conservation. Assess ancient Indian farming techniques and their ecological benefits.
4. Understand the impact of Ayurvedic practices on environmental sustainability.
5. Understand the relationship between traditional Indian festivals and ecological balance.

TEXT BOOKS:

1. S. Narain "Education and Examination Systems in Ancient India" Kalpaz Publications (2017).
2. Prof. Trilok Kumar Jain "Ancient Indian Science of Architecture: The Vastu Shastra" India - The Great Bharat (2025).
3. Geeta Vara "Ayurveda: Ancient Wisdom for Modern Wellbeing" Orion Spring (2018).
4. Llewellyn Vaughan-Lee "Spiritual Ecology: The Cry of the Earth" The Golden Sufi Center (2013).
5. R.S. Meena, "Sustainable Agriculture", Scientific Publishers (India) January 2019..

REFERENCE BOOKS:

1. S. P. Gupta "The Educational Heritage of Ancient India: How an Ecosystem of Learning Was Laid to Waste" Notion Press (2017).
2. Prof. (Dr.) B. B. Puri "Applied Vastu Shastra in Modern Architecture" Pratha Ayurveda (2022).
3. Dr. Ashish S. Jain , Dr. Bhushan R. Rane , Sunil R. Bakliwa "Integration of Ayurvedic Herbal Medicines Into Modern Medicinal Practices", Nirali Prakashan, 2021.
4. P.S. Byadgi & A.K. Pandey "A Textbook of Kayachikitsa" (According to the Syllabus of CCIM, New Delhi); 3 Volumes Saujanya Books (2017).
5. Kalyan Kumar , "Traditional Water Management Systems in India" Aryan Books International, 2007.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	-	-	-	-	3	2	-	-	2	-	1	3	-	2	-
2	1	3	-	2	-	2	2	2	-	-	-	3	2	3	-	2
3	3	-	-	2	-	-	3	-	-	2	-	1	2	3	-	-
4	3	2	-	-	3	2	-	-	-	-	-	3	2	-	-	3
5	-	-	-	2	-	-	3	3	-	-	2	-	-	2	-	3
AVG.	2.0	3.0	0.0	2.0	3.0	2.0	3.0	3.0	0.0	2.0	2.0	2.0	2.0	3.0	2.0	3.0

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

OCE101	AIR AND NOISE POLLUTION CONTROL	L	T	P	C
	ENGINEERING	3	0	0	3

COURSE OBJECTIVES:

The Course prepares the students

- To impart knowledge on the principle and design of control of Indoor/ particulate/ gaseous air pollutant and its emerging trends.
- To create awareness among the sources and effects of air pollution.
- To gain knowledge on air pollution control equipments.
- To develop a knowledge on air quality standards.
- To gain knowledge of characteristics of air pollution and noise pollution.

UNIT-I INTRODUCTION 9

Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution –Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards-Ambient and stack sampling and Analysis of Particulate and Gaseous Pollutants.

UNIT-II METEOROLOGY 9

Effects of Meteorology on Air pollution-Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns-Atmospheric Diffusion Theories-Dispersion models, plume rise.

UNIT-III CONTROL OF PARTICULATE CONTAMINANTS 9

Factors affecting Selection of Control Equipment – Gas Particle Interaction – Working principle, Design and performance equations of Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations.

UNIT-IV CONTROL OF GASEOUS CONTAMINANTS 9

Factors affecting Selection of Control Equipment – Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring - Operational Considerations.

UNIT-V INDOOR AIR QUALITY MANAGEMENT**9**

Air quality standards - Sources, types and control of indoor air pollutants, sick building syndrome and Building related illness - Town planning regulations of industries-Sources and Effects of Noise Pollution – Measurement – Standards – Control and Preventive measures.

TOTAL : 45 PERIODS**COURSE OUTCOMES:**

At the end of the course, learners will be able

1. An understanding of the nature and characteristics of air pollutants, noise pollution and basic concepts of air quality management
2. Ability to identify, formulate and solve air and noise pollution problems
3. Ability to design stacks and particulate air pollution control devices to meet applicable standards.
4. Ability to select control equipment.
5. Ability to ensure quality, control and preventive measures.

TEXT BOOKS:

1. C.S. Rao “Environmental Pollution Control Engineering” 4th Edition (2022), New Age International Publishers.
2. S.C. Bhatia “Textbook of Noise Pollution and Its Control” Edition: 2023, Atlantic Publishers and Distributors.
3. Noel de Nevers, “Air Pollution Control Engineering” (Third Edition), Waveland press, Inc 2017.
4. Daniel Vallero, Fundamentals of Air Pollution, 2014, Fifth Edition, Elsevier’s Science & Technology, Academic Press, USA.
5. Enda Murphy, Eoin A. King, Environmental Noise Pollution: Noise Mapping, Public Health, and Policy, 2014, First Edition, Elsevier’s Science & Technology, USA.

REFERENCE BOOKS:

1. David H.F. Liu, Bela G. Liptak, "Air Pollution", Lweis Publishers, 2000.
2. Arthur C. Stern, "Air Pollution (Vol.I – Vol.VIII)",(Third Edition) Academic Press, 2013.

3. Wayne T. Davis, Joshua S. Fu, Thad Godish, Air Quality, 2021, Sixth Edition, CRC Press, USA.
4. Malcolm J. Crocker, Handbook of Noise and Vibration Control, 2007, John Willey and Sons Inc., USA.
5. M.N Rao and HVN Rao, "Air Pollution", Tata Mcgraw Hill Publishing Company limited, 2007.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	-	-	-	-	1	-	-	1	1	2	-	1	2	1	-
2	-	-	2	3	-	-	3	2	2	-	-	3	-	-	-	1
3	1	2	3	-	-	2	2	3	-	2	-	-	3	-	-	-
4	-	2	-	3	-	-	-	-	2	2	-	2	-	2	1	-
5	1	1	2	3	-	1	3	3	1	1	2	3	2	-	2	-
AVG.	1.0	2.0	2.0	3.0	0.0	1.0	3.0	3.0	2.0	2.0	2.0	3.0	2.0	2.0	1.0	1.0

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

OCE102	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To develop a comprehensive understanding of sustainable development concepts, the EIA process, and stakeholders' roles.
- To acquire skills in EIA procedure, baseline monitoring, and impact assessment for land, water, air, noise, and energy.
- To evaluate policy and legal aspects, and formulate effective EMPs with mitigation strategies.
- Gain proficiency in environmental auditing and review of EIA reports for clearance.
- To analyze rehabilitation plans, and explore economic aspects, including valuation and ecological economics

UNIT-I INTRODUCTION 9

Basic concepts - Impacts of Development on Environment – Rio Principles of Sustainable Development Environmental Impact Assessment (EIA) – Historical development – EIA in project cycle – EIA Notification and Legal Framework – Stakeholders and their Role in EIA.

UNIT-II EIA METHODOLOGIES 9

LCA - EIA Procedure - Baseline monitoring - Prediction and Assessment of Impact on land, water, air, noise and energy, flora and fauna – EIA Methods.

UNIT-III ENVIRONMENTAL MANAGEMENT PLAN 9

Policy and Legal Aspects of EMP - Environmental Policies and Programmes in India - Environmental Laws and Legislations - Environmental Monitoring Plan - Plan for mitigation of adverse impact on water, air and land, water, energy, flora and fauna.

UNIT-IV ENVIRONMENTAL AUDITING 9

Introduction to Environmental Auditing (EnA)-General Audit Methodology- Elements of Audit Process - Waste Audits and Pollution Prevention Assessments - Auditing of EMS – EIA Report Preparation – Review of EIA Reports - Environmental Clearance.

UNIT-V ENVIRONMENTAL MITIGATIONS AND ECONOMICS 9

Rehabilitation and Resettlement Plan - National Rehabilitation and Resettlement Policy - Economics and the Environment - Environmental Valuation - Economics of Natural Resources - Ecological Economics.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

1. Understand sustainable development, articulate EIA processes, and analyze stakeholder roles.
2. Proficient in EIA procedures, baseline monitoring, and impact assessment methodologies.
3. Evaluate policies, formulate effective EMPs, and integrate mitigation strategies.
4. Master environmental auditing, ensuring compliance and sustainability through critical reviews.
5. Analyze rehabilitation plans, integrate economic principles for sustainable decision-making.

TEXT BOOKS:

1. Rachna Bhateria, Mona Sharma, Rimmy Singh, Sumit Kumar, "Environmental Impact Assessment: A Journey to Sustainable Development", Springer Nature, 2024.
2. V.S. Kulkarni, S.N. Kaul, R.K. Trivedy, "A Handbook of Environmental Impact Assessment", Scientific Publishers, 2024.
3. B.B.Hosetti, Arvind Kumar, "Environmental Impact Assessment and Management", Daya Publishing House, 2024.
4. Canter, R.L, "Environmental impact Assessment", 2nd Edition, McGraw Hill Inc, New Delhi, 1995.
5. 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.

REFERENCE BOOKS:

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, 1999.
4. Ministry of Environment and Forests EIA Notification and Sectoral Guides, Government of India, New Delhi, 2010
5. Peter Morris, Riki Therivel "Methods of Environmental Impact Assessment", Routledge Publishers, 2009.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	2	-	-	-	2	-	2	-	3	-	2	1	-	-	1
2	-	1	-	2	-	2	-	2	-	2	-	2	1	-	-	1
3	-	-	2	2	-	2	-	2	-	2	-	2	-	2	-	1
4	-	-	2	3	-	2	-	3	-	3	-	3	1	1	-	1
5	-	-	2	2	-	2	3	2	-	3	-	3	-	1	-	1
AVG.	1.0	2.0	2.0	2.0	0.0	2.0	3.0	2.0	0.0	3.0	0.0	2.0	1.0	1.0	0.0	1.0

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

COURSE OBJECTIVES:

- To Understand and explain the goals and principles of green buildings, including certification programs.
- To analyze the objectives of sustainable development, with a focus on evaluating the impact of energy use and carbon emissions in buildings.
- To Compare traditional building techniques and assess their impact on sustainable building practices.
- To explore the use of solar energy in buildings, considering factors like comfort and location.
- To explore green composites and sustainable approaches to water, waste, and sewage management in the built environment.

UNIT-I INTRODUCTION 9

Definitions, Goals, Principles, Features, Requirements and Benefits - Evaluation of Green Buildings - Green Rating Systems - Codes and Certification Programs - Barriers to the Propagation of Green Buildings.

UNIT-II SUSTAINABILITY AND ENERGY USE 9

Sustainability – Objectives of sustainable development – Sustainable principles - Energy use - carbon emissions – Sustainable building materials – LCA - Embodied Energy in Building Materials – Smart Materials - Transportation Energy for Building Materials - Maintenance Energy for Buildings.

UNIT-III IMPLICATIONS OF BUILDING TECHNOLOGIES 9

Traditional Efficient Building techniques - Masonry Construction and Framed Construction - Alternative building concepts. Recycling of Industrial and Buildings Wastes. Biomass Resources for buildings.

UNIT-IV ENERGY SYSTEMS AND PASSIVE SOLAR DESIGN 9

Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings – Thermal Comfort in Buildings – Building Physics – Daylighting strategies

- Issues – Implications of Geographical Locations - Case studies.

UNIT-V GREEN COMPOSITES FOR BUILDINGS 9

Concepts of Green Composites. Water Utilization in Buildings, Low Energy Approaches to Water Management. Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, students will be able to:

1. Understand and apply principles of green buildings and evaluate them using certification programs.
2. Grasp sustainable development goals and propose eco-friendly solutions for energy use in buildings.
3. Compare traditional building techniques, analyze their impact, and suggest sustainable alternatives.
4. Apply knowledge of solar energy for energy-efficient building design, considering comfort and location.
5. Define and apply green composites, proposing sustainable approaches for water, waste, and sewage management.

TEXT BOOKS:

1. Yudelson Jerry, "Green Building Through Integrated Design" McGraw-Hill Professional Publisher.
2. Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.
3. "Low Energy Cooling For Sustainable Buildings". John Wiley and Sons Ltd, 2009.
4. K.S.Jagadish, B. U. Venkatarama Reddy and K. S. Nanjunda Rao. "Alternative Building Materials and Technologies" New Age International, 2007.
5. "Green Building – Guidebook for sustainable Architecture", Dr. Michael Bauer, Peter mosle, Dr. Micheal Schwarz, Springer, 2007.

REFERENCE BOOKS:

1. Handbook of Green Building Design and Construction: LEED, BREEAM, and Green Globes (2nd Edition) by Sam Kubba, 2017.
2. Charles J. Kibert, "Sustainable Construction: Green Building Design and Delivery (5th Edition)" 2020.
3. Osman Attmann, Green Architecture Advanced Technologies and Materials, McGraw Hill, 2010.
4. Montoya Mike, "Green Building Fundamentals", Pearson Publication, 2011
5. William E. Browning and William J. D. Looney, "Net Zero Energy Buildings: Perception, Design, and Performance" by Wiley (2015).

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	-	-	-	1	2	-	-	-	3	-	2	1	1	2	-
2	1	2	-	2	1	2	-	-	-	2	-	2	1	-	2	-
3	1	2	2	2	1	2	-	-	-	2	-	2	2	-	2	-
4	1	2	2	3	2	2	-	-	-	3	-	3	1	1	2	1
5	1	2	2	2	3	2	3	-	-	3	-	3	1	1	2	-
AVG.	1.0	2.0	2.0	2.0	2.0	2.0	3.0	0	0	3.0	0	2.0	1.0	1.0	2.0	1.0

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

COURSE OBJECTIVES:

- Familiarize students with the data science process.
- Understand the data manipulation functions in Numpy and Pandas.
- Explore different types of machine learning approaches.
- Understand and practice visualization techniques using tools.
- Learn to handle large volumes of data with case studies.

UNIT-I INTRODUCTION 9

Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – data preparation - Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining - Data Warehousing – Basic statistical descriptions of Data.

UNIT-II DATA MANIPULATION 9

Python Shell - Jupyter Notebook - IPython Magic Commands - NumPy Arrays- Universal Functions – Aggregations – Computation on Arrays – Fancy Indexing – Sorting arrays – Structured data – Data manipulation with Pandas – Data Indexing and Selection – Handling missing data – Hierarchical indexing – Combining datasets – Aggregation and Grouping – String operations – Working with time series – High performance.

UNIT-III MACHINE LEARNING 9

The modeling process - Types of machine learning - Supervised learning - Unsupervised learning - Semi-supervised learning- Classification, regression - Clustering – Outliers and Outlier Analysis.

UNIT-IV DATA VISUALIZATION 9

Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn.

UNIT-V HANDLING LARGE DATA**9**

Problems - techniques for handling large volumes of data - programming tips for dealing with large data sets- Case studies: Predicting malicious URLs, Building a recommender system - Tools and techniques needed - Research question - Data preparation - Model building – Presentation and automation.

TOTAL : 45 PERIODS**COURSE OUTCOMES:**

At the end of the course, learners will be able

1. Gain knowledge on data science process.
2. Perform data manipulation functions using Numpy and Pandas.
3. Understand different types of machine learning approaches.
4. Perform data visualization using tools.
5. Handle large volumes of data in practical scenarios.

TEXT BOOKS:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016.
2. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016.

REFERENCE BOOKS:

1. Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017.
2. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	2	3	2	-	-	-	3	1	3	2	-	-	-	-
2	2	2	2	3	3	-	-	-	2	2	3	2	-	-	-	-
3	3	3	3	3	2	-	-	-	2	3	1	1	-	-	-	-
4	2	3	2	3	2	-	-	-	3	3	3	3	-	-	-	-
5	2	3	2	2	3	-	-	-	3	3	1	3	-	-	-	-
AVG.	2.4	2.8	1.3	2.8	2.4	-	-	-	2.6	2.4	2.2	2.2	-	-	-	-

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

COURSE OBJECTIVES:

- To understand the basic concepts of open source software.
- To understand about open source databases.
- To understand about the open source programming languages.
- To understand and apply the concepts in python language.
- To understand the real world problems using case studies.

UNIT-I INTRODUCTION 9

Introduction to Open sources – Need of Open Sources – Advantages of Open Sources–Application of Open Sources. Open source operating systems: LINUX: Introduction –General Overview – Kernel Mode and user mode – Process – Advanced Concepts –Scheduling – Personalities – Cloning – Signals – Development with Linux.

UNIT-II OPEN SOURCE DATABASE 9

MySQL: Introduction – Setting up account – Starting, terminating and writing your ownSQL programs – Record selection Technology – Working with strings – Date and Time– Sorting Query Results – Generating Summary – Working with metadata – Usingsequences – MySQL and Web.

UNIT-III OPEN SOURCE PROGRAMMING LANGUAGES 9

PHP: Introduction – Programming in web environment – variables – constants – data;types – operators – Statements – Functions – Arrays – OOP – String Manipulation and regular expression – File handling and data storage – PHP and SQL database – PHP and LDAP – PHP Connectivity – Sending and receiving E-mails – Debugging and error handling – Security – Templates.

UNIT-IV PYTHON 9

Syntax and Style – Python Objects – Numbers – Sequences – Strings – Lists and Tuples – Dictionaries – Conditionals and Loops – Files – Input and Output – Errors and Exceptions – Functions – Modules – Classes and OOP – Execution

Environment.

UNIT-V CASE STUDIES

9

Apache, BSD, Linux, Mozilla (Firefox), Wikipedia, Joomla, GCC, Open Office.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Explain the basic concepts of open source softwares.
2. Excel in open source databases.
3. Understand about open source programming languages.
4. Apply the concepts using python.
5. Understand the real world problems using the case studies.

TEXT BOOKS:

1. Remy Card, Eric Dumas and Frank Mevel, "The Linux Kernel Book", Wiley Publications, 2003.
2. Steve Suchring, "MySQL Bible", John Wiley, 2002.
3. Kailash Vadera, Bhavyesh Gandhi, "Open Source Technology", Laxmi Publications Pvt Ltd 2012, 1st Edition.

REFERENCE BOOKS:

1. Rasmus Lerdorf and Levin Tatroe, "Programming PHP", O'Reilly, 2002
2. Wesley J. Chun, "Core Python Programming", Prentice Hall, 2001
3. Martin C. Brown, "Perl: The Complete Reference", 2nd Edition, Tata McGraw-Hill Publishing Company Limited, Indian Reprint 2009.
4. Steven Holzner, "PHP: The Complete Reference", 2nd Edition, Tata McGraw-Hill Publishing Company Limited, Indian Reprint 2009.
5. Vikram Vaswani, "MYSQL: The Complete Reference", 2nd Edition, Tata McGraw-Hill Publishing Company Limited, Indian Reprint 2009.
6. Fadi P. Deek and James A. M. McHugh, "Open Source: Technology and Policy", Cambridge Universities Press 2007

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
2	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
3	1	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-
4	1	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-
5	2	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-
AVG.	2.0	-	1.6	-	1.0	-	-	-	-	-	-	-	-	-	-	-

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

COURSE OBJECTIVES:

- To study the fundamentals about IoT
- To study about IoT Access technologies
- To study the design methodology and different IoT hardware platforms.
- To study the basics of IoT Data Analytics and supporting services.
- To study about various IoT case studies and industrial applications.

UNIT-I FUNDAMENTALS OF IoT 9

Evolution of Internet of Things, Enabling Technologies, M2M Communication, IoT World Forum (IoTWF) standardized architecture, Simplified IoT Architecture, Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.

UNIT-II IoT PROTOCOLS 9

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.11ah and Lora WAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks, 6LoWPAN, Application Transport Methods: SCADA, Application Layer Protocols: CoAP and MQTT.

UNIT-III DESIGN AND DEVELOPMENT 9

Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks IoT Platform overview: Overview of IoT supported Hardware platforms such as: Raspberry pi, Arduino Board details.

UNIT-IV DATA ANALYTICS AND SUPPORTING SERVICES 9

Data Analytics: Introduction, Structured Versus Unstructured Data, Data in Motion versus Data at Rest, IoT Data Analytics Challenges, Data Acquiring, Organizing in IoT/M2M, Supporting Services: Computing Using a Cloud Platform for IoT/M2M Applications/Services, Everything as a service and Cloud Service Models.

UNIT-V CASE STUDIES/INDUSTRIAL APPLICATIONS 9

IoT applications in home, infrastructures, buildings, security, Industries, Home appliances, other IoT electronic equipments, Industry 4.0 concepts.

COURSE OUTCOMES:

At the end of this course, students will be able to

1. Understand the basics of IoT.
2. Implement the state of the Architecture of an IoT
3. Understand design methodology and hardware platforms involved in IoT.
4. Understand how to analyze and organize the data.
5. Compare IOT Applications in Industrial & real world.

TEXT BOOKS:

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017. (unit 1,2,3)
2. Internet of Things - A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015. (unit 5)
3. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education. (unit 4)

REFERENCE BOOKS:

1. The Internet of Things - Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012 (for Unit2).
2. "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Jan Ho"ller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.
3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer, 2011.
4. Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, Michael Margolis, Arduino Cookbook and O'Reilly Media, 2011

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	3	2				2			1	2	-	-	-
2	3	3	3	3									-	2	-	-
3	3	3	3		3		2	1		2			-	-	1	-
4	3	3	3	3	3						2		-	-	2	-
5	3	3	3	3	2	3	2			3	2	1	-	2	-	2
AVG.	3	3	3	3	2.5	3	2	1	-	2.5	2	1	2	2	1.5	2

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

COURSE OBJECTIVES:

- To understand the mechanics of operation and characteristics of linear model of machine learning
- Use R to implement methods for training and model selection ‘
- Acquire Knowledge in various learning techniques like decision tree, Analytical, Inductive and Reinforced learning.
- Identify and apply the appropriate machine learning techniques for classification, Pattern recognition, optimization and decision problems.
- Development of techniques in information science applications by applying Computational intelligence and appropriate machine learning techniques.

UNIT-I INTRODUCTION 9

Machine learning -Examples of Machine Learning applications-Learning Associations- Classification-Regression-Unsupervised Learning-Reinforcement Learning-Supervised learning: Learning a class from Examples-Regression-Model Selection and Generalization. Case Study: Familiarity with R tool and Python programming language and libraries.

UNIT-II CONCEPT LEARNING AND DECISION-TREE LEARNING 9

Concept Learning - Concept learning Task - Concept Learning as search -Finding a maximally specific hypothesis - Version Spaces and Candidate elimination Algorithm -Inductive Bias Decision Tree Learning - Decision Tree representation - Problems for Decision Tree Learning - Hypothesis Search space - Inductive Bias in Decision Tree Learning - Issues in Decision Tree Learning. Case Study: Implementation of decision tree algorithm for problems in Retail Domain.

UNIT-III MULTILAYER PERCEPTRONS AND DEEP LEARNING 9

The Perceptron-Training a Perceptron-Learning Boolean Functions-Multilayer Perceptrons- MLP as Universal Approximator Back propagation Algorithm-Training Procedures Convolution Networks -The Convolution Operation-Pooling-Convolution and Pooling as an infinitely strong prior -Variants of the Basic Convolution Function

-Structured Outputs -Data Types -Efficient Convolution Algorithms -Random and Unsupervised features. Case Study: Implementation of Back propagation algorithm for problems in financial domain.

UNIT-IV	CLUSTERING	9
----------------	-------------------	----------

Similarity-Based Clustering - Unsupervised learning problems - Hierarchical Agglomerative Clustering (HAC) - Single-link, complete-link, group-average similarity- k-Means and Mixtures of Gaussians-Flat clusteringk-Means algorithms- Mixture of Gaussian modelEM-algorithm for mixture of Gaussian model. Case Study: Implementation of clustering algorithm for problems in financial/insurance/health care domain.

UNIT-V	REINFORCEMENT LEARNING	9
---------------	-------------------------------	----------

Introduction - learning task - Q learning - The Q function - Algorithm for Q learning - convergence- experimentation strategies - updating sequence -Non deterministic rewards and actions - Temporal difference learning -Generalizing from examples - relationship to dynamic programming Case Study: Implementation of Q learning algorithm/reinforcement learning for problems in automotive domain/games.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, students will be able to

1. Understand the basic ideas and objective of machine learning
2. Understand the problem of over fitting in machine learning.
3. Transfer concrete problems to machine learning problems and select appropriate models to solve them.
4. Understand how to analyze and organize the data using clustering methods.
5. Understand reinforcement learning algorithms and experiment strategies.

TEXT BOOKS:

1. Ethem Alpaydin, "Introduction to Machine Learning", The MIT Press, September 2014, ISBN 978-0-262-02818-9.(Units 1,3(Multilayer Perceptrons) & 4)
2. Mitchell, Tom, "Machine Learning", New York, McGraw-Hill, First Edition, 2003. (Units 2,5)

REFERENCE BOOKS:

1. Ian GoodFellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press Book (Unit 3 - Convolutional Networks), Nov. 2016
2. Stephen Marshland, "Machine Learning: An Algorithmic Perspective", Chapman & Hall/CRC 2009.
3. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", MIT Press (MA) 2012.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	-	-	-	-	1	1	-	1	-	-	1	-	-	1	-
2	1	1	-	-	1	-	-	-	1	-	-	1	-	-	1	-
3	2	1	1	-	-	-	1	-	1	1	-	1	-	-	2	-
4	1	1	2	1	-	-	1	-	1	1	1	1	-	1	2	-
5	1	1	1	1	-	-	-	1	1	1	-	-	1	1	2	2
AVG.	1.2	1	1.3	1	1	1	1	-	1	-	-	1	1	1	1.6	2

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

COURSE OBJECTIVES:

- To understand the Tamil grammar and programming basics for Tamil computing.
- To understand the various types of Tamil Computing applications.
- To make the students understand the use of Tamil computing tools and Resources.
- To strengthen the students' ability to carry out the Computational Linguistics in Tamil computing.
- To understand the concepts of Tamil text processing using open – Tamil python library.

UNIT-I TAMIL GRAMMAR 9

Introduction to Computational Linguistics-Grammars-Alphabets: Classification & Properties - Words: classification and components - Sentences: Structures and word ordering.

UNIT-II PROGRAMMING BASICS FOR TAMIL COMPUTING 9

History of Tamil Computing - Standards & Fonts - UNICODE - Object Oriented Tamil Computing - Tamil text processing using open-Tamil python library.

UNIT-III COMPUTATIONAL LINGUISTICS 9

Basic linguistics - Phonology - Phonology computing - lexicography - syntax - semantics - pragmatics- Regular languages-and their limitations- Finite-state automata.

UNIT-IV TAMIL COMPUTING TOOLS & RESOURCES 9

POS Tagger - Morphological Analyser - Morphological Generator - Sentence Parser - Named Entity Recognizer - Word Sense Disambiguator - Ontologies.

UNIT-V TAMIL COMPUTING APPLICATIONS 9

Machine Translation -Information retrieval & Extraction - Question Answering - Text Summarization- Automatic Indexing - Text Mining - Conceptual Search.

COURSE OUTCOMES:

At the end of this course, students will be able to

1. Explain classification of Tamil grammar and properties
2. Adopt a suitable process for Tamil computing tools.
3. Analyze the different types of computational linguistics such as phonology, Morphology, lexicography.
4. Perform and analyze the Tamil computing applications.
5. Analyze and process the Tamil python library.

TEXT BOOKS:

1. The Oxford Handbook of Computational Linguistics, Edited by Ruslan Mitkov, Oxford University Press, 2014.
2. Tamil Computing, Dr.R.Ponnusamy, Allied Publishers private limited, 2024.

REFERENCE BOOKS:

1. Translation - Theory and Application, Valarmathi, International Institute of Tamil Studies, First Edition, 2001.
2. Tholkaappiyam - Thodariyal, Shanmugam, International Institute of Tamil Studies, First Edition, 2004.
3. J.E.Hopcroft, R.Motwani and J.D Ullman, - Introduction to Automata Theory, Languages and Computations, Third Edition, Pearson Education, 2013.
4. Natural language processing and computational linguistics, Bhargav Srinivasa Desikan Packt Publishing, first edition 2018.
5. The Phonology and morphology of tamil chrisdas Prathima, 2016.
6. Pos Tasser R Morphological Analzser Shodhganga inflibnet.ac.in.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	-	-	-	-	1	1	-	1	-	-	1	-	-	1	-
2	1	1	-	-	1	-	-	-	1	-	-	1	-	-	1	-
3	2	1	1	-	-	-	1	-	1	1	-	1	-	-	2	-
4	1	1	2	1	-	-	1	-	1	1	1	1	-	1	2	-
5	1	1	1	1	-	-	-	1	1	1	-	-	1	1	2	2
AVG.	1.2	1	1.3	1	1	1	1	1	1	1	1	1	1	1	1.6	2

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

OCY101	CYBER FORENSIC AND INVESTIGATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Principles of digital evidence handling and forensic investigation techniques.
- Proficiency in using forensic tools for imaging, data recovery, and analysis.
- Understanding legal and ethical considerations in cyber investigations.
- Incident response planning and execution for cyber incidents.
- Documentation and reporting of forensic findings for stakeholders and legal purposes.

UNIT-I INTRODUCTION TO CYBER FORENSICS 9

Computer Forensics Fundamentals – Types of Computer Forensics Technology – Types of Computer Forensics Systems – Vendor and Computer Forensics Services.

UNIT-II COMPUTER FORENSICS EVIDENCE AND CAPTURE 9

Data Recovery – Evidence Collection and Data Seizure-Duplication and Preservation of Digital Evidence-Computer Image Verification and Authentication.

UNIT-III COMPUTER FORENSIC ANALYSIS 9

Discovery of Electronic Evidence- Identification of Data – Reconstructing Past Events – Fighting against Macro Threats – Information Warfare Arsenal – Tactics of the Military – Tactics of Terrorist and Rogues – Tactics of Private Companies.

UNIT-IV INVESTIGATION 9

Arsenal – Surveillance Tools – Hackers and Theft of Components – Contemporary Computer Crime- Identity Theft and Identity Fraud – Organized Crime & Terrorism – Avenues Prosecution and Government Efforts – Applying the First Amendment to Computer Related Crime-The Fourth Amendment and other Legal Issues.

UNIT-V COMPUTER FORENSIC INVESTIGATION CASES 9

Developing Forensic Capabilities – Searching and Seizing Computer Related Evidence – Processing Evidence and Report Preparation – Future Issues.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, students will be able to

1. To demonstrate proficiency in using forensic tools and techniques for digital evidence analysis.
2. To critically evaluate and interpret digital artifacts to reconstruct cyber incident timelines.
3. To apply legal and ethical principles to ensure compliance in cyber forensic investigations.
4. To formulate and implement incident response strategies to mitigate cyber threats effectively.
5. To prepare clear and comprehensive forensic reports and presentations for stakeholders.

TEXT BOOKS:

1. John R. Vacca, "Computer Forensics: Computer Crime Scene Investigation", Cengage Learning, 2nd Edition, 2005. (CHAPTERS 1 – 18). (UNIT I – IV)
2. Marjie T Britz, "Computer Forensics and Cyber Crime: An Introduction", Pearson Education, 2nd Edition, 2008. (CHAPTERS 3 – 13). (UNIT IV – V)

REFERENCE BOOKS:

1. MariE-Helen Maras, "Computer Forensics: Cybercriminals, Laws, and Evidence", Jones & Bartlett Learning; 2nd Edition, 2014.
2. Chad Steel, "Windows Forensics", Wiley, 1st Edition, 2006.
3. Majid Yar, "Cybercrime and Society", SAGE Publications Ltd, Hardcover, 2nd Edition, 2013.
4. Robert M Slade, "Software Forensics: Collecting Evidence from the Scene of a Digital Crime", Tata McGraw Hill, Paperback, 1st Edition, 2004.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
2	-	3	-	3	-		-	-	-	-	-	-	-	2	-	-
3	3	-	2		-	3	-	-	-	-	-	-	-	-	3	-
4	2	-	2		-	-	-	-	-	-	-	-	-	2		-
5	3	-	-	2	-	2	-	-	-	-	-	-	-	-	2	-
AVG.	2.7	2.5	2	2.5	-	2.5	-	-	-	-	-	-	3	2	2.5	-

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

COURSE OBJECTIVES:

- To Understand Social Media Platforms: Learn how popular social media platforms work.
- To Identify Security Risks: Recognize threats and vulnerabilities on social media.
- To Privacy and Data Protection: Protect personal information on social media.
- To Legal and Ethical Issues: Understand legal and ethical issues in social media.
- To Security Best Practices: Apply methods to secure social media accounts.

UNIT-I INTRODUCTION TO SOCIAL MEDIA SECURITY 9

Social Media Platforms-Communication Impact-Cybersecurity Basics-Security Threats-User Awareness-Breach Case Studies-Data Collection-Security Features-Future Trends.

UNIT-II PRIVACY AND ACCOUNT SECURITY 9

Privacy Settings-Strong Passwords-Two-Factor Authentication (2FA)-Geotagging Risks Personal Information- Third-Party Apps-Account Takeover-Encryption Role-Safe Posting.

UNIT-III THREATS AND ATTACKS 9

Social Engineering-Cybercriminal Tactics-Suspicious Activity-Malware Links-Hacking Cases-Suspicious Content-Security Tests-Insider Threats-Threat Intelligence.

UNIT-IV LEGAL AND ETHICAL ISSUES 9

International Laws-Intellectual Property-Privacy Policies-Ethical Data Use-User Responsibilities-Legal Disputes- Freedom of Speech-Compliance Requirements-Regulation Future.

UNIT-V	ONLINE REPUTATION AND POLICIES	9
Reputation	Strategies-Brand	Impact-Crisis
Management-Corporate	Communication-Social	Media Policies- Governance
Role-Monitoring	Tools-	Employee Training-Cybersecurity Integration.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, students will be able to

1. To Understand Social Media Platforms.
2. To Identify Security Threats.
3. To Protect Privacy and Apply best practices to protect personal information on social media.
4. To Address Legal and Ethical Issues.
5. To Apply Security Measures and Use tools and techniques to secure social media.

TEXT BOOKS:

1. "Social Media Security: Leveraging Social Networking While Mitigating Risk" by Michael Cross.
2. "The Social Media Handbook: Rules, Policies, and Best Practices to Successfully Manage Your Organization's Social Media Presence, Posts, and Potential Legal Issues" by Nancy Flynn.

REFERENCE BOOKS:

1. "Phishing Dark Waters: The Offensive and Defensive Sides of Malicious Emails" by Christopher Hadnagy and Michele Fincher.
2. The Ethical Hack: A Framework for Business Value Penetration Testing" by James S. Tiller.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	2	-	3	-	-	-	-	-	-	-	-	3	-	2	-
2	-	1	-	2	-	-	-	-	-	-	-	-	3	-	1	-
3	-	-	1	2	3	-	-	-	-	-	-	-	3	-	1	-
4	-	1	-	2	-	-	-	-	-	-	-	-	3	-	2	-
5	1	1	-	2	2	-	-	-	-	-	-	-	3	1	2	-
AVG.	1	1.2	1	2.2	2.5	-	-	-	-	-	-	-	3	1	1.6	-

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

OEC101	INTRODUCTION TO 5G COMMUNICATION	L	T	P	C
	NETWORKS	3	0	0	3

OBJECTIVES:

- To understand the evolution of wireless networks.
- To learn the various features of 5G.
- To get acquainted with the fundamentals of EPC.
- To study the processes associated with 5G architecture.
- To explore the spectrum sharing and spectrum trading.
- To assess the security features in 5G networks.

UNIT-I: EVOLUTION OF WIRELESS NETWORKS 9

Networks evolution: 1G, 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.

UNIT-IV: PROTOCOLS AND SPECTRUM MANAGEMENT 9

5G protocols: 5G NAS, NGAP, GTP-U, IP Sec and GRE, Mobility management, Command and control, Spectrum sharing and Spectrum trading, Cognitive radio based on 5G.

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 : 45 Periods

COURSE OUTCOMES:

On completion of the course, the student will be able to

- Emphasize the basic theory of evolution of communication techniques
- Apply the concepts of 4G communication
- Assess the need for 5G communication Techniques
- Comprehend architecture and protocols for 5G communication
- Understand the principles of dynamic spectrum management
- Analyze the security aspects in 5G networks

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

CO - PO and CO - PSO MAPPING:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	2	2	-	2	-	-	-	-	-	3	2	2
2	3	3	3	2	-	2	-	-	-	-	-	2	2	-
3	3	3	3	2	-	2	-	-	-	-	-	2	2	-
4	3	3	3	2	-	2	-	-	-	-	-	2	2	-
5	3	3	3	2	-	2	-	-	-	-	-	2	2	-
6	3	2	3	2	-	2	-	-	-	-	-	2	2	2
AVG.	3	3	3	2	-	2	-	-	-	-	-	2	2	2

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

OEC102	INTRODUCTION TO INDUSTRIAL IoT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand basic industrial processes and its reference architecture
- To perceive the knowledge of networks and programming of IIOT.
- To study the role of sensors, actuators and communication protocols used for interfacing.
- To introduce and familiarize the industry 4.0
- To master security in IIOT
- To study application of IIOT in various fields

UNIT-I: INTRODUCTION TO INDUSTRIAL IoT AND ITS ARCHITECTURE 9

IIoT Introduction, Industrial Internet Architecture Framework – Functional Viewpoint – Operational Domain, Information Domain, Application Domain, Business Domain – Implementation View point – Architectural Topology – Three Tier Topology – Data Management.

UNIT-II: NETWORKING AND PROGRAMMING OF IIoT 9

Industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication. Industrial IoT- Layers: IIoT Communication, IIoT Networking. Industrial IoT: IIoT Analytics - Introduction, Machine Learning and Data Science, R and Julia Programming, Data Management with Hadoop.

UNIT-III: SENSOR AND INTERFACING 9

Introduction to sensors, Transducers, Classification, Roles of sensors in IIOT, Various types of sensors, Design of sensors, sensor architecture, special requirements for IIOT sensors, Role of actuators, types of actuators. Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet, BACNet, Current, and M2M.

UNIT-IV: COMPUTATION IN IIoT AND SECURITY 9

SDN in IIoT, Data Center Networks, Industrial IoT: Security and Fog Computing- Cloud Computing in IIoT, Industrial IoT Application Domains: Factories and Assembly Line, Food Industry.

UNIT-V: IIoT APPLICATIONS

9

Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security: AR and VR safety applications, Facility Management. Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries.

TOTAL : 45 Periods

COURSE OUTCOMES:

On completion of the course, the student will be able to:

- Interpret basic industrial processes and its reference architecture
- Comprehend to the modern networking technologies and programming of IIoT.
- Illustrate the sensors, actuators and communication protocols used for interfacing.
- Analyze the concepts and gain insights into Industry 4.0.
- Handle real time security issues in IIoT and Realize the importance of IIoT applications in real time.
- Create numerous IoT applications with the physical world of humans and real life problem solving.

TEXT BOOKS:

1. S. Misra, C. Roy, and A. Mukherjee, Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.2020
2. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress, 2017.
3. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B.Rawart (Springer).

REFERENCES:

1. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
2. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014
3. Francis da Costa, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013
4. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key, applications and Protocols", Wiley, 2012
5. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1	-	1	-	-	-	-	-	-	-	-	3	1	2
2	1	-	1	-	-	-	-	-	-	-	-	2	2	2
3	2	3	3	3	-	-	-	-	-	-	-	2	2	3
4	1	-	2	-	-	-	-	-	-	-	-	2	2	2
5	2	1	3	2	-	-	-	-	-	-	-	2	3	2
6	2	3	3	2	-	-	-	-	-	-	-	2	3	2
AVG.	2	3	3	2	-	-	-	-	-	-	-	2	2	2

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

OEC103	ARDUINO PROGRAMMING AND ITS	L	T	P	C
	APPLICATIONS	3	0	0	3

OBJECTIVES:

- To understand the evolution of IoT boards
- To program Arduino to control lights, motors and other devices
- To learn Arduino's architecture, including inputs and connectors for add-on devices.
- To add third-party components such as LCDs, accelerometers, gyroscopes, and GPS trackers to extend Arduino's functionality.
- To explore various options in programming Arduino boards
- To test, debug, and deploy the Arduino to solve real world problems

UNIT-I: INTRODUCTION TO SENSORS 9

Transducers, Classification, Roles of sensors in IoT, Various types of sensors, Design of sensors, sensor architecture, special requirements for IOT sensors, Role of actuators, types of actuators.

UNIT-II: ARDUINO GPIOs and APIs 9

Hardware requirement for Arduino, Connecting remotely over the network using VNC, GPIO Basics, Controlling GPIO Outputs Using a Web Interface, APIs / Packages- Quark SOC processor.

UNIT-III: ARDUINO INTERFACES 9

Sensor with Arduino- Humidity, Proximity, IR Motion, Accelerometer, Sound, Light Distance, Pressure, Thermal - Reading various sensor data on serial monitor and LCD Display.

UNIT-IV: PROGRAMMING IN ARDUINO IoT DEVICE 9

Preparing the development environment (Arduino IDE), Exploring the Arduino language syntax, Coding, compiling, and uploading to the microcontroller, Working with Arduino Communication Modules: Bluetooth Modules, Wi-Fi Modules and I2C and SPI.

UNIT-V: PROGRAMMING ESP 8266 MODULE**9**

ESP8266 Wi-Fi Serial Module: Overview, Setting Up the Hardware, Interfacing with Arduino, Creating an IoT Temperature and Humidity Sensor System, Overview of DHT-22 Sensor, Interfacing the Hardware: Arduino, ESP8266 WiFi Module, and DHT-22 Sensor, Checking Your Data via Thing Speak.

TOTAL : 45 Periods**COURSE OUTCOMES:**

On completion of the course, the student will be able to

- Understand the basics of sensors, its functioning.
- Execute basic and advanced assembly language programs.
- Learn the ways to interface I/O devices with processor for task sharing.
- Evoke the basics of co-processor and its ways to handle float values by its instruction set.
- Recognize the functionality of micro controller, latest version processors and its applications.
- Acquire design thinking capability, ability to design a component with realistic constraints, to solve real world engineering problems and analyse the results.

TEXT BOOKS:

1. Simon Monk, Hacking Electronics: Learning Electronics with Arduino and Raspberry Pi, 2nd Edition, McGraw-Hill Education, 2017.
2. Donald Norris, The Internet of Things: Do-It-Yourself Projects with Arduino, Raspberry Pi, and BeagleBone Black, 1 st edition, McGraw Hill Education, 2015

REFERENCES:

1. Marco Schwartz, Home Automation with Arduino, 3rd edition, Open Home Automation 2014.
2. Schwartz, Marco. Internet of things with arduino cookbook, 1st edition, Packt Publishing Ltd, 2016.

3. Kooijman, Matthijs. Building Wireless Sensor Networks Using Arduino, 1st edition, Packt Publishing Ltd, 2015

CO - PO and CO - PSO MAPPING:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	2	2	-	-	-	-	-	-	-	3	2	2
2	3	3	3	2	-	-	-	-	-	-	-	2	2	-
3	3	3	3	2	-	-	-	-	-	-	-	2	2	-
4	3	3	3	2	-	-	-	-	-	-	-	2	2	-
5	3	3	3	2	-	-	-	-	-	-	-	2	2	-
6	3	2	3	2	-	-	-	-	-	-	-	2	2	2
AVG.	3	3	3	2	-	-	-	-	-	-	-	2	2	2

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

OMD101	INTRODUCTION TO FOOD PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The student should be made to:

- To learn about the shelf life of food products.
- To gain knowledge on the storage of food products.
- To know about the thermal and non-thermal processing methods of food.
- To design different types of Dryers and methods to prevent food wastage.
- To understand the Food Hygiene methods and its importance

UNIT-I FOOD PROCESSING 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. Retort pouch packing, Aseptic packaging.

UNIT-III THERMAL METHODS AND NON-THERMAL METHODS 9

Newer methods of thermal processing- batch and continuous - In container sterilization canning - application of infra-red microwaves - ohmic heating - control of water activity - preservation by concentration and dehydration - osmotic methods. Super Critical Technology for Preservation - Chemical preservatives, preservation by ionizing radiations, ultrasonics, high pressure, fermentation, curing, pickling, smoking, membrane technology. Hurdle technology.

UNIT-IV DRYING PROCESS FOR TYPICAL FOODS & FOOD WASTES IN VARIOUS PROCESSES 9

Rate of drying for food products; design parameters of different type of dryers; properties of air-water mixtures. Psychometric chart, freezing and cold storage, freeze concentration, dehydro-freezing, freeze drying, IQF; calculation of refrigeration load, design of freezers and cold storages. 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 : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, students will be able to

1. Aware of the different methods applied to preserving foods.
2. Explain the food handling and storage processes.
3. Analyze the thermal and non-thermal processing methods.
4. Explore the drying process of foods.
5. Understand Food Hazards, Adulteration, and Safety in handling and procurement & Microbial considerations and sanitation.

TEXT BOOKS:

1. Karnal, Marcus and D.B. Lund "Physical Principles of Food Preservation".Rutledge, 2003.
2. VanGarde, S.J. and Woodburn. M "Food Preservation and Safety Principles and Practice".Surbhi Publications, 2001.

3. Sivasankar, B. "Food Processing & Preservation", Prentice Hall of India, 2002.
4. Khetarpaul, Neelam, "Food Processing and Preservation", Daya Publications, 2005.

REFERENCE BOOKS:

1. Shafiur M Rahman, "Handbook of Food Preservation", Second Edition, CRC Press, 2007
2. Zeuthen Peter, Bøgh-Sørensen Leif, "Food Preservation Techniques", Wood Head Publishing, Cambridge, England, 2005.
3. Ranganna S, "Handbook of Canning and Aseptic Packaging", Tata McGraw-Hill, 2000.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	-	-	3	-	1	1	-	-	-	-	-	-	1
2	2	3	1	2	-	-	-	2	-	-	-	2	-	1
3	3	2	1	2	-	1	1	-	-	-	-	2	-	1
4	3	2	1	2	-	1	1	-	-	-	-	2	-	1
5	3	1	2	-	-	1	1	-	-	-	-	2	-	1
AVG.	3	2	1.3	2.3	-	1	1	2	-	-	-	2	-	1

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

COURSE OBJECTIVES:

- To explore the characteristics of electrode configuration.
- To study the characteristics of Bio signals.
- To explain the necessity of bio amplifiers in biomedical signal processing.
- To analyze the different techniques used for measurement of non-electrical bio-parameters.
- To understand the biochemical measurement techniques and sensors.

UNIT-I ELECTRODE CONFIGURATIONS 9

Origin of bio potential and its propagation. Frequency and amplitude ranges. Electrode configurations: Electrode-electrolyte interface, electrode–skin interface impedance, polarization effects of electrode – non- polarizable electrodes. Unipolar and bipolar configuration, classification of electrodes.

UNIT-II BIOSIGNAL CHARACTERISTICS 9

Bio signals characteristics – ECG-frequency and amplitude ranges – Einthoven's triangle, standard 12 lead system. EEG - EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. EMG - Electrode configuration -unipolar and bipolar mode.

UNIT-III BIOAMPLIFIERS 9

Need for bio-amplifier - Differential bio-amplifier – Single ended amplifier - Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference.

UNIT-IV MEASUREMENT OF BIO SIGNALS 9

Temperature, respiration rate and pulse rate measurements. Blood Pressure - indirect methods: auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers - systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurements.

UNIT-V BIOCHEMICAL MEASUREMENTS**9**

Biochemical sensors - pH, 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 : 45 PERIODS**COURSE OUTCOMES:**

At the end of this course, students will be able to

1. Illustrate the origin of various biological signals and their characteristics.
2. Apply knowledge of bio signal characteristics.
3. Gain knowledge on various amplifiers involved in monitoring bio signals.
4. Identify appropriate instruments and methods for each physiological parameter.
5. Examine the biochemical measurement techniques.

TEXT BOOKS:

1. Leslie Cromwell, "Biomedical Instrumentation and measurement", 2nd edition, Prentice hall of India, New Delhi, 2015.
2. John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.
3. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2003.

REFERENCE BOOKS:

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.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	1	1	-	-	-	-	-	-	-	-	2	1
2	3	2	1	1	-	-	-	-	-	-	-	-	2	1
3	3	2	1	1	-	-	-	-	-	-	-	-	2	1
4	3	2	1	1	-	-	-	-	-	-	1	-	2	1
5	3	2	1	1	-	-	-	-	-	-	1	-	2	1
AVG.	3	2	1	1	-	-	-	-	-	-	1	-	2	1

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

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 – Carbonization – 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 : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, students will be able to

1. Discuss the Indian and global energy scenario.
2. Describe the various solar energy technologies and its applications.
3. Explain the various wind energy technologies.
4. Explore the various bio-energy technologies.
5. Discuss the ocean and geothermal technologies.

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.

REFERENCE BOOKS:

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.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	2			1							3			
2	3	3	2			1							3			
3	3	3	2			1							3			
4	3	3	2			1							3			
5	3	3	2			1							3			
AVG.	3	3	2	-	-	1	-	-	-	-	-	-	3	-	-	-

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

COURSE OBJECTIVES:

- Acquire knowledge in the field of energy conservation and management.
- Study the various measures for energy conservation in electrical devices both static & rotating machineries
- Analyze the energy efficiency in thermal utilities
- Know the concept of compressed air system and improve the efficiency.
- Understand and analyze of Energy Economics.

UNIT-I INTRODUCTION 9

Energy - Power – Past & Present scenario of World; National Energy consumption Data –Environmental aspects associated with energy utilization – Energy conservation and its importance - need for energy management – Energy accounting -Energy monitoring, targeting and reporting- Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers.

UNIT-II ELECTRICAL SYSTEMS 9

Electrical load management and maximum demand control - power factor improvement and its benefit - selection and location of capacitors - performance assessment of PF capacitors automatic power factor controllers - transformer losses - Electric motors: motor efficiency - factors affecting motor performance - energy saving opportunities with energy efficient motors– Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination. Lighting System: Light source, choice of lighting, luminance requirements – ballast - energy efficient lighting controls - energy conservation avenues.

UNIT-III THERMAL SYSTEMS 9

Introduction to fuels- Boilers: Types, combustion in boilers, performances evaluation, analysis of losses - energy conservation opportunities - FBC boilers - Steam System: Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, condensate and flash steam recovery system, identifying opportunities for energy savings - Furnaces: Classification, general fuel economy

measures in furnaces, excess air, heat distribution, temperature control, draft control, waste heat recovery – Refractory : types, selection and application of refractories, heat loss .

UNIT-IV COMPRESSED AIR SYSTEM 9

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems –Cooling Towers – Diesel Generating System - methods adopted for effecting ENCON – economics of ENCON adoption in all the utilities.

UNIT-V ECONOMICS 9

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, students will be able to

1. Acquire knowledge in the field of energy conservation and management process.
2. Learn the various measures for energy conservation in electrical devices.
3. Design the effective thermal utility system.
4. Improve the efficiency in compressed air system
5. Suggest methodologies for Energy Economics.

TEXT BOOKS:

1. Mehmet Kanoğlu, Yunus A. Çengel, 'Energy Efficiency and Management for Engineers', 1st Edition, McGraw-Hill Education, 2020
2. D Moncef Krati, "Energy Audit of Building Systems: An Engineering Approach", Second Edition, CRC Press, 2016.
3. Sonal Desai, 'Handbook of Energy Audit', McGraw Hill Education (India) Private Limited, 2015.

REFERENCE BOOKS:

1. Michael P.Deru, Jim Kelsey, 'Procedures for Commercial Building Energy Audits', American Society of Heating, Refrigerating and Air conditioning

Engineers, 2011.

2. Charles M. Gottschalk, 'Industrial Energy Conservation', Wiley, 1996.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	1		1		3				2			1			
2			2		1				2			1	1	2		
3		1		3		2							1			
4	3					3		2			2		1			
5		2		3	2		1	2				2	2			
AVG.	2	1.33	2	2.33	1.5	2.66	1	2	2	2	2	1.5	1.2	2	-	-

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

COURSE OBJECTIVES:

- To know about the general aspects of Electric and Hybrid Vehicles (EHV), including architectures.
- To acquire the knowledge on modelling, sizing of batteries.
- To understand the working principle, construction and characteristics of various motors.
- To provide knowledge about various power converters and control.
- To understand the Hybrid and Electric vehicles

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-. History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles.

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 : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, students will be able to

1. Understand the operation and architecture of electric and hybrid vehicles.
2. Identify various energy source options like battery and fuel cell.
3. Select suitable electric motor for applications in hybrid and electric vehicles.
4. Explain the role of power electronics in hybrid and electric vehicles.
5. Analyze the energy and design requirement for hybrid and electric vehicles.

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.

REFERENCE BOOKS:

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.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	2	3	2					1	1	2		2	
2	3	3	3	2	3	2						1		1		1
3	3	3	3	2	3	2	3					2	2			1
4	3	3	3	2	3	2					1	1				
5	3	3	3	2	3	2	2				1	1	1			
AVG.	3	3	3	2	3	2	2.5	-	-	-	1	1.2	1.6	1	2	1

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

COURSE OBJECTIVES:

- Provide a comprehensive understanding of multimedia concepts and components.
- Equip students with the knowledge to design and handle multimedia systems and files.
- Develop skills in multimedia authoring, hypermedia messaging, and user interface design.
- Introduce augmented reality techniques and their integration with existing development environments.
- Explore virtual reality techniques and their applications in creating immersive experiences

UNIT-I INTRODUCTION TO MULTIMEDIA 9

Multimedia - Multimedia system architecture – Evolving technologies for multimedia
 -Components of multimedia – Multimedia Hardware and Software-Web and Internet
 multimedia applications –Data Representation: Text, Images, Audio, Video -
 Transition from conventional media to digital media.

UNIT-II MULTIMEDIA SYSTEM DESIGN & FILE HANDLING 9

Defining objects for multimedia systems – Multimedia data interface standards –
 Multimedia databases- Compression and decompression– Data and file format
 standards – Multimedia I/O technologies – Digital voice and audio – Video image
 and animation – Full motion video – Storage and retrieval technologies.

UNIT-III HYPERMEDIA 9

Multimedia authoring and user interface - Hypermedia messaging -Mobile
 messaging – Hypermedia message component – Creating hypermedia message –
 Integrated multimedia message standards – Integrated document management –
 Distributed multimedia systems. CASE STUDY: Blender graphics and
 Fundamentals – Drawing Basic Shapes – Modelling – Shading & Textures.

UNIT-IV AUGMENTED REALITY 9

Working with AR techniques, compatibility with the environment, system architecture, AR terminology, application areas of AR, Integration of AR toolkits with existing IDE's (Unity-Vuforia, Visual Studio, Netbeans, IntelliJ IDEA, Android, iOS), connectivity of smart devices with AR.

UNIT-V VIRTUAL REALITY 9

Integration of VR techniques, Contents objects and scale, Gaze Based Control, Handy Interactables, IDE setup with package files, concepts and features of VR, VR project example

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, students will be able to

1. Understand and explain the fundamental concepts of multimedia and its components.
2. Design and handle multimedia systems and files.
3. Develop and manage hypermedia content and applications.
4. Apply augmented reality techniques and integrate AR toolkits with various IDEs.
5. Develop virtual reality content and understand its applications and features.

TEXT BOOKS:

1. Multimedia: Making It Work (8th Edition) by Tay Vaughan and Fundamentals of Multimedia by Ze-Nian Li and Mark S. Drew Publisher, (Unit I & II)
2. Yvonne, B., & Alistair, G. (1997). Multimedia and Hypertext: The Internet and Beyond. MIT Press. (Unit 3)
3. Dieter Schmalstieg and Tobias Hollerer, "Augmented Reality: Principles and Practice," Addison-Wesley Professional, 2016. (Unit 4)
4. Understanding Virtual Reality: Interface, Application, and Design (2nd Edition) by William R. Sherman and Alan B. Craig Publisher: Morgan Kaufmann, (Unit 5)

REFERENCE BOOKS:

1. Li, Z., Drew, M., & Liu, J. (2004). Fundamentals of Multimedia. Pearson. Judith Jeffcoate, "Multimedia in practice: Technology and Applications", PHI, 1998.
2. Furht, B. (Ed.). (1998). Handbook of Multimedia Computing. CRC Press.
3. Billinghurst, M., Clark, A., & Lee, G. (2015). A Survey of Augmented Reality. Foundations and Trends® in Human-Computer Interaction, 8(2-3), 73-272.
4. Sherman, W. R., & Craig, A. B. (2018). Understanding Virtual Reality: Interface, Application, and Design (2nd ed.). Morgan Kaufmann

List of Open Source Software/ Learning website:

1. Tay Vaughan, "Multimedia: Making It Work," Tata McGraw-Hill, 2008.
2. Ze-Nian Li and Mark S. Drew, "Fundamentals of Multimedia," Pearson Education, 2004.
3. Gaurav Bhatnagar and Shikha Mehta, "Introduction to Multimedia Systems," Cambridge University Press, 2000.
4. Tony Parisi, "Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile," O'Reilly Media, 2015

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	-	1	1	-	-	-	2	3	1	3	2	1
2	1	-	2	-	3	3	-	-	-	3	3	1	1	-	2
3	3	2	2	-	2	1	1	1	1	1	1	1	3	2	2
4	3	3	3	-	2	1	1	1	1	1	1	1	3	3	3
5	3	3	3	-	3	1	1	1	1	1	1	1	3	3	3
AVG.	2.6	2.4	2.4	-	2.2	1.4	1.0	1.0	1.0	1.6	1.8	1.0	2.6	2.0	2.3

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

OIT102	3D PRINTING AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To develop CAD models for 3D printing.
- To import and export CAD data and generate STL file.
- To select a specific material for the given application.
- To select a 3D printing process for an application.
- To produce a product using 3D printing or Additive Manufacturing (AM).

UNIT-I 3D PRINTING (ADDITIVE MANUFACTURING) 9

Introduction, The Generic AM Process, Classification of AM Process, Advantages, Additive V/s Conventional Manufacturing processes, Applications- the Benefits of AM.

UNIT-II CAD FOR ADDITIVE MANUFACTURING 9

Steps in Additive Manufacturing-Variation from one AM Machine to another- Application Areas That Don't Involve Conventional CAD Modeling-CAD Tools for AM -Preparation of CAD Models: The STL File, STL File Format, Binary/ASCII, Creating STL Files from a CAD System -Problems with STL Files.

UNIT-III ADDITIVE MANUFACTURING TECHNIQUES 9

Stereo- Lithography, LOM, FDM, SLS, SLM, Binder Jet technology. Process, Process parameter, Process, Selection for various applications. Additive Manufacturing Application Domains: Aerospace, Electronics, HealthCare, Defence, Automotive, Construction, Food Processing, Machine Tools.

UNIT-IV MATERIALS 9

Polymers, Metals, Non-Metals, Ceramics. Various forms of raw material – Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties. Support Materials.

UNIT-V ADDITIVE MANUFACTURING EQUIPMENT AND POST 9 **PROCESSING**

Process equipment- design and process parameters, Governing bonding mechanism, Common faults and troubleshooting, Process design, Post processing: requirement and techniques, Product quality, Inspection and testing, Defects and their causes.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, students will be able to

1. Develop CAD models for 3D printing.
2. Import and Export CAD data and generate. STL file.
3. Select a specific material for the given application.
4. Select a 3D printing process for an application.
5. Produce a product using 3D Printing or Additive Manufacturing (AM).

TEXT BOOKS:

1. 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. (Unit I & II)
2. Ian Gibson, David W. Rosen and Brent Stucker “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, 2nd edition, Springer., United States, 2015, ISBN13: 978-1493921126. (Unit II to V).

REFERENCE BOOKS:

1. Khanna Editorial, “3D Printing and Design”, Khanna Publishing House, Delhi.
2. CK Chua, Kah Fai Leong, “3D Printing and Rapid Prototyping- Principles and Applications”,World Scientific, 2017.
3. J.D. Majumdar and I. Manna, “Laser-Assisted Fabrication of Materials”, Springer SeriesIn Material Science, 2013.
4. L. Lu, J. Fuh and Y.S. Wong, “Laser-Induced Materials and Processes for Rapid Prototyping”,Kulwer Academic Press, 2001.
5. Zhiqiang Fan And Frank Liou, “Numerical Modelling of the Additive Manufacturing (AM)Processes of Titanium Alloy”, InTech, 2012.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	-	2	-	-	-	-	-	-	-	-	2	-	-	-	-
2	-	2	3	-	2	-	-	-	-	-	-	2	-	-	-	-
3	-	-	2	2	-	-	-	-	-	-	-	-	-	-	3	2
4	-	-	-	3	2	-	-	-	-	-	2	-	-	-	3	2
5	-	-	2	3	2	-	-	-	-	-	-	-	-	-	2	1
AVG.	2	2	2.2	2.6	2	-	-	-	-	-	2	2	-	-	2.6	1.6

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

COURSE OBJECTIVES:

- Design static web page using Markup languages.
- Design and implement web pages using style sheets.
- Implement with java script web applications with dynamic web pages.
- Understand working of Web servers and Design Methodologies with MVC Architecture.
- Develop web applications using XML

UNIT-I INTRODUCTION TO WEB FRAMEWORKS 9

Basics of web development – Overview of web frameworks - MVC architecture - Popular web frameworks: Django, Flask, Ruby on Rails, Laravel, Express.js - Benefits of using web frameworks.

UNIT-II CLIENT- SIDE FRAMEWORKS 9

Introduction to client-side frameworks - React.js: Components, JSX, State and Props, Lifecycle Methods - Angular: Modules, Components, Services, Directives, Data Binding - Vue.js: Vue instance, Templates, Components, Vue Router.

UNIT-III SERVER - SIDE FRAMEWORKS 9

Introduction to server-side frameworks - Django: Models, Views, Templates, Forms, Admin Interface - Flask: Routing, Templates, WTFForms, SQLAlchemy - Node.js with Express.js:Middleware, Routing, Templating, REST APIs.

UNIT-IV DATABASE INTEGRATION 9

Database fundamentals - SQL vs NoSQL databases - ORM (Object-Relational Mapping) concepts - Integrating databases with Django (using Django ORM) - Integrating databases with Flask (using SQLAlchemy) - Integrating databases with Node.js using Mongoose for MongoDB.

UNIT-V FULL-STACK DEVELOPMENT 9

Overview of full-stack development - RESTful APIs and Web Services - Authentication and Authorization - Deployment and Hosting - Case Studies: Building a full-stack application with React and Django/Node.js.

COURSE OUTCOMES:

At the end of this course, students will be able to

1. Understand the fundamental concepts and architecture of web frameworks.
2. Develop web applications using client-side frameworks.
3. Build dynamic server-side applications with popular server-side frameworks.
4. Integrate databases and manage data within web applications.
5. Implement full-stack web applications combining client side and server-side technologies.

TEXT BOOKS:

1. "Web Development with Node and Express: Leveraging the JavaScript Stack" by Ethan Brown (Unit 1,3,4,5)
2. "Django for Beginners: Build websites with Python and Django" by William S. Vincent (Unit 1,3,5)
3. "Learning React: A Hands-On Guide to Building Web Applications Using React and Redux" by Kirupa Chinnathambi (Unit 2,5)

REFERENCE BOOKS:

1. "Flask Web Development: Developing Web Applications with Python" by Miguel Grinberg (Unit 3,4)
2. "Pro Angular 9: Build Powerful and Dynamic Web Apps" by Adam Freeman (Unit 2)
3. "Full-Stack Vue.js 2 and Laravel 5: Bring the frontend and backend together with Vue, Vuex, and Laravel" by Anthony Gore (Unit 1,5)

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	2	3	-	-	-	-	2	1	2	3	2	2	-
2	2	3	3	2	3	-	-	-	2	3	2	2	3	2	3	-
3	2	3	3	3	3	-	-	-	2	2	2	2	3	2	3	-
4	2	2	3	2	3	-	-	-	2	2	1	2	3	3	3	-
5	2	3	3	3	3	-	-	-	2	3	3	2	3	3	3	-
AVG.	2.2	2.6	2.8	2.4	3	-	-	-	1.6	2.4	1.8	2	3	2.4	2.8	-

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

COURSE OBJECTIVES

1. To introduce the underlying principles of operations in different Refrigeration & Air conditioning systems and components.
2. To provide knowledge on design aspects of Refrigeration & Air conditioning systems.
3. To study the Vapour absorption and air refrigeration systems.
4. To learn the psychrometric properties and processes.
5. To study the air conditioning systems and load estimation.

UNIT – I INTRODUCTION**9**

Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable properties – Classification - Nomenclature - ODP & GWP.

UNIT – II VAPOUR COMPRESSION REFRIGERATION SYSTEM**9**

Vapor compression cycle: p-h and T-s diagrams - deviations from theoretical cycle – subcooling and super heating- effects of condenser and evaporator pressure on COP- multipressure system -low temperature refrigeration - Cascade systems – problems. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators.

UNIT – III OTHER REFRIGERATION SYSTEMS**9**

Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration – Magnetic Vortex and Pulse tube refrigeration systems.

UNIT – IV PSYCHROMETRIC PROPERTIES AND PROCESSES**9**

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.

UNIT – V AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION**9**

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system; Filters; Air

Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls.

TOTAL:45 PERIODS

OUTCOMES:

At the end of the course the students would be able to

1. Explain the basic concepts of Refrigeration
2. Explain the Vapor compression Refrigeration systems and to solve problems
3. Discuss the various types of Refrigeration systems
4. Calculate the Psychrometric properties and its use in psychrometric processes
5. Explain the concepts of Air conditioning and to solve problems

TEXT BOOKS:

1. Arora, C.P., "Refrigeration and Air Conditioning", 3rd edition, McGraw Hill, New Delhi, 2010
2. Textbook of Refrigeration And Air-Conditioning (M.E.)by R.S. Khurmi | 10 February 2019

REFERENCES:

1. ASHRAE Hand book, Fundamentals, 2010
2. JonesW.P., "Air conditioning engineering", 5th edition, Elsevier Butterworth-Heinemann, 2007

OME101	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	2	1	1	1			2		1			1	2	2
CO 2	2	1	1	1			2		1			1	2	2
CO 3	2	1	1	1			2		1			1	2	2
CO 4	2	1	1	1			2		1			1	2	2
CO 5	2	1	1	1			2		1			1	2	2
Average	2	1	1	1			2		1			1	2	2

(1 – LOW, 2-MEDIUM, 3-HIGH)

OME102	ADVANCED MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3

OBJECTIVES:

The main learning objective of this course is:

1. To describe the concepts of various metal casting processes.
2. To demonstrate the concepts of various metal joining processes.
3. To describe unconventional machining processes
4. To demonstrate thermal and electrical based processes.
5. To describe the chemical and electrochemical-based process parameters, their influence on performance, and their application.

UNIT-I: METAL CASTING 9

Casting terminology, pattern material, allowance; Pattern types: Single piece, split, gated; Core prints, moulding sand properties, design of patterns, moulds and cores; solidification and cooling; riser and gating design. Melting furnaces: Blast and Cupola Furnaces; Principle of special casting processes: Shell - investment - Ceramic mould - Pressure die casting - Centrifugal Casting - Stir casting; Defects in Sand casting

UNIT-II: JOINING PROCESSES 9

Operating principle, basic equipment, merits and applications of fusion welding processes: Gas welding - Types - Flame characteristics; Manual metal arc welding - Gas Tungsten arc welding
- Gas metal arc welding - Submerged arc welding - Electro slag welding; Operating principle and applications of resistance welding - Plasma arc welding - Thermit welding - Electron beam welding - Friction welding and Friction Stir Welding. brazing, soldering and adhesive bonding; Weld defects: types, causes and cure.

UNIT-III: MECHANICAL ENERGY BASED PROCESSES 9

Unconventional machining Process – Need – classification – merits, demerits and applications. Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining – Ultrasonic Machining - (AJM, WJM, AWJM and USM) - Working Principles – equipment used – Process parameters – MRR- Applications.

UNIT-IV: THERMAL AND ELECTRICAL ENERGY BASED PROCESSES 9

Electric Discharge Machining (EDM) – Wire cut EDM – Working Principle-equipment - Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits- Tool Wear –Dielectric – Flushing – Applications. Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM) – Working Principles – Equipment –Types – Beam control techniques – Applications.

UNIT-V: CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES 9

Chemical machining and Electro-Chemical machining (CHM and ECM) - Etchants – Maskant – techniques of applying maskants - Process Parameters – Surface finish and MRR-Applications. Principles of ECM- Equipment -Surface Roughness and MRR Electrical circuit -Process Parameters ECG and ECH – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of this course, the students will be able to:

1. Understand the various metal casting processes.
2. Understand the various metal joining techniques.
3. Describe the unconventional machining processes and the mechanical processes.
4. Understand the thermal and electrical-based processes.
5. Understand the chemical and electrochemical-based process parameters, their influence on performance, and their application.

TEXTBOOKS:

1. Serope Kalpakjian, Steven R.Schmid, “Manufacturing Engineering and Technology”, Pearson Education, Eighth Edition, 2020.
2. P.N. Rao, “Manufacturing Technology: Foundry, Forming and Welding – Volume 1”, Tata McGraw-Hill Publishing Limited, 2019.

REFERENCE BOOKS:

1. P.C. Sharma, "A text book of Production Technology (Manufacturing Processes)",
S. Chand and Company, 8th Edition 2014.
2. S.Gowri, P.Hariharan, and A.Suresh Babu, "Manufacturing Technology 1",
Pearson Education, 2020.

E- RESOURCES:

<https://archive.nptel.ac.in/courses/112/107/112107219>

<https://archive.nptel.ac.in/courses/112/105/112105212>

OME102	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2		1		1		1		1	1		1	1	1
CO2	2		1		1		1		1	1		1	1	1
CO3	2		1		1		1		1	1		1	1	1
CO4	2		1		1		1		1	1		1	1	1
CO5	2		1		1		1		1	1		1	1	1
Average	2		1		1		1		1	1		1	1	2

(1-LOW, 2-MEDIUM, 3-HIGH)

OME103	MATERIAL TESTING AND CHARACTERIZATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

The main learning objective of this course is:

1. To describe the phase structure of metals/alloys.
2. To demonstrate the heat treatment process employed for various materials.
3. To describe the classification of ferrous and nonferrous alloys.
4. To describe the Practical exposure towards microstructure of Engineering Materials.
5. To demonstrate the Mechanical testing tools for engineering materials.

UNIT-I: BINARY PHASE DIAGRAM 9

Solid solutions: Substitutional and interstitial – Compound – Phase diagram: Classification - Phase reactions with an example: Isomorphous, eutectic, eutectoid, peritectic and peritectoid, Iron – Iron carbide diagram.

UNIT-II: HEAT TREATMENT PROCESSES 9

Full, stress relief, recrystallization and spheroidizing annealing – normalizing, hardening and tempering of steel –phase transformation - Isothermal transformation (TTT) diagram for Eutectoid Steel – cooling curves - CCR –Hardenability - Jominy end quench test – Austempering - martempering. Case hardening - carburizing, nitriding, cyaniding, carbonitriding, flame and induction hardening

UNIT-III: FERROUS ALLOYS 9

Classification, properties, microstructure, processing and applications of low, medium & high carbon steel & FG, SG, White, Malleable cast iron – effect of alloying elements on steel (Cr, Mo, V, Ti, Ni & W) - stainless steel and tool steels - HSLA steel & Maraging steels – Die steel, Wear of Metals - BIS Specification.

UNIT-IV: NON-FERROUS ALLOYS 9

Properties, Composition, Applications: Copper and its alloys - Brass, Bronze and Cupronickel – Aluminium and its alloys – Duralumin- Bearing alloys. Nickel and Titanium base alloys – Metals for low and high temperature applications- BIS Specification.

UNIT-V: MECHANICAL TESTING**9**

Mechanical properties - stress - strain curve for ferrous and non-ferrous alloys - Mechanism of plastic deformation, slip and twinning – Fracture: types – Griffith theory - Material testing: Tensile, compression and shear loads –Hardness tests: Brinell, Rockwell and Vickers - Impact test: Izod and Charpy - Fatigue and creep tests - fracture toughness tests - Characterization techniques: Optical, SEM, XRD.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

Upon Completion of this course, the students will be able:

1. To recall the phase reactions of various metals and alloys.
2. To have great exposure in the heat treatment processes and know their purpose in engineering applications
3. To have knowledge in the classification, properties and applications of various ferrous alloys.
4. To classification and application of various nonferrous alloy materials.
5. To Identify the various mechanical properties for the ferrous and nonferrous alloys using modern testing facilities.

TEXTBOOKS:

1. Jindal. U.C “Material science and Metallurgy”, Pearson New Delhi, 2015.
2. Selvakumar N, “Engineering Metallurgy and Nanotechnology” Scitech, Publications (India) Pvt. Ltd., 2018

REFERENCE BOOKS:

1. Raghavan.V, “Materials Science and Engineering”, Prentice-Hall, 6th Edition, 2015.
2. William D Callister and David G. Rethwisch, “Material Science and Engineering: An Introduction”, John Wiley, 10th Edition, 2018.

E- RESOURCES:

<https://nptel.ac.in/courses/112108150>

<https://www.digimat.in/nptel/courses/video/113107078/L01.html>

OME103	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	3	1								1	1	1
CO2	3	1	3	1								1	1	1
CO3	3	1	3	1								1	1	1
CO4	3	1	3	1								1	1	1
CO5	3	1	3	1								1	1	1
Average	3	1	3	1								2	1	1

(1-LOW, 2-MEDIUM, 3-HIGH)

OME104	HAZARDOUS WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. At the end of the course the student shall be able to understand the type, nature of hazardous wastes.
2. To study the hazardous wastes management.
3. To study the biomedical waste management.
4. To study the radioactive waste management.
5. To study the E-Waste Management.

UNIT I INTRODUCTION 9

Hazardous waste definition- Regulatory aspects of Hazardous Waste Management in India – Sources, characterization, categories - Analysis of hazardous waste -Physical and biological routes of transport of hazardous substances.

UNIT II HAZARDOUS WASTES MANAGEMENT 9

Handling, collection, storage and transport- TSDF concept -Hazardous waste treatment technologies-Physical, chemical and thermal treatment of hazardous waste–Solidification-Chemical fixation–Encapsulation-Pyrolysis and Incineration–Biological Treatment of Hazardous Waste, Hazardous waste landfills-Site selections-design and operation-HW reduction- Recycling and reuse–Hazardous Site remediation – onsite and offsite Techniques.

UNIT III BIOMEDICAL WASTE MANAGEMENT 9

Biomedical waste–Definition– Regulatory aspects of Biomedical Waste. Sources–Classification– Waste Handling and Collection–Segregation and labeling- Treatment – autoclaving, Incineration, Chemical Disinfection – disposal-Infection control Practices.

UNIT IV RADIOACTIVE WASTE MANAGEMENT 9

Radioactive waste: Definition–Measurement of Radiation -Sources-Effects -Low level and high level radioactive wastes-Transuranic Waste-and their management–Uranium Mine and Tailings, Characterization – Treatment and Control - Radiation standard by ICRP and AERB.

UNIT V E-WASTE MANAGEMENT

9

Regulatory aspects of E-I Waste management, Waste characteristics- Generation-- Collection - Material Composition-Transport-- Treatment and disposal. Recycling and Recovery – intergraded e- waste management

TOTAL: 45 PERIODS

OUTCOMES:

Upon the completion of this course the students will be able to

1. Gain the knowledge of the type, nature hazardous wastes.
2. Ability to plan minimization of hazardous wastes.
3. Ability to handle the bio medical Waste.
4. Ability to handle the radioactive waste.
5. Ability to handle the E- Waste Management.

TEXTBOOKS:

1. Hazardous waste management Charles A. Wentz. Second edition 1995. McGraw Hill international.
2. Hazardous waste management Michael D. La Gerga, Philip L. Buckingham, Jeffrey C. Evans, Second edition 2010. Waveland Press.

REFERENCES:

1. Basic Hazardous waste management, "William C. Blackman Jr", Third Edition, 2001, Lewis Publishers
2. Integrated solid waste management George Tchobanoglous, Hilary Theisen & Samuel A. Vigil.

OME104	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	1				3		1			1	1	2
CO2	2	1	1				3		1			1	1	2
CO3	2	1	1				3		1			1	1	2
CO4	2	1	1				3		1			1	1	2
CO5	2	1	1				3		1			1	1	2
Average	2	1	1				3		1			1	1	2

(1-LOW, 2-MEDIUM, 3-HIGH)

OBJECTIVES:

1. The intention and purpose of this course is to study the basics of electronics, emission controls and its Importance in automobiles.
2. To study the Ignition and Injection system in Automobiles
3. To study the various sensors and actuators used in automobiles for improving fuel economy and emission control.
4. To study the various blocks of mechatronics control units used for control of fuel, ignition and exhaust systems.
5. To learn about different types of chassis and mechatronics safety systems in automobile.

UNIT I INTRODUCTION**9**

Evolution of electronics in automobiles – emission laws – introduction to Euro I, Euro II, Euro III, Euro IV, Euro V standards – Equivalent Bharat Standards. Charging systems: Working and design of charging circuit diagram – Alternators – Requirements of starting system - Starter motors and starter circuits.

UNIT II IGNITION AND INJECTION SYSTEMS**9**

Ignition systems: Ignition fundamentals - Electronic ignition systems - Programmed Ignition – Distribution less ignition - Direct ignition – Spark Plugs. Electronic fuel Control: Basics of combustion – Engine fuelling and exhaust emissions – Electronic control of carburetion – Petrol fuel injection – Diesel fuel injection.

UNIT III SENSOR AND ACTUATORS IN AUTOMOTIVES**9**

Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall effect, Throttle angle, temperature, exhaust gas oxygen sensors – study of fuel injector, exhaust gas recirculation actuators, stepper motor actuator, and vacuum operated actuator.

UNIT IV ENGINE CONTROL SYSTEMS

9

Control modes for fuel control-engine control subsystems – ignition control methodologies – different ECU's used in the engine management – block diagram of the engine management system. In vehicle networks: CAN standard, format of CAN standard – diagnostics systems in modern automobiles

UNIT V CHASSIS AND SAFETY SYSTEMS

9

Traction control system – Cruise control system – electronic control of automatic transmission –

antilock braking system – electronic suspension system – working of air bag and role of MEMS in airbag systems – centralized door locking system – climate control of cars.

TOTAL: 45 PERIODS

OUTCOMES:

Upon the completion of this course the students will be able to

1. Know the importance of emission standards in automobiles.
2. Understand the electronic fuel injection and ignition components and their function.
3. Choose and use sensors and equipment for measuring mechanical quantities temperature and appropriate actuators.
4. Diagnose electronic engine control systems problems with appropriate diagnostic tools.
5. Analyze the chassis and vehicle safety system.

TEXTBOOKS:

1. Ribbens, "Understanding Automotive Electronics", 8th Edition, Elsevier, Indian Reprint, 2017.
2. Barry Hollembeak, "Automotive Electricity, Electronics & Computer Controls", Delmar Publishers, 7th edition, 2019.

REFERENCES:

1. Richard K. Dupuy "Fuel System and Emission controls", Check Chart Publication, 4th edition, 2000.
2. Ronald. K. Jurgon, "Automotive Electronics Handbook", McGraw-Hill, 1999.

OME105	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	1	1						1	1	1	2
CO2	3	2	1	1	1						1	1	1	2
CO3	3	2	1	1	1						1	1	1	2
CO4	3	2	1	1	1						1	1	1	2
CO5	3	2	1	1	1						1	1	1	2
Average	3	2	1	1	1						1	1	1	2

(1-LOW, 2-MEDIUM, 3-HIGH)

(Common to all branches)

OBJECTIVES

- To make the students familiar with the properties and applications of nanomaterials.
- To acquaint the student with the synthesis of nanomaterials by different methods.
- To provide knowledge on the different characterisation techniques employed to characterise the nanomaterials.
- To inculcate the students on the knowledge of nanocomposites, biodegradable polymer-based nanocomposites, and clay polymer nanocomposites.
- To enlighten the needs and utilization of nanomaterials in various fields such as energy, water treatment process, agriculture, electronics, medicine, engineering and Information technology.

UNIT I PROPERTIES OF NANOMATERIALS⁹

Definition – importance of nano structured materials - size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nanomaterials. Surface area - band gap energy and its applications. Photochemistry and electrochemistry of nanomaterials –ionic properties of nanomaterials- Nanocatalysis. Green Materials – biomaterials, biopolymers and bioplastics.

UNIT II SYNTHESIS OF NANOMATERIALS⁹

Bottom-up and top-down approach to obtain nanomaterials. Chemical methods: co-precipitation methods, sol-gel technique, photochemical synthesis. Physical methods: high energy ball milling, PVD methods, gas phase condensation and magnetron sputtering.

UNIT III STRUCTURAL CHARACTERISTICS⁹

Introduction, principles, instrumentation and applications of powder X-ray diffraction, scanning electron microscopy, transmission electron microscopy, scanning probe microscopy, nanoindentation, small angle X-ray and neutron scattering and BET analysis method.

UNIT IV NANOCOMPOSITES⁹

Introduction, the importance of nanocomposites, binary and ternary nanocomposites. Synthesis, properties and applications of metal-metal oxide and metal oxide-metal oxide nanocomposites, biodegradable polymer-based nanocomposites, thermoplastic nanocomposites, nylon-6 nanocomposites, clay polymer nanocomposites.

UNIT V APPLICATIONS OF NANOMATERIALS⁹

Introduction, applications of nanomaterials in renewable energy generation, drug delivery, cosmetics, tissue engineering, bioinformatics, nanomedicine, molecular motors, bioelectronics & spintronics, textiles, cosmetics, agriculture & food technology, high integrated circuits, information technology, defence and aerospace. Practice of nanoparticles for environmental remediation and water treatment.

Total Periods: 45

OUTCOMES

At the end of the course, the student should be able to:

1. Evaluate and understand the different types of nanomaterials and their properties.
2. Understand the proper methods for synthesizing nanomaterials.
3. Recommend the characterization techniques for various nanomaterials.
4. Illustrate the functioning and properties of nanocomposites and their interference.
5. Develop a more profound knowledge on the applications of nanomaterials in various fields.

TEXTBOOKS

1. C. N. R. Rao, Achim Muller, Anthony K. Cheetham, "The Chemistry of Nanomaterials: Synthesis, Properties and Applications", 2nd Edition Wiley-VCH, Germany, 2006.
2. Geoffrey A. Ozin, Andre C. Arsenault, Ludovico Cademartiri, Chad A. Mirkin, "Nanochemistry: A Chemical Approach to Nanomaterials", RSC Publishing, 2nd Edition, United Kingdom, 2008.

7. Azamal Husen, Khwaja Salahuddin Siddiqi, "Advances in Smart Nanomaterials and their Applications (Micro and Nano Technologies)", 1st Edition, Elsevier, Netherlands, 2023.

REFERENCES

1. William A Goddard "Handbook of Nanoscience, Engineering and Technology", 3rd Edition, CRC Taylor and Francis, United Kingdom, 2012.
2. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties & Applications", Imperial College Press, London, 2004.
3. N. Kumar, "Concise concepts of nanoscience and nanomaterials", Scientific publishers, New Delhi, 2019.
4. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, Hyderabad, 2018.
5. Korada, Viswanatha Sharma, Hamid, Nor Hisham, Engineering Applications of Nanotechnology: From Energy to Drug Delivery, Springer, United States, 2017.

Course Outcomes	PROGRAM OUTCOMES												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	2	-	-	-	-	-	-	-	-	1	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
CO4	2	1	1	1	-	1	-	1	-	-	-	1	-	-	-	-
CO5	2	1	1	1	1	1	-	1	-	-	-	1	-	-	-	-
AVG	2	0.6	0.8	0.4	0.2	0.2	-	0.2	-	-	-	0.8	-	-	-	-

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

OBJECTIVES:

- To understand the sensors and actuators
- To facilitate the knowledge about photoactive functional soft materials
- To enrich the idea of Functional magnetic materials
- To explore bio mimics, bionics and biomineralization
- To enhance the fundamental knowledge about Energy Functional materials and molecular Electronics

UNIT I FUNCTIONAL MATERIALS FOR SENSORS AND ACTUATORS 9

Introduction of sensors - differences between transducers, Sensors and Actuators- Conducting polymers sensor materials- Conducting polymer FET sensor - Chemi resistive sensor. Introduction of actuators and its working principle - Electrochromic and Electroactive Polymer actuators: Wet and Dry Electroactive polymer actuators (EAP).

UNIT II PHOTOACTIVE FUNCTIONAL SOFT MATERIALS 9

Introduction - soft materials-photo thermal effect-photo isomerisation-photo switches - opto fluidics. micro soft robotics-light driven micro pumps and micro mixers – Photo acutuation. Photo tunable photonic crystals-photo patterning and alignment. Optical control in a chiral photo magnet.

UNIT III FUNCTIONAL MAGNETIC MATERIALS 9

Magneto caloric effect-magnetic cooling and heating-Magneto caloric materials for heat pumping applications. Soft magnetic wires for sensor applications-Magnetic bistability and domain wall propagation. slow magnetic relaxation-magnetic molecular materials - single molecule magnets-single ion magnets - single chain magnets - molecular spin qubits.

UNIT IV ENERGY MATERIALS AND MOLECULAR ELECTRONICS 9

Electro chemical capacitor - super capacitors for energy storage - single junction solar cell- Tandem solar cell - Dye sensitized solar cells – Quantum dot solar cell - Organic solar cells –

Semiconductor nanostructures. Superconductors for energy storage systems and transportation. Organic electronics- Organic LED – spintronics - dilute magnetic semiconductors.

UNIT V BIO-INSPIRED MATERIALS 9

Bio-inspired materials, Classification, Biomimics, Spider Silk, Lotus Leaf, Gecko feet, Synovial fluid, 'Bionics' - Bio-inspired Information Technologies, Artificial Sensory Organs, Biomineralization-En route to Nanotechnology; Biometals – bioceramics- bio synthetic polymers.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course,

- The students will gain knowledge on the basics of conducting polymer sensors, actuators and FET sensors.
- The students will have adequate knowledge on the soft materials, and micro soft robotics.
- The students will have knowledge on the concepts Magneto caloric effect, magnetic cooling and heating.
- The students will understand the basics of Bio-inspired materials and Bio-inspired Information Technologies
- The students will get knowledge on electro chemical capacitor and spintronics.

TEXT BOOKS:

1. Hasse Fredriksson, KTH Stockholm, Sweden and Ulla Åkerlind University of Stockholm, Sweden 'Physics of Functional Materials' John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England, 2008.
2. S Banerjee, A.K. Tyagi, 'Functional Materials- Preparation, Processing and Applications' Elsevier , 2011.

3. Chander Prakash, Sunpreet Singh, J. Paulo Davim, 'Functional and Smart Materials', CRC Press, 2020.
4. Arcady Zhukov, 'Novel Functional Magnetic Materials- Fundamentals and Applications', Springer International Publishing, 2016.
5. Insup Noh, 'Biomimetic Medical Materials- From Nanotechnology to 3D Bioprinting', Springer Singapore, 2018.

REFERENCE BOOKS:

1. Quan Li, 'Photoactive Functional Soft Materials Preparation, Properties, and Applications' Wiley-VCH, 2019.
2. Hee-Gweon Woo, Hong Li, 'Advanced Functional Materials', Springer, 2011.
3. Rupitsch, Johann, S., Piezoelectric Sensors and Actuators. Springer-Verlag Berlin Heidelberg, 2018.
4. G. Arthanareeswaran, Pei Sean Goh, S. A. Gokula Krishnan, 'Functional Polymers and Nanomaterials for Emerging Membrane Applications', CRC Press, 2023.

Course Outcomes	PROGRAM OUTCOMES												PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	2	-	-	1	1	-	-	-	-	1	-	-	-	-
2	3	2	2	1	2	1	1	-	-	-		1	-	-	-	-
3	3	2	1	1	2	1	1	-	-	-	-	1	-	-	-	-
4	3	2	2	1	1	1	1	-	-	-	-	1	-	-	-	-
5	3	2	1	1	1	1	1	-	-	-	-	1	-	-	-	-
Avg	3	1.8	1.6	1	1.5	1	1	-	-	-	-	1	-	-	-	-

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

MINOR DEGREE COURSES

VERTICAL 1: FINTECH AND BLOCKCHAIN

BAM101

FINANCIAL MANAGEMENT

LTPC

3 0 0 3

COURSE OBJECTIVES

1. To acquire the knowledge of the decision areas in finance.
2. To learn the various sources of Finance.
3. To describe about capital budgeting and cost of capital.
4. To discuss on how to construct a robust capital structure and dividend policy.
5. 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 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

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 - Working capital operating cycle. Cash Management: Motives for holding cash – Objectives and Strategies of Cash Management. Receivables Management: Objectives - Credit policies.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will have an understanding on Time value of money and role of a finance manager.
2. Students will be able to analyze the various avenues available to generate long term funds for investments through capital markets and other sources.
3. Students will be able to apply various techniques for Investment decisions.
4. Students will be able to choose the right approach for financing and dividend decisions to solve business issues.
5. Students will be able to analyze the requirement and management of working capital.

REFERENCES

1. M.Y. Khan and P.K. Jain Financial Management, text, problems and cases Tata McGraw Hill, 8th edition 2017.
2. I.M. Pandey Financial Management, Vikas Publishing House Pvt. Ltd., 11th edition, 2018.
3. Prasanna Chandra, Financial Management – Theory and Practice, 9th edition, Tata McGraw Hill, 2017.
4. Rajiv Srivastava and Anil Misra Financial Management, Oxford University Press, 2011.
5. Parasuraman, N.R Financial Management: a step-by-step approach, 2nd edition; Cengage Learning India Pvt. Ltd., 2019.

COURSE OBJECTIVES

1. To describe the investment environment and understand the factors influencing investment decisions.
2. To explain the methods of valuing bonds and equities.
3. To examine various approaches used in the valuation of securities.
4. To understand the principles of portfolio construction and the role of diversification in creating efficient portfolios.
5. To discuss the mechanisms of investor protection in India, including regulatory frameworks and investor rights.

UNIT I THE INVESTMENT ENVIRONMENT 9

The investment decision process, Types of Investments – Commodities, Real Estate and Financial Assets, the Indian securities market, the market participants and trading of securities, security market indices, sources of financial information, Concept of return and risk, Impact of Taxes and Inflation on return.

UNIT II FIXED INCOME SECURITIES 9

Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, default risk and credit rating. Yield Measures: Current Yield, Yield to Maturity (YTM), Yield to Call (YTC) Money Market Instruments (Treasury Bills, Certificates of Deposit, Commercial Paper). Credit Rating Agencies in India (CRISIL, ICRA, CARE, India Ratings)

UNIT III APPROACHES TO EQUITY ANALYSIS 9

Introduction to Fundamental Analysis, Technical, Analyze macroeconomic indicators: GDP, interest rates, inflation, etc. Sector and industry analysis (Porter's Five Forces). 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. Concept of Fair Disclosure and Transparency. Sustainable Investing and ESG.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will understand basic investment concepts and their significance, and analyze various investment avenues including stocks, bonds, mutual funds, real estate, commodities, and financial derivatives.
2. Students will evaluate risk and return profiles of different investment options using appropriate tools and techniques, and interpret market trends and economic indicators to make informed investment decisions.
3. Students will be able to apply principles of portfolio construction and management to optimize investment returns.
4. Students can able to develop a long-term investment strategy aligned with financial goals and risk appetite.
5. Students can able to explain the regulatory framework for investor protection in India and the principles of sustainable and ethical investing.

REFERENCES

1. Pinto, J. E., Henry, E., Robinson, T. R., & Stowe, J. D. Equity Asset Valuation (4th ed.). Wiley India 2023.
2. Chandra, P. Fundamentals of Investment (Revised ed.). McGraw-Hill Education 2022.
3. Mishkin, F. S., & Eakins, S. G. Financial Markets and Institutions (9th ed., Indian adaptation by Aparna Pujari 2021.
4. Sundaresan, S. Fixed Income Securities (4th ed.). McGraw-Hill Education 2021.
5. Graham, B., & Dodd, D. Security Analysis (7th ed.). McGraw-Hill Education 2020.

COURSE OBJECTIVES

1. To understand the Banking system in India.
2. To grasp how banks, raise their sources and how they deploy it.
3. To understand the development in banking technology.
4. To understand the financial services in India.
5. To 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 :45 PERIODS

COURSE OUTCOMES

1. Students will be able to identify and describe the roles and interrelationship of institutions in the banking, financial services, and insurance sectors.
2. Students will understand key functions such as deposits, loans, credit creation, and payment systems in both commercial and central banking.
3. Students will analyze various products such as savings accounts, fixed deposits, mutual funds, credit cards, and insurance policies.
4. Students will demonstrate an understanding of the regulatory environment, including acts, guidelines, and the roles of RBI, SEBI, IRDAI, etc.
5. Students will assess the impact of digital banking, and e-insurance services on customer experience and operational efficiency.

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.
4. Indian Financial System M. Y. Khan, McGraw Hill Education, 2019 10th Edition.
5. Financial Markets and Institutions, L. M. Bhole & Jitendra Mahakud, McGraw Hill Education, 2021 6th Edition.

COURSE OBJECTIVES:

- To understand Blockchain's fundamental components, and examine decentralization using blockchain.
- To explain how cryptocurrency works, from when a transaction is created to when it is considered part of the Blockchain.
- To explain the components of Ethereum and Programming Languages for Ethereum.
- To study the basics of Hyperledger and Web3.
- To know about alternative Blockchains and Blockchain projects in different domains.

UNIT I INTRODUCTION TO BLOCKCHAIN 9

History of Blockchain – Types of Blockchain – Consensus – Decentralization using Blockchain – Blockchain and Full Ecosystem Decentralization – 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.

UNIT III ETHEREUM 9

The Ethereum Network – Components of Ethereum Ecosystem – Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols – Solidity Language.

UNIT IV WEB3 AND HYPERLEDGER 9

Introduction to Web3 – Contract Deployment – POST Requests – Development Frameworks – Hyperledger as a Protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger – Corda.

UNIT V ALTERNATIVE BLOCKCHAINS AND NEXT EMERGING TRENDS 9

Kadena – Ripple – Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous Tools.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the students will be able to:

1. Understand the technology components of Blockchain and how it works behind the scenes.
2. Understand Bitcoin and its limitations by comparing with other alternative coins.
3. Devise solution using the Ethereum model.
4. Understand and use Hyperledger and its development framework.
5. Track alternative Blockchains and emerging trends in Blockchain.

TEXTBOOK:

1. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Second Edition, Packt Publishing, 2018.

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, “Blockchain Applications: A Hands On Approach”, VPT, 2017.
2. Andreas Antonopoulos, Satoshi Nakamoto, “Mastering Bitcoin”, O’Reilly, 2014.
3. Roger Wattenhofer, “The Science of the Blockchain” CreateSpace Independent Publishing, 2016.
4. A. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press, 2016.
5. Alex Leverington, “Ethereum Programming” Packt Publishing, 2017.

CSM101	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	-	1	-	-	3	-	-	1	-	-	3	-	-	-
CO2	-	3	3	-	-	-	-	3	3	-	-	-	-	3	-	-
CO3	-	-	3	1	-	-	-	-	3	1	-	-	-	-	3	-
CO4	3	-	-	-	-	-	3	-	-	-	-	-	1	1	-	-
CO5	-	-	-	-	3	-	-	-	-	-	3	-	2	3	1	3
CON	3	3	3	1	3	-	3	3	3	1	3	-	2	2.3	2	3

COURSE OBJECTIVES

1. To introduce the foundational concepts of Financial Technology (FinTech) and its applications in personal finance, inclusive finance, and digital financial services.
2. To familiarize students with digital payment systems and cryptocurrencies, including their underlying technologies, security concerns, and legal frameworks.
3. To provide insights into InsurTech innovations, focusing on the integration of AI, ML, and IoT in risk management, underwriting, and fraud detection in insurance.
4. To enable understanding of peer-to-peer lending models and crowdfunding ecosystems, with a focus on digital infrastructure and financing solutions for SMEs and MSMEs.
5. To develop awareness of global and domestic FinTech regulations, and the emergence of RegTech as a tool for ensuring regulatory compliance and fraud monitoring using AI.

UNIT I INTRODUCTION TO FINTECH AND DIGITAL FINANCE**9**

Overview of FinTech: Definition, scope, applications. History of Financial Innovation and Digitization. Alternative Finance: Crowdfunding – Types (Charity, Equity), platforms. Introduction to Initial Coin Offering (ICO). Role of FinTech in personal finance and inclusive finance.

UNIT II DIGITAL PAYMENTS AND CRYPTOCURRENCIES**9**

Introduction to Cryptocurrencies: Bitcoin and Applications. Types of Cryptocurrencies and Digital Wallets. Basics of Blockchain Technology. National Payment Systems: Real-Time Gross Settlement (RTGS), Immediate Payment Service (IMPS), Unified Payments Interface (UPI). Digital Payments: Smart Cards, Mobile Payments, Payment Gateways, Virtual Currencies. Legal, Security, Privacy, and Ethical Issues in Digital Transactions.

UNIT III INSURTECH AND DIGITAL INSURANCE INNOVATIONS**9**

Introduction to InsurTech. Role of (Artificial Intelligence (AI), Machine Language (ML), and Internet of Things (IoT) in insurance services. Risk Modelling, Fraud Detection. Innovations in Claims Processing and Underwriting. Impact on traditional insurance business models.

UNIT IV P2P LENDING AND FINANCIAL INCLUSION**9**

Peer-to-Peer (P2P) and Marketplace Lending. Architecture and Technology Platforms. Crowdfunding Unicorns and Business Models. Financing for SME/MSME – Opportunities, Challenges, and FinTech Solutions.

UNIT V FINTECH REGULATIONS AND REGTECH

9

Global and Indian FinTech Regulations. Legal and Regulatory Risks. RegTech: Definition, Evolution. RegTech Ecosystem – Institutions, Startups, Regulators. Role of AI in Compliance and Fraud Monitoring.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students can able to explain the fundamentals of cryptocurrencies, digital wallets, blockchain and payment systems such as UPI, RTGS, and IMPS, along with related security and regulatory aspects.
2. Students will describe the evolution of digital finance and analyze alternative finance models like crowdfunding and Initial Coin Offerings (ICO).
3. Students will evaluate the role of AI, ML, and IoT in InsurTech applications such as underwriting, claims processing, risk modeling, and fraud detection.
4. Students will analyze P2P lending and crowdfunding platforms, infrastructure, and innovations for SME/MSME financing.
5. Students will interpret FinTech regulations and assess the role of RegTech and AI in ensuring compliance and detecting fraud.

REFERENCES

1. Swanson, Seth Fintech for Beginners: Understanding and Utilizing the Power of Technology. Create Space Independent Publishing Platform 2016.
2. Tanda, Alessandra & Schena, Cristiana-Maria FinTech, BigTech and Banks: Digitalisation and Its Impact on Banking Business Models. Springer 2019.
3. Diedrich, Henning Ethereum : Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations. Wildfire Publishing 2016.
4. William, Jacob Fin Tech: The Beginner's Guide to Financial Technology. Create Space Independent Publishing Platform 2016.
5. Indian Institute of Banking and Finance (IIBF) Digital Banking. Taxmann Publications 2016.

COURSE OBJECTIVES

1. To learn about history, importance and evolution of Fintech
2. To acquire the knowledge of Fintech in payment industry
3. To acquire the knowledge of Fintech in insurance industry
4. To learn the Fintech developments around the world
5. 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: 45 PERIODS

COURSE OUTCOMES

1. Students can able to understand and describe the historical phases of FinTech.
2. Students can able to recognize how FinTech is revolutionizing payments, lending, wealth tech, insurance, and emerging sectors across different regions.
3. Students can able to understand the nuances of fintech in wealth management industry.
4. Students can able to compare major FinTech hubs and understand strategic collaborations between traditional financial institutions and tech firms.
5. Students will understand the future of fintech.

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

COURSE OBJECTIVES

1. To develop and strengthen the entrepreneurial quality and motivation of learners.
2. To impart the entrepreneurial skills and traits essential to become successful entrepreneurs.
3. To apply the principles and theories of entrepreneurship and management in Technology oriented businesses.
4. To empower the learners to run a Technology driven business efficiently and effectively.
5. To cultivate entrepreneurial skills, increase awareness of entrepreneurship, and foster a culture of innovation and job creation.

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 – Barriers to Entrepreneurship– 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- Managing Techno Stress – Eustress and Distress – Coping Strategies of Techno Stress.

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:45 PERIODS

COURSE OUTCOMES

1. Students will be able to learn the basics of Entrepreneurship.
2. Students can understand the business ownership patterns and environment.
3. Students can understand the Job opportunities in Industries relating to Technopreneurship.
4. Students will learn about applications of technopreneurship and successful technopreneurs.
5. Students will acquaint with the recent and emerging trends in entrepreneurship.

REFERENCES

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.
3. Daniel Mankani. Technopreneurship: The successful Entrepreneur in the new Economy. Prentice Hall 2003.
4. Edward Elgar. Entrepreneurship, Cooperation and the Firm: The Emergence and Survival of High-Technology Ventures in Europe. Edi: Jan Ulijn, Dominique Drillon, and Frank Lasch. Wiley Pub 2007.
5. Lang,J.TheHigh-TechEntrepreneur'sHandbook,Ft.com 2002.

COURSE OBJECTIVES

1. To develop and strengthen the Leadership qualities and motivation of learners.
2. To impart the Leadership skills and traits essential to become successful entrepreneurs.
3. To apply the principles and theories of Team Building in managing Technology oriented businesses.
4. To empower the learners to build robust teams for running and leading a business efficiently and effectively.
5. To emphasize the importance of ethics and values in leadership practices.

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 – Effective Communication in Leadership - 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 – Change Management - Role of Ethics and Values in Organisational Leadership.

UNIT V LEADERSHIP EFFECTIVENESS

9

Leadership Behaviour - Assessment of Leadership Behaviors - Destructive Leadership - Motivation and Leadership – Motivation and Employee Engagement - Managerial Incompetence and Derailment Conflict Management - Negotiation and Leadership - Culture and Leadership - Global Leadership – Recent Trends in Leadership.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will learn the basics of managing teams for business.
2. students will understand developing effective teams for business management.
3. Students will understand the fundamentals of leadership for running a business.
4. Students will learn about the importance of leadership for business development.
5. Students will acquaint with emerging trends in leadership effectiveness for entrepreneurs.

REFERENCES

1. "Leadership and Team Building" by Uday Kumar Haldar, First Edition, Oxford University Press, New Delhi 2010.
2. "The Five Dysfunctions of a Team: A Leadership Fable" by Patrick Lencioni, 20th Anniversary Edition, Jossey-Bass 2002.
3. Hughes, R.L, Ginnett, R.C., & Curphy, G.J., Leadership: Enhancing the lessons of experience, 9th Ed, McGraw Hill Education, Chennai, India. 2019.
4. Katzenback, J.R., Smith,D.K., The Wisdom of Teams: Creating the High Performance Organisations, Harvard Business Review Press, 2015.
5. Haldar, U.K., Leadership and Team Building, Oxford University Press, 2010.

COURSE OBJECTIVES

1. To develop the creativity skills among the learners.
2. To impart the knowledge of creative intelligence essential for entrepreneurs.
3. To impart the knowledge of Innovation in Industries.
4. To know the applications of innovation in entrepreneurship.
5. To develop innovative business models for business.

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 - Creativity Training.

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- Inbound and Outbound Ideation-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: 45 PERIODS

COURSE OUTCOMES

1. Students will learn the basics of creativity for developing Entrepreneurship
2. Students will understand the importance of creative intelligence for business growth
3. Students will understand the advances through Innovation in Industries
4. Students will learn about applications of innovation in building successful ventures
5. Students will acquaint with developing innovative business models to run the business efficiently and effectively

REFERENCES

1. Creativity and Innovation in Entrepreneurship, Kankha, Sultan Chand & Sons, 2021.
2. Innovation Management, C.S.G. Krishnama charyulu, R. Lalitha, Himalaya Publishing House, 2nd edition, 2017.
3. Paul Trott, Innovation Management and New Product Development, 4e, Pearson, 2018.
4. A. Dale Timpe, Creativity, Jaico Publishing House, 2003. Brian Clegg, Paul Birch, Creativity, Kogan Page, 2009.
5. Tidd, J., & Bessant, J. Managing innovation: Integrating technological, market and organizational change. UK: Wiley 2020.

COURSE OBJECTIVES

1. To provide basic knowledge of concepts, principles, tools and techniques of marketing for entrepreneurs
2. 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.
3. To give them an understanding of fundamental premise underlying market driven strategies and the basic philosophies and tools of marketing management for business owners.
4. To consider the various decision areas within marketing and the tools and methods used by marketing managers for making decisions.
5. To appreciate how a marketing perspective is important in your own personal and professional development.

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: 45 PERIODS

COURSE OUTCOMES

1. Students will have the awareness of marketing management process.
2. Students will understand the marketing environment.
3. Students will acquaint about product and pricing strategies.
4. Students will have the knowledge of promotion and distribution in marketing management.
5. Students can comprehend the contemporary marketing scenarios and offer solutions to marketing issues.

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.

COURSE OBJECTIVES

1. To introduce the basic concepts, structure and functions of human resource management for entrepreneurs.
2. To create an awareness of the roles, functions and functioning of human resource department.
3. To understand the methods and techniques followed by Human Resource Management practitioners.
4. To understand the training and compensation practices in Industry
5. To create an awareness on controlling measures followed HR practitioners.

UNIT I INTRODUCTION TO HRM 9

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 –e Recruitment - Selection Process- Selection techniques -E-Selection- 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 :45 PERIODS

COURSE OUTCOMES

1. Students will understand the Evolution of HRM and Challenges faced by HR Managers
2. Students will learn about the HR Planning Methods and practices.
3. Students will acquaint about the Recruitment and Selection Techniques followed in Industries.
4. Students will know about the methods of Training and Employee Development.
5. Students will comprehend the techniques of controlling human resources in organisations.

REFERENCES

1. Gary Dessler and Biju Varkkey, Human Resource Management, 14e, Pearson, 2015.
2. David A. Decenzo, Stephen.P.Robbins, and Susan L. Verhulst, Human Resource Management, Wiley, International Student Edition, 11th Edition, 2014
3. Mathis and Jackson, Human Resource Management, Cengage Learning 15e, 2017.
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

COURSE OBJECTIVES

1. To introduce the fundamentals of financing entrepreneurial ventures.
2. To understand the structure and avenues for debt and equity financing.
3. To explore government initiatives and institutional frameworks for start-ups.
4. To equip students with practical knowledge of fundraising processes for new ventures.
5. To develop competencies in evaluating financing strategies for new businesses.

UNIT I ESSENTIALS OF NEW BUSINESS VENTURE**9**

Setting up new Business Ventures – Need - Scope - Startup Ecosystem in India-Franchising - Location Strategy, Registration Process - Legal Requirements- 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– Importance – Funding New Ventures–Need–Scope– Types – Cost of Project–Means of Financing -Estimation of Working Capital–Requirement of funds– Mix of Debt and Equity - Challenges and Opportunities.

UNIT III SOURCES OF DEBT FINANCING**9**

Fund for Capital Assets - Term Loans - Leasing and Hire Purchase - Money Market instruments – Bonds, Debentures, 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- Venture Valuation- meaning and Basic Mechanics of Valuation

UNIT V METHODS OF FUND RAISING FOR NEW VENTURES**9**

Investor Decision Process - Identifying the appropriate investors- Targeting investors- Building Investor Relationships-Investor Selection Criteria- Company Creation-Raising Funds-Seed Funding- VC Selection Criteria – Process- Methods- VC Investment Process in India-Recent Trends

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will learn the basics of starting a new business venture.
2. Students can identify various venture financing opportunities
3. Students will understand the sources of debt financing.
4. Students will understand the sources of equity financing.
5. Students will acquaint and Formulate strategies for effective fundraising in real-world scenarios.

REFERENCES

1. Chandra, P. Projects: Planning, analysis, financing, implementation, and review (8th ed.). McGraw Hill Education, 2017.
2. Ramsinghani, M., The business of venture capital: The art of raising a fund, structuring investments, portfolio management, and exits (3rd ed.). Wiley. 2021.
3. Prasanna Chandra, Projects planning, Analysis, Selection, Financing, Implementation and Review, McGraw Hill Education India Pvt Ltd, New Delhi, 2019.
4. Byers, Thomas. Technology Ventures: From Idea to Enterprise. McGraw – Hill Higher Education, 2014
5. Steven Rogers, Entrepreneurial Finance: Finance and Business Strategies for the Serious Entrepreneur 3e, Tata Mc Graw Hill, 2014.

VERTICAL 3: PUBLIC ADMINISTRATION

BAM301	PRINCIPLES OF PUBLIC ADMINISTRATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To understand the nature, scope and essentials of Public Administration administrative theories and concepts to make sense of administrative practices.
2. To evaluate the changing paradigms of Public Administration.
3. To understand the synthesizing knowledge of public administration from public perspective.
4. To study and explore the approaches of administrative process.
5. To cover the principles, practices and the impact of public administration on society.

UNIT I INTRODUCTION TO PUBLIC ADMINISTRATION 9

Meaning- Nature and Scope of Public Administration, Evolution of Public Administration, Public Administration and Private Administration, Public Administration –Arts, Science or both, Public Administration - relations to other social sciences, Importance of Public Administration.

UNIT II EMERGING TRENDS IN PUBLIC ADMINISTRATION 9

New Public Administration–Formulating the structure, New Public Management, Globalization and Public Administration, Paradigm Shift from Government to Governance.

UNIT III ADMINISTRATIVE ORGANIZATIONS 9

Forms of Administrative Organizations –Departments, Public Corporations, Public sector undertakings, Independent Regulatory Commissions, Line and Staff Agencies, Administrative Tribunal.

UNIT IV APPROACHES AND THEORIES OF PUBLIC ADMINISTRATION 9

Classical Approach, Administrative Approach, Scientific Management Approach, Bureaucratic Approach, Human Relations Approach, Ecological Approach.

UNIT V PRINCIPLES AND PRACTICES OF PUBLIC ADMINISTRATION 9

Chief Executive - Meaning, Types, Functions & Qualities of Chief Executive, Supervision, Communication - meaning, types of communication & its importance in Public Administration, Centralization & Decentralization, Public Relation, Meaning, Methods & Significance, Decision making - Types, Techniques and Processes, Leadership - Styles –Approaches.

COURSE OUTCOMES

1. Students will understand public administration theory and concepts from multiple perspectives.
2. Students will appreciate the nature, scope and dynamics of Public Administration.
3. Students will acquaint with India's development experience and changing role of administration practices.
4. Students will grasp the administrative theories, concepts and principles to make sense of administration in the developing era.
5. Students will demonstrate the integrative knowledge, skills and ethics necessary for responsible Administrative, management and leadership positions.

REFERENCES

1. Lakshmi Kanth ,Public Administration by McGraw Hill,2018
2. Rosenbloom David, Public Administration: Understanding Management, Politics, and Law in the Public Sector, McGraw Hill, 2018.
3. Avasthi and Maheswari: Public Administration in India, Agra:Lakshmi Narain Agarwal,2013.
4. Ramesh K Arora: Indian Public Administration, New Delhi: Wishwa Prakashan, 2012.
5. R.B. Jain: Public Administration in India,21st Century Challenges for Good Governance, New Delhi: Deep and Deep, 2002.

COURSE OBJECTIVES

1. To know about the basic structure of Indian Constitution, Fundamental Rights(FR's), DPSP's and Fundamental Duties (FD's) of our constitution.
2. To know about the functioning of three wings of the government i.e., executive, legislative and judiciary.
3. To know the State Executive s Union territories.
4. To know about the Local Administration from Corporation to Village Level.
5. To learn the pattern of Election systems and concept of E-Governance.

UNIT I INTRODUCTION**9**

Meaning of the Constitution Law and Constitutionalism - Constituent Assembly. Government of India Act of 1935 and Indian Independence Act of 1947 – Enforcement of COI and its Salient Features – Why Tamilnadu's "Sengol" in Parliament (1947 & 2023)- Samvidhan Divas - The Preamble. The Constitutional amendments in India - National Emergency, President Rule, Financial Emergency - Fundamental Rights and Duties, Directive Principles of State Policy.

UNIT II THE CENTRE: EXECUTIVE, LEGISLATIVE AND JUDICIARY**9**

Meaning of Indian Flag & Ashoka Chakra. Indian Parliament – RS - LS – Power & Functions. Honourable "The President" & "The Vice President", "The Prime Minister" - Power & Functions - Comparison of Indian President with the United States - Central Ministry of Council. The Independence of the Supreme Court - Appointment of Supreme & High Courts Judges (Collegium) - Judicial Review, Judicial Activism, and PIL -, The Lokpal & Lok Ayuktas 2013 – NRC & CAA (Illegal Migrants) - Abrogation of Article 370 in J & K – Need of Uniform Civil Code.

UNIT III THE STATE GOVERNMENT, UNION TERRITORIES STATE LEGISLATURE**9**

Madras Presidency to Tamil Nadu – Tamil Nadu Emblem. State Executives – His Excellency "The Governor" – Power & Functions, Chief Minister – Power & Functions, State Cabinet, Members of Legislative Assembly – Role. Union Territories – Power & Functions. Federal System, Centre-State Relations. High Court & Subordinate Courts- Lok Adalat 1982 Vs Arbitration Tribunal.

UNIT IV LOCAL ADMINISTRATION**9**

Corporation – Mayor, Chairman District Administration Head - Role and Importance, Role of Elected Representative – Pachayati Raj; Functions PRI – Grama Sabha. Block level Organizational Hierarchy, Village level - Role of Elected and Appointed officials - Importance of grass-root democracy.

UNIT V ELECTION SYSTEMS AND E-GOVERNANCE**9**

Election Commission: Role of Chief Election Commissioner - State Election Commission – One India One Election. National Good Governance Day - Governance and role of Engineers in E-Governance, Need for reformed engineering serving at the Centre and State, E- Courts, Role of I.T. professionals in Judiciary, Problem of Alienation and Secessionism in few states creating hurdles in Industrial development.

TOTAL: 45 PERIODS**COURSE OUTCOMES**

1. Students will identify and explore the basic features and modalities about Indian constitution.
2. Students will differentiate and relate the functioning of 3 wings of India.
3. Students will understand the state level executives and state courts
4. Students will identify the role of Mayor and elected representatives of Municipalities
5. Students will know the role of Election Commission apply knowledge and E-governance.

REFERENCES

1. BR. Ambedkar, Rupa Publications. The Constitution of India. Rupa Publications. 2024.
2. Singh, M. P. (Ed.). EBC's V. N. Shukla's Constitution of India (14th ed., reprint 2024). Eastern Book Company.
3. Bakshi, P. M The Constitution of India (19th ed.). Universal Law Publishing (LexisNexis) 2023.
4. Babu, D. D. Introduction to the Constitution of India (27th ed.). Lexis Nexis 2024.
5. Sharma, B. K. Introduction to the Constitution of India (11th ed.). PHI Learning 2024.

COURSE OBJECTIVES

1. To understand the fundamental principles, scope, and evolution of Public Personnel Administration.
2. To analyze different types of personnel systems and their relevance in democratic governance.
3. To examine the processes of recruitment, training and promotion within the public sector.
4. To gain insights into the structure and functioning of All India Services and State Public Service Commissions.
5. To evaluate employer-employee relations, wage systems and benefits in the context of public sector employment.

UNIT I INTRODUCTION TO PERSONNEL ADMINISTRATION**9**

Meaning, Scope and Importance of Personnel Administration - Evolution of Public Personnel Administration-Personnel Administration vs. Human Resource Management – Challenges in Personnel Administration – Types of Personnel Systems Bureaucratic, Democratic and Representative systems-Emerging Trends in Personnel Administration

UNIT II PERSONNEL SYSTEMS AND ADMINISTRATIVE ETHICS**9**

Generalist Vs Specialist – Comparative Analysis of Personnel Systems – Role of Civil Servants in Policy Implementation - Relationship between Civil Servants and Political Executives - Mechanisms for Promoting Administrative Accountability-Civil Servant's Relationship with Political Executive – Ethics and Integrity in Administration - Mechanisms for Promoting Administrative Accountability

UNIT III RECRUITMENT, TRAINING AND PROMOTION**9**

Recruitment: Direct Recruitment and Recruitment from Within – Methods of Manpower Planning- Training: Objectives and Need –Types of Training: Induction, In-service, Orientation, Refresher - Performance Appraisal and Merit-based Promotion – Promotion

UNIT IV PUBLIC SERVICE FRAMEWORK IN INDIA**9**

All India Services – Structure and Cadre Management – Rules and Regulations Governing Service Conditions – Code of Conduct and Disciplinary Actions –State Public Service Commissions: Functions and Autonomy - UPSC and Its Constitutional Mandate - Reservation Policy in Services - Gender Sensitization and Inclusivity in Services.

UNIT V EMPLOYEE RELATIONS AND COMPENSATIONS

9

Employer Employee Relations – Wage Theories and Compensation Models – Principles of Pay Fixation
-Salary Structures in Indian Civil Services –Salary Structures in Indian Civil Services –Social Security
Benefits and Retirement Schemes - Wage and Salary Administration – Allowances and Benefits

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will demonstrate a comprehensive understanding of the nature, scope, and importance of public personnel administration
2. Students will be able to distinguish between bureaucratic, democratic, and representative personnel systems in public administration.
3. Students will apply knowledge of recruitment, training and promotion practices to real-world administrative scenarios.
4. Students will critically analyze the structure and functioning of the All India Services and State Public Service Commissions.
5. Students will evaluate wage and salary administration, allowances and employee relations within the framework of public sector employment.

REFERENCES

1. Public Personnel Administration, 6th Ed, by David H. Rosenbloom, Robert S. Kravchuk, Richard M. Clerkin 2015.
2. Personnel Management in Government, 7th Ed, by R. Wayne Boss 2016.
3. Human Resource Management in Public Service, 5th Ed, by Richard C. Kearney, Jerrell D. Coggburn 2015.
4. Public Administration: An Introduction, 12th Ed, by David H. Rosenbloom, Robert S. Kravchuk, Richard M. Clerkin 2019.
5. Public Personnel Management, 4th Ed, by Donald E. Klingner, John Nalbandian 2018

COURSE OBJECTIVES

1. To introduce students to the evolution of administrative thought
2. To study the contributions of key administrative thinkers
3. To develop an understanding of leadership, governance, and management principles
4. To relate classical theories to contemporary administrative practices
5. To enhance analytical and critical thinking skills

UNIT I INTRODUCTION TO PUBLIC ADMINISTRATION 9

Meaning, Scope and significance of Public Administration, Evolution of Public Administration as a discipline and Identity of Public Administration. Public Administration - Introduction, Principles of Organization and Management, Public Policy and Governance, Administrative Structure in India, Ethics and Accountability in Public Administration, Technology and Public Administration, Contemporary Issues in Public Administration.

UNIT II THEORIES OF ORGANIZATION 9

Theories of Organization: Scientific Management Theory, Classical Model, Human Relations Theory. Introduction to Organizations, Neo-Classical Theories, Modern Theories, Contemporary Approaches, Organization Design and Structure, Leadership and Motivation in Organizations, Applications to Modern Industry and Technology.

UNIT III ORGANIZATIONAL BEHAVIOUR AND DESIGN 9

Organization goals and Behaviour, Groups in organization and group dynamics, Organizational Design. Organizational Behaviour - Introduction, Individual Behaviour in Organizations, Group Behaviour and Team Dynamics, Leadership and Power, Conflict and Negotiation, Organizational Culture and Climate, Organizational Change and Development, Contemporary Issues in OB.

UNIT IV MOTIVATION AND LEADERSHIP 9

Motivation Theories, content, process and contemporary; Theories of Leadership: Traditional and Modern: Process and techniques of decision-making Motivation - Definition and Importance, Content Theories, Process Theories. Leadership - Meaning, Roles, and Importance of Leadership, Leadership

Theories. Decision Making - Nature and Types of Decisions, Decision-Making Process: Steps and Models. Contemporary Perspectives, Applications and Case Studies.

UNIT V ADMINISTRATIVE THINKERS

9

Administrative thinkers: Kautilya, Woodrow Willson, C.I. Barnard. Peter Drucker Introduction to Administrative Thought, Kautilya (Chanakya) - Arthashastra: Concepts of Governance and Statecraft. Woodrow Wilson - The Study of Administration as a discipline. Chester I. Barnard - The Functions of the Executive, Concept of Formal and Informal Organizations, Peter F. Drucker - Management by Objectives (MBO), Comparing Key Contributions: Classical vs Modern Perspectives. Administrative Principles in Startups, Tech Companies, and Government Projects.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will understand foundational ideas of administration
2. Students will be able to analyze different administrative and management theories
3. Students will apply classical principles to modern contexts
4. Students will be able to evaluate the role of leadership and ethics in administration
5. Students will develop problem-solving skills using administrative models

REFERENCES

1. R. K. Sapru – Administrative Theories & Management Thought, 3rd Edition, 2013
2. “Public Administration Theories & Principles” (Vidya R., Rajaram), Kindle 2024 Edition
3. Fernando Lunenburg & Allen Irby – included in Development of Administrative Theory, SAGE Publications 2022
4. Global Encyclopedia of Public Administration, Public Policy, and Governance. Springer Publications, 2nd Edition, 2020
5. Administrative Theories: Approaches, Concepts and Thinkers in Public Administration, Rakesh Hooja, Ramesh K Arora 2007

COURSE OBJECTIVES

1. To understand the historical evolution and constitutional framework of Indian administration.
2. To analyze the role and functioning of key constitutional authorities and administrative institutions.
3. To explore the structure, functions, and challenges of local governance and grassroots administration.
4. To examine the impact of coalition politics and the role of ethics in administrative integrity
5. To evaluate the mechanisms for corruption control, including Ombudsman, Lokpal & Lok Ayukta.

UNIT I INTRODUCTION TO INDIAN ADMINISTRATION**9**

Evolution and Constitutional Context of Indian Administration, Constitutional Authorities: Finance Commission, Union Public Services Commission, Election Commission, Comptroller and Auditor General of India, Attorney General of India, Separation of powers and checks & balances in governance

UNIT II LOCAL GOVERNMENT AND ADMINISTRATION**9**

Role & Functions of the District Collector, Relationship between the District Collector and Superintendent of Police, Role of Block Development Officer in development programmes, Local Government, Role of Smart Cities & Urban Local Bodies in governance

UNIT III CONSTITUTIONAL AMENDMENTS**9**

Main Features of 73rd Constitutional Amendment Act 1992, Salient Features of 74th Constitutional Amendment Act 1992, Implementation challenges and success stories of decentralized governance, Case studies on local governance reforms

UNIT IV POLITICS AND ETHICS**9**

Coalition politics in India, Integrity and Vigilance in Indian Administration, Role of transparency and accountability in governance (RTI Act, Citizen Charters), Ethical dilemmas in civil services and administrative ethics.

UNIT V TECHNOLOGY IN ADMINISTRATION

9

Corruption–Ombudsman, Lokpal & Lok Ayuktha, Recent anti-corruption measures (Whistle blower Protection Act, Black Money laws), Digital governance and technology-driven transparency in administration

TOTAL:45 PERIODS

COURSE OUTCOMES

1. Students will gain a comprehensive understanding of India's administrative system, governance structure, and reforms.
2. They will be able to critically assess the functioning of constitutional authorities and their influence on policymaking
3. Learners will develop the ability to analyze local governance models and propose solutions for administrative challenges.
4. They will demonstrate awareness of political dynamics, ethics, and accountability in governance.
5. Graduates will be equipped to evaluate anti-corruption measures and suggest improvements for transparent administration.

REFERENCES

1. S.R. Maheswari : Indian Administration - Orient Black Swan, Sixth edition, 2001
2. Indian Public Administration: Institutions and Issues by Rajni Arora & Ramesh K. Goyal - New Age International Publishers, Fourth edition, 2022
3. Indian Administration - Evolution and Practice by Bidyut Chakrabarty – SAGE Publications India Pvt, Ltd. First edition,2019
4. Khera. S.S : Administration in India – Asia Publishing House, Bombay, First edition,1964
5. Ramesh K. Arora : Indian Public Administration - New Age International Publishers, Fourth edition, 2022

COURSE OBJECTIVES

1. To provide students with a comprehensive understanding of the meaning, nature, scope, and significance of public policy.
2. To equip students with knowledge of various approaches to policy analysis and familiarize them with key models such as Dror's Optimal Model.
3. To enable students to understand the stages of the policy-making process, including formulation, implementation, and evaluation.
4. To analyze the role of institutions, bureaucracy, interest groups, and political parties in the public policy process.
5. To introduce students to significant public policies in India, such as the New Economic Policy, Population Policy, Agricultural Policy, and Information Technology Policy.

UNIT I INTRODUCTION TO PUBLIC POLICY**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 – Importance and relevance of public policy in modern society.

UNIT II POLICY APPROACHES**9**

Approaches in Policy Analysis - Institutional Approach – Incremental Approach and System's Approach – Dror's Optimal Model- Comparison of different approaches.

UNIT III POLICY FRAMEWORK**9**

Major stages involved in Policy making Process – Policy Formulation – Policy Implementation – Policy Evaluation – Feedback mechanism and Policy change.

UNIT IV ROLE OF POLITICS IN POLICY FRAMEWORK**9**

Institutional Framework of Policy making – Role of Bureaucracy – Role of Interest Groups and Role of Political Parties – Role of Judiciary.

UNIT V TECHNOLOGY IN POLICY FRAMEWORK**9**

Introduction to the following Public Policies – New Economic Policy – Population Policy – Agriculture policy - Information Technology Policy – Digital India Initiative.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students can able to know the importance of public policy and its interdisciplinary connections, especially with political science and public administration.
2. Students can able to assess different approaches and models used in policy analysis, including institutional, incremental, systems approaches, and Dror's Optimal Model.
3. Students will understand the stages involved in the policy-making process, from formulation through to evaluation.
4. Students can able to analyze the institutional framework and the roles played by bureaucracy, political parties, and interest groups in policy-making.
5. Students can able to evaluate the key public policies in India, understanding their context, objectives, and impacts.

REFERENCES

1. Anderson, J. E., Moyer, J., & Chichirau, G. Public Policymaking: An Introduction (9th ed.). New Delhi, India: Cengage India 2023.
2. Bardach, E., & Patashnik, E. M. A Practical Guide for Policy Analysis: The Eightfold Path to More Effective Problem Solving (7th ed.). Washington, DC: CQ Press 2023.
3. Cairney, P. Understanding Public Policy: Theories and Issues (2nd ed.). London: Bloomsbury Academic 2024.
4. Kraft, M. E., & Furlong, S. R. (Public Policy: Politics, Analysis, and Alternatives (8th ed.). Thousand Oaks, CA: CQ Press 2023.
5. Smith, K. B., & Larimer, C. W. The Public Policy Theory Primer (3rd ed.). New York, NY: Routledge 2017.

VERTICAL 4: BUSINESS DATA ANALYTICS

BAM401

STATISTICS FOR MANAGEMENT

L T P C

3 0 0 3

COURSE OBJECTIVES

1. To apply statistical methods to analyze engineering and management problems.
2. To use descriptive statistics and probability theory to summarize, interpret, and present engineering and business data effectively.
3. To employ inferential statistical tools such as hypothesis testing, confidence intervals, and regression analysis to solve real-world management and engineering problems.
4. To utilize statistical software/tools to perform data analysis and interpret output for strategic planning, quality control, and operational efficiency.
5. To develop problem-solving skills by applying statistical reasoning to project management, production processes, and optimization in engineering enterprises.

UNIT I INTRODUCTION

9

Concepts of Experiment, Event, Sample Space, Basic definitions and addition and multiplication rules for probability, Baye's theorem and random variables, Importance of Statistics in Business and Engineering, Probability distributions: Binomial, Poisson, Uniform and Normal distributions.

UNIT II SAMPLING DISTRIBUTION AND ESTIMATION

9

Introduction to Sampling, Population vs. Sample, Concept of a Sampling Distribution, Introduction to sampling distributions, Central limit theorem and applications, sampling techniques, Point and Interval estimates of population parameters. Confidence Interval for the Mean (Known and Unknown Population Variance)

UNIT III TESTING OF HYPOTHESIS - PARAMETRIC TESTS

9

Introduction to Hypothesis Testing - Definition and Importance of Hypothesis Testing in Engineering and Business, Basic Concepts: Null Hypothesis (H_0), Alternative Hypothesis (H_1), Type I and Type II Errors, Significance Level (α) and Power of a Test, p-Value: Concept and Interpretation. Parametric Tests for Mean (t-test), Parametric Tests for Proportions (Z-test), Analysis of Variance (ANOVA).

UNIT IV TESTING OF HYPOTHESIS - NON-PARAMETRIC TESTS

9

Introduction to Non-Parametric Tests, Differences Between Parametric and Non-Parametric Tests, Sign Test (Concept of the Sign Test for One-Sample Data), Mann-Whitney U Test (Wilcoxon Rank-Sum Test), Wilcoxon Signed-Rank Test (Testing Differences for Paired Data), Kruskal-Wallis H Test (Testing for Differences Between More Than Two Independent Groups), Chi-Square Test for Goodness of Fit (Goodness of Fit Test, Test for Independence, Analyzing Relationships Between Categorical Variables), Friedman Test (Non-Parametric Test for Comparing More Than Two Related Groups).

UNIT V CORRELATION AND REGRESSION

9

Introduction to Correlation and Regression, Correlation Analysis - Pearson's Correlation Coefficient (r), Spearman's Rank Correlation. Simple Linear Regression - Introduction to Regression Analysis, Simple Linear Model, Multiple Linear Regression, Applications of Correlation and Regression in Engineering - Quality Control and Six Sigma, Reliability Engineering, Optimization Problems.

TOTAL:45 PERIODS

COURSE OUTCOMES

1. Students will be able to facilitate objective solutions in business decision making.
2. Students will understand and solve business problems.
3. Students will apply statistical techniques to data sets, and correctly interpret the results.
4. Students will develop skill-set that is in demand in both the research and business environments.
5. Students will be able to apply the statistical techniques in a work setting.

REFERENCES

1. Richard I. Levin, David S. Rubin, Masood H Siddiqui, Sanjay Rastogi, Statistics for Management, Pearson Education, 8th Edition, 2017.
2. Fundamentals of Mathematical Statistics, by S.C. Gupta and V.K. Kapoor Revised Edition 2020.
3. Prem. S. Mann, Introductory Statistics, Wiley Publications, 9th Edition, 2015.
4. T N Srivastava and Shailaja Rego, Statistics for Management, Tata McGraw Hill, 3rd Edition 2017.
5. Ken Black, Applied Business Statistics, 7th Edition, Wiley India Edition, 2012.

COURSE OBJECTIVES

1. To familiarize students with the fundamental principles and scope of datamining and business intelligence.
2. To develop an understanding of data preparation and data quality issues in business analytics.
3. To explain key datamining techniques such as classification, clustering, and association rule mining from a business view point.
4. To expose students to the practical applications of datamining in various business functions.
5. To sensitize students to the ethical, strategic and managerial implications of using datamining for decision-making.

UNIT I INTRODUCTION TO DATAMINING AND BUSINESS INTELLIGENCE 9

Data Mining – Definition – Purpose – Role in Business Intelligence – Scope – Importance in Managerial Decision-Making – Difference between Data Mining and Business Analytics – Knowledge Discovery in Databases (KDD) – CRISP – DM Methodology – Phases of Data Mining Process – Applications in Business – Benefits and Limitations – Organizational Challenges in Data Mining Implementation.

UNIT II DATA PREPARATION AND DATA UNDERSTANDING 9

Types and Sources of Business Data – Structured and Unstructured Data–Importance of Data Quality – Data Cleaning and Handling Missing Values – Data Normalization and Transformation – Exploratory Data Analysis (EDA) – Descriptive Statistics – Frequency Distributions–Data Visualization Techniques–Graphs and Charts–Use of Dashboards for Business Insights – Role of EDA in Business Decision-Making.

UNIT III CORE DATA MINING TECHNIQUES 9

Overview of Data Mining Techniques – Classification – Concept and Applications – Decision Trees – Logistic Regression – Business Use Cases – Clustering – Concept and Business Use –Customer Segmentation – Behavioral Grouping – Association Rule Mining – Market Basket Analysis–Support, Confidence and Lift – Interpretation of Rules – Use in Retail and Marketing–Non-Technical Overview of Techniques.

UNIT IV FUNCTIONAL APPLICATIONS OF DATA MINING IN BUSINESS 9

Applications in Marketing–Customer Profiling–Targeted Campaigns– Churn Prediction– Applications in Finance – Risk Assessment – Credit Scoring – Fraud Detection – Applications in HR – Employee Attrition – Workforce Analytics – Applications in Operations–Demand Forecasting – Inventory Optimization – Vendor Analysis – Real-Life Business Use Cases – Managerial Interpretation of Results.

UNIT V MANAGERIAL PERSPECTIVES, ETHICS AND EMERGING TRENDS 9

Managerial Role in Business Intelligence – Framing Business Problems – Interpretation of Data Mining Results – Reporting and Communication of Insights – Ethical Issues – Data Privacy – Consent – Algorithmic Bias – Transparency – Recent Trends – Self–Service BI–Real- Time Analytics – Augmented Intelligence – Role of Managers in Promoting Data-Driven Culture–Challenges and Future Opportunities.

COURSE OUTCOMES

1. Students will be able to explain the core concepts and process models used in data mining and business intelligence.
2. Students will recognize the importance of data quality, organization and visualization in deriving insights.
3. Students will be able to interpret the basic logic of classification, clustering, and association rules with practical business examples
4. Students will be able to apply conceptual knowledge of datamining techniques to functional business problems.
5. Students will be able to evaluate the role of ethics, managerial insight and business context in the implementation of data-driven strategies.

REFERENCES

1. Galit Shmueli, Nitin R. Patel, and Peter C. Bruce, Data Mining for Business Analytics: Concepts, Techniques, and Applications with XL Miner, 3rd Edition, 2016, Wiley.
2. U Dinesh Kumar, Business Analytics: The Science of Data – Driven Decision Making, 2nd Edition, 2020, Wiley India Pvt. Ltd.
3. V. Ramesh and K.N. Prasad, Data Mining and Data Warehousing, 2nd Edition, 2020, Wiley India Pvt. Ltd.
4. V.P Jain, Data Mining Techniques for Marketing, Sales, and Customer Relationship Management, 1st Edition, 2016, BPB Publications.
5. Anil Maheshwari, Data Analytics Made Accessible, 2nd Edition, 2017, Amazon Digital Services LLC.

COURSE OBJECTIVES

1. To develop the ability of the learners to define and implement HR metrics that are aligned with the overall business strategy.
2. To know the different types of HR metrics and understand their respective impact and application.
3. To understand the impact and use of HR metrics and their connection with HR analytics.
4. To understand common work force issues and resolving the musing people analytics.
5. The learners will be conversant about HR metrics and ready to apply at work settings.

UNIT I INTRODUCTION TO HR ANALYTICS 9

HR analytics - People Analytics: Definition- context - stages of maturity - Human Capital in the Value Chain: impact on business. HR Analytics vs HR Metrics – 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- Recruitment to HR cost - Recruitment analysis.

UNIT III HR ANALYTICS II: TRAINING AND DEVELOPMENT 9

Training & Development Metrics: Percentage of employee trained- Internally and externally trained-Training hours and cost per employee - ROI -Optimising the ROI of HR Programs - Training and Development analysis.

UNIT IV HR ANALYTICS III: EMPLOYEE ENGAGEMENT AND CAREER PROGRESSION 9

Employee Engagement Metrics: Talent Retention - Retention index - Voluntary and involuntary turnover- Turnover by department, grades, performance, and service tenure - Internal hired index - Engagement Survey Analysis. Career Progression Metrics : Promotion index - Rotation index - Career path index - Level wise succession readiness index.

UNIT V HR ANALYTICS IV: WORK FORCE DIVERSITY AND DEVELOPMENT 9

Workforce Diversity and Development Metrics: Employees per manager - Workforce age profiling - Workforce service profiling- Churn over index - Workforce diversity index - Gender mix - Differently abled index- Revenue per employee – Operating cost per employee - PBT per employee - HR cost per employee- HR budget variance - Compensation to HR cost.

TOTAL:45 PERIODS

COURSE OUTCOMES

1. Students will be conversant about HR metrics and ready to apply at work settings.
2. Students will be able to resolve HR issues using people analytics.
3. Students will gain knowledge about analytics of training and development.
4. Students will know about the analytics of employee engagement and career progression
5. Students are competent in the analytics of work force diversity and development.

REFERENCES

1. Ferrar, J., & Green, D. Excellence in People Analytics: How to Use Data to Create Value and Drive Business Success (2nd ed.). Kogan Page. 2021.
2. Soundararajan, R., & Singh, K. Winning on HR Analytics: Leveraging Data for Competitive Advantage. SAGE Publications Pvt. Ltd. 2022.
3. Edwards, M. R., Minbaeva, D., Levenson, A., & Huselid, M. A. (Eds.). Workforce Analytics: A Global Perspective. Routledge. 2023.
4. Jang, D., Edwards, M., & Edwards, K. Using R in HR Analytics. Kogan Page 2023.
5. Lochab, A., Duhan, P., & Dangi, H.K. HR Analytics: Concepts and Applications. S. Chand Publishing. 2025.

COURSE OBJECTIVES

1. To showcase today's opportunities to leverage the power of marketing on the web and social media through web analytics.
2. Understand the role of social media web analytics within the digital marketing landscape.
3. Identify, define, and interpret commonly used web metrics and KPIs.
4. Understand analytical methods to transform social media data into marketing insights.
5. Understand the process of search engine optimization and the search behaviors of customers.

UNIT I MARKETING ANALYTICS**9**

Introduction to Marketing Analytics - Marketing Budget and Marketing Performance Measure, Marketing Metrics and Its Applications - Financial Implications of Various Marketing Strategies- Geographical Mapping, Data Exploration, Market Basket Analysis.

UNIT II COMMUNITY BUILDING AND MANAGEMENT**9**

The History and Evolution of Social Media, Understanding the Science of Social Media, Goals for Using Social Media, Social Media Audience and Influencers, Keys to Community Building, Promoting Social Media Pages, Linking Social Media Accounts, The Viral Impact of Social Media, and Social Media as a Business.

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. - Social Media Analytics- Insights Gained from Social Media- Customized Campaign Performance Reports - Observations of Social Media Use.

UNIT IV WEB ANALYTICS**9**

Web Analytics—Present and Future—Data Collection—Importance and Options, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of A Successful Web Analytics Strategy, Web Analytics Fundamentals, Concepts, Proposals & Reports, Web Data Analysis.

UNIT V SEARCH ANALYTICS**9**

Search Engine Optimization (SEO), User Engagement, User-Generated Content, Web Traffic Analysis, Navigation, Usability, Eye Tracking, Online Security and Ethics, Content Management System, Data Visualization. RSS Feeds, Mobile Platforms, Understanding Search Behaviors.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. The students will understand Marketing in Social Media, Web, and Social Media Analytics and their Potential Impact.
2. The students will be able to enhance their social media marketing skills.
3. The students can develop a mass communication strategy and guide marketing campaigns.
4. The students will understand the fundamentals and concepts of web analytics.
5. The students will learn to use the resulting insights effectively to support website design decisions, campaign optimisation, search analytics, etc.

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.

COURSE OBJECTIVES

1. To introduce students to the foundational concepts of analytics and their strategic role in transforming supply chains using descriptive, predictive, and prescriptive methods.
2. To equip learners with quantitative tools for warehousing decisions, including mathematical programming and heuristic methods for facility layout and space optimization.
3. To develop an in-depth understanding of inventory management techniques, emphasizing risk analysis, aggregation models, and multi-echelon planning.
4. To provide analytical skills to model and solve complex transportation and distribution network problems using graph theory, flow models, and routing algorithms.
5. To enable application of Multi-Criteria Decision-Making (MCDM) techniques such as AHP, DEA, and TOPSIS in supply chain decision scenarios.

UNIT I INTRODUCTION**9**

Introduction to analytics – descriptive, predictive, and prescriptive analytics, Data-driven supply chains, Road map for data-driven supply chains. Transforming supply chains, Barriers to implementation of supply chain strategies.

UNIT II WAREHOUSING DECISIONS**9**

Mathematical programming models - P-median methods - Guided LP approach - Balmer–Wolfe method, Greedy drop heuristics, Dynamic location models, Space determination and layout methods.

UNIT III INVENTORY MANAGEMENT**9**

Inventory aggregation models - Dynamic lot sizing methods, Multi-echelon inventory models, Aggregate inventory system and limit, Risk analysis in the supply chain - Measuring transit risks, Supply risks, Delivering risks, and risk pooling strategies.

UNIT IV TRANSPORTATION NETWORK MODELS**9**

The notion of graphs, Minimal spanning trees, Shortest path algorithms, Maximal flow problems, Multistage transshipments, and transportation problems, Set covering and set partitioning problems, Traveling salesman algorithms, and deficit function approach, Scheduling Algorithms.

UNIT V – MCDM MODELS**9**

Multi-Criteria Decision-Making (MCDM) Techniques, Analytic Hierarchy Process (AHP), Data Envelopment Analysis (DEA), Fuzzy Logic and Techniques, the Analytical Network Process (ANP), TOPSIS-Application in SCM.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will understand and explain the concepts of descriptive, predictive, and prescriptive analytics and their role in enhancing data-driven supply chain decision-making.
2. Students will apply mathematical programming and heuristic methods such as P-median, Guided LP, and Greedy Drop techniques to make effective warehousing and location decisions.
3. Students will analyze and manage inventory using aggregation models, multi-echelon systems, and risk pooling strategies to improve supply chain resilience and efficiency.
4. Students will solve transportation network problems using graph-based algorithms like shortest path, maximal flow, and traveling salesman models to optimize logistics performance.
5. Students will evaluate complex supply chain scenarios using Multi-Criteria Decision-Making (MCDM) techniques such as AHP, DEA, TOPSIS, and fuzzy logic for better strategic decision-Making.

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: Supply Chain Analytics for Perishable Products, Springer, 2013.
4. Muthu Mathirajan, Chandrasekharan Rajendran, Sowmyanarayanan Sadagopan, Arunachalam Ravindran, Parasuram Balasubramanian, Analytics in Operations/Supply Chain Management , I.K. International Publishing House Pvt. Ltd., 2016.
5. Gerhard J. Plenert, Supply Chain Optimization through Segmentation and Analytics, CRC Press, Taylor & Francis Group, 2014.

COURSE OBJECTIVES

1. To introduce fundamental financial concepts and decision-making techniques relevant to corporate finance.
2. To familiarize students with the basics of financial markets and time-series analysis techniques for estimating risk and return.
3. To provide insights into portfolio theory and option pricing models used for investment analysis.
4. To expose students to basic technical indicators and simulation strategies for analyzing stock market behavior.
5. To enable students to understand and apply basic credit risk models using statistical and machine learning techniques.

UNIT I FOUNDATIONS OF CORPORATE FINANCIAL ANALYSIS**9**

Introduction to financial analytics. Basic financial models – Time value of money, cash flow analysis, cost of capital. Project appraisal methods – Payback period, NPV, IRR. Capital budgeting and financial break-even analysis.

UNIT II FINANCIAL MARKET DATA AND TIME-SERIES ANALYSIS**9**

Introduction to financial market instruments – Stocks and Bonds. Basics of risk and return. Overview of financial data and Time-Series characteristics. Introduction to Value at Risk (VaR). Basics of Auto Regressive Moving Average (ARMA), Autoregressive Conditional Heteroscedasticity (ARCH), and Generalized Autoregressive Conditional Heteroscedasticity (GARCH) models for volatility forecasting.

UNIT III PORTFOLIO THEORY AND DERIVATIVES**9**

Portfolio diversification and risk-return trade-off. Capital Asset Pricing Model (CAPM). Sharpe ratio. Option pricing basics – Binomial model, Black-Scholes model. Implied volatility and option strategies.

UNIT IV TECHNICAL ANALYSIS AND TRADING SIMULATIONS**9**

Overview of technical indicators – Relative Strength Index (RSI), Moving Average Convergence Divergence (MACD), Rate of Change (ROC), Moving Averages, Candlestick patterns. Simulation of basic trading strategies. Introduction to algorithmic trading concepts. Prediction of stock prices using chart patterns.

UNIT V CREDIT RISK ANALYTICS

9

Introduction to credit risk. Data pre-processing for credit modelling. Logistic regression, decision trees, and model evaluation techniques. Application of analytics in credit scoring and loan approvals, and evaluating credit risk model.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will apply core financial concepts to evaluate corporate investment decisions using tools like NPV and IRR.
2. Students will analyze risk and return using financial time-series models and interpret key market indicators.
3. Students can able to construct and assess investment portfolios and derivative strategies using theoretical models.
4. Students will use basic technical analysis indicators and simulate simple trading strategies.
5. Students can develop and evaluate credit risk models using statistical methods like logistic regression and decision trees.

REFERENCES

1. Mark J. Bennett, Dirk L. Hugen, "Financial Analytics with R: Building a Laptop Laboratory for Data Science", Cambridge University Press, 1st Edition, 2016.
2. Pavel Ryzhov, "Haskell Financial Data Modeling and Predictive Analytics", Packt Publishing, 1st Edition, 2013.
3. Edward E. Williams, John A. Dobelman, "Quantitative Financial Analytics: The Path to Investment Profits", World Scientific Publishing, 1st Edition, 2017.
4. Yuxing Yan, "Python for Finance – Second Edition: Apply Powerful Finance Models and Quantitative Analysis with Python", Packt Publishing, 2nd Edition, 2017.
5. James Ma Weiming, "Mastering Python for Finance – Second Edition: Implement Advanced State-of-the-Art Financial Statistical Applications Using Python", Packt Publishing, 2nd Edition, 2019.

AGM501	SUSTAINABLE INFRASTRUCTURE	L	T	P	C
	DEVELOPMENT	3	0	0	3

- To impart knowledge about sustainable Infrastructure development goals.
- To practices and to understand the concepts of sustainable planning, design, construction, maintenance and decommissioning of infrastructure projects.
- To understand how infrastructure projects are conceptualised and planned and the project lifecycle phases
- To learn concepts related to infrastructure economics and finance, including various project feasibility models
- To understand and assess the use of various risk management processes and practices in the context of infrastructure projects

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.

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 : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Understand the environment sustainability goals at global and Indian scenario.
2. Understand risks in development of projects and suggest mitigation measures.
3. Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.
4. Explain Life Cycle Analysis and life cycle cost of construction materials.
5. Explain the new technologies for maintenance of infrastructure projects.

TEXTBOOKS:

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

REFERENCE BOOKS:

1. Kerry Turner. R, "Sustainable Environmental Management", Principles and Practice Publisher: Belhaven Press.
2. Munier N, "Introduction to Sustainability", Springer 2005.
3. Sharma, "Sustainable Smart Cities In India: Challenges And Future Perspectives", SPRINGER, 2022.
4. Ralph Horne, Tim Grant, Karli Verghese, Life Cycle Assessment: Principles, Practice and Prospects, Csiro Publishing,2009
5. 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

AGM501	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
C01	2	-	1	1	-	2	3	1	1	-	2	1	1	2	1	-
C02	3	1	3	2	1	2	2	-	1	1	1	2	2	2	2	-
C03	2	2	3	1	1	1	1	-	-	-	1	1	1	3	1	-
C04	3	1	3	2	2	1	3	1	1	1	1	2	2	2	2	-
C05	3	1	2	2	2	2	3	1	-	1	1	2	2	3	2	-
Average	3	1	3	2	2	2	3	1	1	1	1	2	2	3	2	-

AGM502	SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To educate the students about the issues of sustainability in agroecosystems,
- To introduce the concepts and principles of agroecology as applied to the design and management of sustainable agricultural systems for a changing world.
- To emphasize on the importance of environment and agriculture on changing global scenario and the emerging issues connected to it.
- To introduce the students about the importance of the land and water resources in India.
- To study the importance of sustainable agriculture for the growing population, various resources required and their sustainability.

UNIT- I AGROECOLOGY , AGROECOSYSTEM AND SUSTAINABLE 9 **AGRICULTURE CONCEPTS**

Ecosystem definition - Biotic Vs. abiotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture - Problems associated with industrial agriculture/food systems - Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems.

UNIT- II SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT 9

Soil health definition - Factors to consider (physical, chemical and biological) - Composition of healthy soils - Soil erosion and possible control measures - Techniques to build healthy soil - Management practices for improving soil nutrient - Ecologically sustainable strategies for pest and disease control.

UNIT- III WATER MANAGEMENT 9

Soil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling - Fertigation - Advanced

irrigation systems and agricultural practices for sustainable water use.

UNIT- IV ENERGY AND WASTE MANAGEMENT 9

Types and sources of agricultural wastes - Composition of agricultural wastes - Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture.

UNIT- V EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS 9

Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production - Goals and components of a community food system - Case studies.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able

1. Have an in-depth knowledge about the concepts, principles and advantages of sustainable agriculture
2. Discuss the sustainable ways in managing soil health, nutrients, pests and diseases
3. Suggest the ways to optimize the use of water in agriculture to promote an ecological use of resources
4. Develop energy and waste management plans for promoting sustainable agriculture in non-sustainable farming areas
5. Assess an ecosystem for its level of sustainability and prescribe ways of converting to a sustainable system through the redesign of a conventional agroecosystem

TEXTBOOKS:

1. Approaches to Sustainable Agriculture — Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020
2. M.Lakshmi Narasaiah, Environment and Agriculture, Discovery Pub. House, 2006.
3. Arvind Kumar, Environment and Agriculture, ABH Publications, New Delhi, 2005.
4. Saroja Raman, “Agricultural Sustainability – Principles, Processes and Prospects”, CRC Press, 2013.

5. Prof Johannes S. C. Wiskerke, Dr Nevin Cohen, Dr Laine Young, Prof Alison Blay-Palmer, Achieving sustainable urban agriculture, 2020.

REFERENCE BOOKS:

1. Agricultural Economics and Agribusiness, Cramer, Jensen, and Southgate, John Wiley.
2. Agricultural Economics, Drummond and Goodwin, Prentice Hall.
3. T.C. Byerly, Environment and Agriculture, United States Dept. of Agriculture, Economic Research Service, 2006.
4. Natural bioactive products in sustainable agriculture, Singh, J. & Yadav, A.N., Springer, 2020
5. Organic Farming for Sustainable Agriculture, Nandwani, D., Springer, 2016.

AGM502	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
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	-	-
Average	3	2	3	2	2	2	1	2	2	2	2	1	3	2	3	-

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-pyrolytic 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 –Polyurethane- reactions polymers for medical purposes - Collagens- Elastin- Cellulose and derivatives-Synthetic polymeric membranes and their biological applications

UNIT- III BIO CERAMICS AND BIOCOMPOSITES 9

General properties- Bio ceramics -Silicate glass - Alumina (Al₂O₃) -Zirconia (ZrO₂)-Carbon- Calcium phosphates (CaP)- Resorbable Ceramics- surface reactive ceramics- Biomedical Composites- Polymer Matrix Composite(PMC)-Ceramic Matrix Composite(CMC)-Metal Matrix Composite (MMC)– glass ceramics - Orthopedic implants-Tissue engineering scaffolds

UNIT- IV METALS AS BIOMATERIALS 9

biomedical metals-types and properties-stainless steel-Cobalt chromium alloys-Titanium alloys-Tantalum-Nickel titanium alloy (Nitinol)- magnesium-based biodegradable alloys-surface properties of metal implants for osteointegration-medical application-corrosion of metallic implants — biological tolerance of implant metals

UNIT- V NANOBIO MATERIALS

9

Steel construction, Types of steel used for construction, Methods of utilizing steel construction, Advantages and Applications of steel in construction.

Advanced Materials: Adhesives in construction industry-Acrylics, Bridge bearings, Industrial waste materials in concrete Rapid wall panels, Moisture Barriers, Polymer foams and polymers in Building Physics. Polymer concrete composites.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Students will gain familiarity with Biomaterials and they will understand their importance.
2. Students will get an overview of different biopolymers and their properties
3. Students gain knowledge on some of the important Bioceramics and Biocomposite materials
4. Students gain knowledge on metals as biomaterials
5. Student gains knowledge on the importance of nanobiomaterials in biomedical applications.

TEXTBOOKS:

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.

REFERENCE BOOKS:

1. Vasif Hasirci, Nesrin Hasirci “Fundamentals of Biomaterials” Springer, 2018
2. Leopoldo Javier Rios Gonzalez. “Handbook of Research on Bioenergy and Biomaterials: Consolidated and green process” Apple academic press, 2021.
3. Devarajan Thangadurai, Jeyabalan Sangeetha, Ram Prasad “Functional Bionanomaterials” springer, 2020.
4. Sujata.V.Bhat Biomaterials; Narosa Publishing house, 2002.
5. VasifHasirci, NesrinHasirci “Fundamentals of Biomaterials” Springer, 2018

AGM503	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	3	2	2	1	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	1	2	1	-	-	-	-	-	-	-	-	-	-
CO3	2	1	1	-	1	1	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	-	-	1	-	-	-	-	-	-	-	-	-	-
CO5	2	2	1	-	2	1	-	-	-	-	-	-	-	-	-	-
Average	2.2	1.8	1.8		1.7	1	-	-	-	-	-	-	-	-	-	-

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 : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Students will acquire knowledge about energy sustainability and principles of different

electrochemical devices and working of fuel cells and their application.

2. The students gain knowledge on different types of supercapacitors and the performance of various materials.
3. Comprehend and learn concepts related to building automation hardware and software and their application in smart buildings
4. Examine and apply lighting control, air conditioning and related applications in the context of smart buildings
5. Assess and apply other critical smart building applications and appreciate the role of data analytics in the control of building systems

TEXTBOOKS:

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

REFERENCE BOOKS:

1. Electrode Materials for Supercapacitors: A Review of Recent Advances, Parnia Forouzandeh, Vignesh Kumaravel and Suresh C. Pillai, catalysts 2020.
2. 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.
3. Review of next generation photovoltaic solar cell technology and comparative materialistic development Neeraj Kant, Pushpendra Singh, Materials Today: Proceedings, 2022.
4. Raphael, B. (2022). Construction and Building Automation: From Concepts to Implementation. Routledge.
5. Sinopoli, J. M. (2009). Smart buildings systems for architects, owners and builders.

Butterworth-Heinemann.

AGM504	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	-	-	-	-	3	-	-	-	-	-	2	-	-	-
CO2	1	-	-	-	-	-	-	-	1	-	-	2	-	3	1	-
CO3	-	-	-	3		1	2	-	-	-	-	-	-	2	-	2
CO4	-	-	-	-	-	-	-	1	-	-	3	-	1	-	2	-
CO5	-	-	-	-	-	1	1	3	2	-	-	2	-	-	-	-
Average	1.5	-	-	3	-	1	2	2	1.5	-	3	2	1.5	2.5	1.5	2

OBJECTIVES:

- To acquire knowledge on green systems and the environment, energy technology and efficiency, and sustainability.
- To understand the principles of green chemistry and eco friendly methodologies.
- To create awareness on Cleaner development mechanisms.
- To develop concepts on various energy efficient systems and green buildings.
- To provide green engineering solutions to energy demand, reduced energy

UNIT- I PRINCIPLES OF GREEN CHEMISTRY 9

Introduction to green chemistry and technology. Twelve principles of green chemistry, Green technology-definition, importance, factors affecting green technology. Role of industry, government and institutions; industrial ecology, role of industrial ecology in green technology.

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

Cleaner development technologies Cleaner development mechanisms, role of industry; reuse, reduce and recycle, raw material substitution; wealth from waste; carbon credits, carbon trading, carbon sequestration, eco labelling. Oxidation technology for waste water treatment- Cavitation, Fenton chemistry, photocatalysis and hybrid processes.

UNIT- IV DESIGNING GREEN PROCESSES 9

Energy efficient systems and processes Energy efficient motors, energy efficient lighting, control and selection of luminaries; bio-fuels, fuel cells- working, selection of fuels, Green manufacturing systems, selection of recyclable and environment friendly materials in

manufacturing, design and implementation of sustainable green production systems.

UNIT- V GREEN NANOTECHNOLOGY

9

Green Buildings Definition- Features and benefits, Fundamental planning decisions for energy efficient building- site selection, buildings forms and orientations, building fabrics and insulation, ventilation, passive solar features. Ecofriendly and cost effective materials, Energy management, roof top solar photovoltaic system and solar tracking system, alternating roofing systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To understand the principles of green engineering and technology
2. To learn about pollution using hazardous chemicals and solvents
3. To modify processes and products to make them green and safe.
4. To design processes and products using green technology.
5. To understand advanced technology in green synthesis.

TEXTBOOKS:

1. Soli J. Arceivala, "GREEN TECHNOLOGIES", McGraw Hill Education, 2017.
2. Khan B.H, Non conventional energy resources, Tata McGraw-Hill, New Delhi 2006.
3. Green Chemistry – An introductory text - M. Lancaster, RSC, 2016.
4. Rashmi Sanghi and M.M. Srivastava, Green Chemistry-Environment Friendly Alternatives, Narosa Publishing House, New Delhi 2009.
5. Paul L. Bishop, Pollution prevention–Fundamentals and Practices, McGraw-Hill-international 2000.

REFERENCE BOOKS:

1. Ritu Dogra, "Renewable Energy and Green Technology", Brillion Publishing, 2023.
2. Green chemistry metrics - Alexi Lapkin and david Constable (Eds) ,Wiley publications, 2008
3. Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017

4. Green technology and design for the environment, Samir B. Billatos, Nadia A. Basaly, Taylor & Francis, Washington, DC, ©1997
5. Sambit Kumar Mishra, Zdzislaw Polkowski, Samarjeet Borah, Ritesh Dash, “AI in Manufacturing and Green Technology: Methods and Applications” CRC Press, 2021.

AGM505	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	-	-	-	1	2	-	-	-	3	-	2	1	1	2	-
CO2	1	2	-	2	1	2	-	-	-	2	-	2	1	-	2	-
CO3	1	2	2	2	1	2	-	-	-	2	-	2	2	-	2	-
CO4	1	2	2	3	2	2	-	-	-	3	-	3	1	1	2	1
CO5	1	2	2	2	3	2	3	-	-	3	-	3	1	1	2	-
Average	1.0	2.0	2.0	2.0	2.0	2.0	3.0	0	0	3.0	0	2.0	1.0	1.0	2.0	1.0

AGM506	ENVIRONMENTAL QUALITY MONITORING AND ANALYSIS	L	T	P	C
		3	0	0	3

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 know the analytical and instrumental methods to measure various IEQ parameters
- To familiarize the regulations, standards and guidelines of IEQ
- To learn the fundamentals of computational fluid dynamics (CFD)

UNIT- I ENVIRONMENTAL MONITORING AND STANDARDS 9

Introduction to indoor environmental quality – Parameters: Thermal Comfort - thermal balance of human body – instrumentation and measurement - impact of thermal comfort on human productivity and health.

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) & 9
RISK ASSESSMENT

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

Fundamentals of mass transport – definition of intraphase and inter-phase chemical flux; interphase mass transport, diffusion coefficient and convection mass transfer coefficients. Chemical Exchange between air-water Overall transport model and scenarios.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the students will know

1. Basic concepts of environmental standards and monitoring.
2. The ambient air quality and water quality standards;
3. The various instrumental methods and their principles for environmental monitoring.
4. The significance of environmental standards in monitoring quality and sustainability of the environment.
5. The various ways of raising environmental awareness among the people.

TEXTBOOKS:

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 soil wastes / Pradyot Patnaik, © 1997 by CRC Press, Inc.
3. Pengler, J.D.; McCarthy, J.F.; Same, J.M., Indoor Air Quality Handbook. McGraw Hill, 2000.
4. Environmental monitoring / edited by G. Bruce Wiersma, © 2004 by CRC Press LLC.
5. Daoliang Li, Shuangyin Liu, “Water Quality Monitoring and Management” Elsevier, 2018.

REFERENCE BOOKS:

1. Nazaroff, W.W., and Alvarez-Cohen, L., Environmental Engineering Science. Wiley sons, Newyork, 2001.
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. Maroni, M.; Seifert, B.; Lindvall, T., Indoor Air Quality: A Comprehensive Reference Book. Elsevier Science Ltd, 1996.
4. Heaslip, G. (1975) Environmental Data Handling. John Wiley & Sons. New York.
5. Nicolas Mazzeo, “Air Quality Monitoring, Assessment and Management”, IntechOpen.

CE	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	2	-	-	-	2	-	2	-	3	-	2	1	-	-	1
CO2	-	1	-	2	-	2	-	2	-	2	-	2	1	-	-	1
CO3	-	-	2	2	-	2	-	2	-	2	-	2	-	2	-	1
CO4	-	-	2	3	-	2	-	3	-	3	-	3	1	1	-	1
CO5	-	-	2	2	-	2	3	2	-	3	-	3	-	1	-	1
Average	1.0	2.0	2.0	2.0	0.0	2.0	3.0	2.0	0.0	3.0	0.0	2.0	1.0	1.0	0.0	1.0