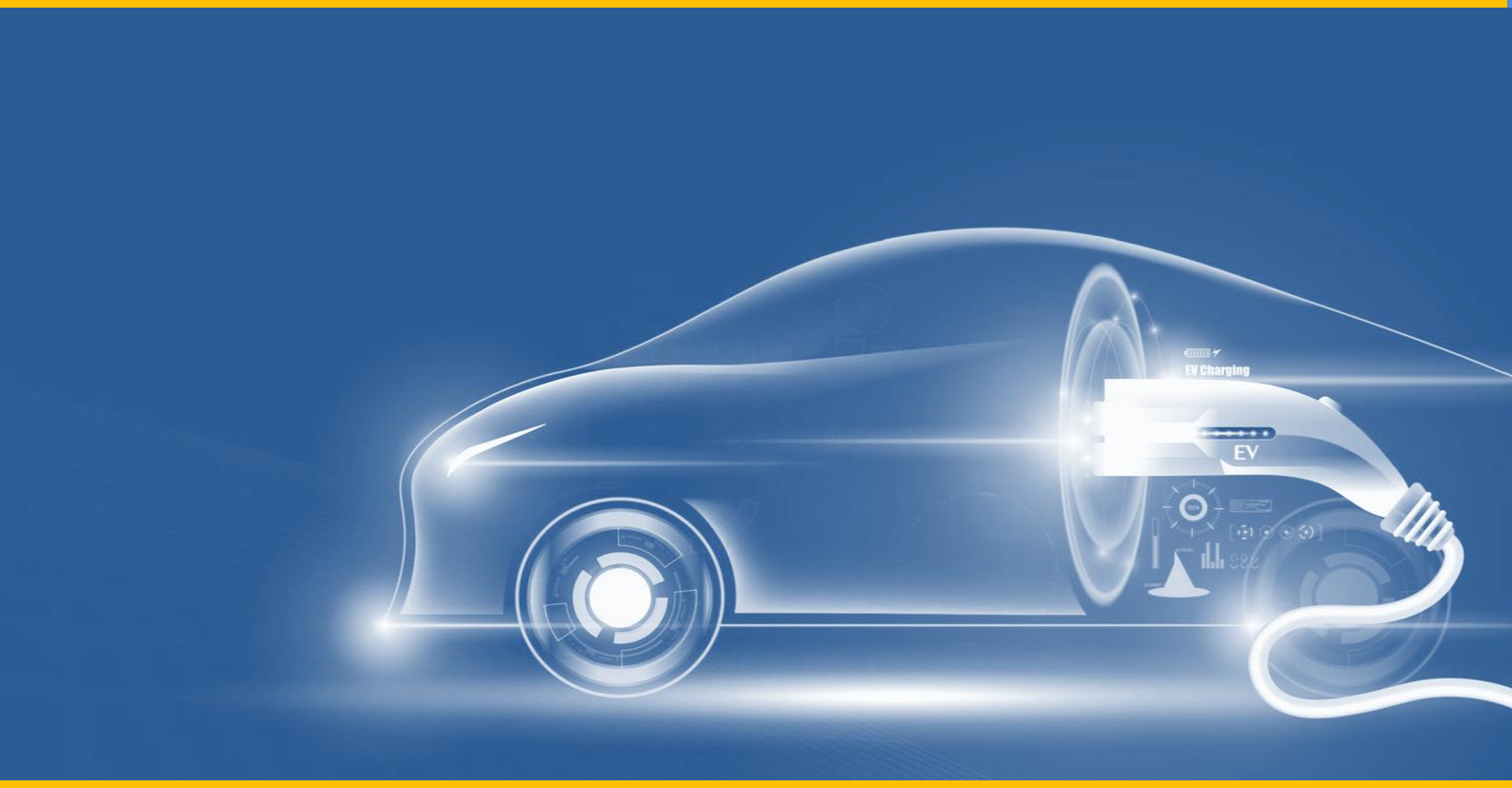
M.I.E.T. ENGINEERING COLLEGE

(Autonomous)

Tiruchirappalli-620007

Curriculum & Syllabus

(Regulations 2024)



B.E. Electrical and Electronics Engineering

M.I.E.T. ENGINEERING COLLEGE
(AUTONOMOUS)
(Approved by AICTE, New Delhi and Affiliated to Anna University, Chennai)
Accredited by NBA (CIVIL, CSE, ECE, EEE & MECH)
Accredited with 'A+' grade by NAAC
(An ISO 9001:2015 Certified Institution)
(Recognized by UGC under section 2(f) & 12(B) of UGC Act, 1956)
TRICHY - PUDUKKOTTAI MAIN ROAD, TRICHY - 620 007

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

CURRICULUM AND SYLLABUS

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING
(Regulations 2024)

Vision

To be recognized as a centre of excellence in Electrical and Electronics Engineering, contribution to the needs of stakeholders.

Mission

- To impart Quality Education through comprehensive exposure, value additions and effective teaching learning process.
- To facilitate learning environment in view of challenges in the field of Electrical and Electronics Engineering.
- To provide platform for students to update the contemporary knowledge withprofessional quality and commitment to lifelong learning.

Program Outcomes (POs)

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **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
3. **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.
4. **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.
5. **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.
6. **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.
7. **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.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
10. **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.

11. **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.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

1. Apply fundamental knowledge to identify, formulate, design and investigate various problems of electrical and electronic circuits, power electronics and power systems.
2. Gradaunds are able to apply their technical and professional skills in multi disciplinary environments.

Program Educational Objectives (PEOs)

1. To strengthen knowledge in the application modern tools and technological skill so as to identify, comprehend and solve problems.
2. To provide personality development training and activities to develop leadership quality, life long learning and ethical practices to have successful career as professional engineers.
3. To expose to active research and development activities using current technologies.

Mapping of PEOs with Pos and PSOs

PEOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO1
PEO1	3	3	3	3	3	2	2	1	2	1	1	3	3	2
PEO2	3	2	3	1	1	2	2	3	3	3	2	3	3	2
PEO3	3	3	3	3	3	3	2	1	2	1	3	3	3	2

1 - Low, 2 - Medium, 3 – High

CHOICE BASED CREDIT SYSTEM
CURRICULUM AND SYLLABUS FOR SEMESTER I TO VIII

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24IP1101	Induction Programme	-	-	-	-	-	0
2.	24HS1101	Professional English	HSMC	3	0	2	5	4
3.	24MU1101	Matrices and Calculus	BSC	3	1	0	4	4
4.	24PH1101	Engineering Physics	BSC	3	0	2	5	4
5.	24CY1101	Engineering Chemistry	BSC	3	0	2	5	4
6.	24GE1101	Problem Solving and Python Programming	ESC	3	0	2	5	4
7.	24GE1102	Heritage of Tamils தமிழர் மரபு	HSMC	1	0	0	1	1
8.	24GE1201	Professional Development	ESC	0	0	4	4	2
			Total	**16**	**1**	**12**	**29**	**23**

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24HS2101	Writing Skills for Professionals / Language Elective	HSMC	3	0	0	3	3
2.	24MU2101	Statistics and Numerical Methods	BSC	3	1	0	4	4
3.	24PH2101	Material Science	BSC	3	0	0	3	3
4.	24GE2101	Engineering Graphics	ESC	2	0	4	6	4
5.	24GE2102	Fundamentals of Building and Mechanical Sciences	ESC	3	0	2	5	4
6.	24EE2101	Circuit Analysis	PCC	3	0	2	5	4
7.	24GE2103	Tamils and Technology தமிழரும் தொழில்நுட்பமும்	HSMC	1	0	0	1	1
8.	24GE2201	Engineering Practice Laboratory	ESC	0	0	4	4	2
			Total	**18**	**1**	**12**	**31**	**25**

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24MU3102	Transforms and Complex Functions	BSC	3	1	0	4	4
2.	24EE3101	Electromagnetic Theory	PCC	3	0	2	5	4
3.	24EE3102	DC Machines and Transformers	PCC	3	0	0	3	3
4.	24EE3103	Analog Electronics	PCC	3	0	2	5	4
5.	24EE3104	Transmission and Distribution	PCC	3	0	2	5	4
6.	24EE3105	Data Structures using C & C++	ESC	3	0	2	5	4
7.	24MC31XX	Mandatory course I	MC	1	0	0	1	0
8.	24EE3201	DC Machines and Transformers Laboratory	PCC	0	0	3	3	1.5
9.	24EE3202	Electrical Workshop	PCC	0	0	3	3	1.5
			Total	**19**	**1**	**14**	**34**	**26**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24EE4101	Power System Analysis	PCC	3	0	2	5	4
2.	24CY4101	Environmental Science and Engineering	BSC	2	0	0	2	2
3.	24EE4102	Electrical Machines II	PCC	3	0	0	3	3
4.	24EE4103	Digital Electronics	PCC	3	0	2	5	4
5.	24EEPEXX	Professional Elective I	PEC	3	0	0	3	3
6.	24EE4104	Measurements and Instrumentation	PCC	3	0	2	5	4
7.	24EE4201	AC Machines Laboratory	PCC	0	0	3	3	1.5
8.	24EE4202	Instrumentation and PLC Laboratory	ESC	0	0	3	3	1.5
9.	24GE4201	Technical Seminar	EEC	0	0	2	2	1
			Total	**17**	**0**	**14**	**31**	**24**

SEMESTER V

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24EE5101	Renewable Energy Resources	PCC	3	0	0	3	3
2.	24EE5102	Control Systems	PCC	3	0	2	5	4
3.	24EE5103	Power Electronics and Drives	PCC	3	0	2	5	4
4.	24EEPEXX	Professional Elective II	PEC	3	0	0	3	3
5.	24EEPEXX	Professional Elective III	PEC	3	0	0	3	3
6.	24OXXXXX	Open elective I	OEC	3	0	2	5	4
7.	24MC51XX	Mandatory Course II	MC	1	0	0	1	0
8.	24EE5201	Renewable Energy Resources Laboratory	PCC	0	0	3	3	1.5
9.	24EE5202	Electrical Estimation and Costing Laboratory	PCC	0	0	3	3	1.5
			Total	**19**	**0**	**12**	**31**	**24**

SEMESTER VI

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24EE6101	Protection and Switchgear	PCC	3	0	0	3	3
2.	24EE6102	Microprocessor, Microcontroller and Embedded Systems	PCC	3	0	2	5	4
3.	24EE6103	Power System Operation and Control	PCC	3	0	2	5	4
4.	24EEPEXX	Professional Elective IV	PEC	3	0	0	3	3
5.	24EEPEXX	Professional Elective V	PEC	3	0	0	3	3
6.	24OXXXXX	Open elective II	OEC	3	0	0	3	3
7.	24EE6201	Power System Simulation Laboratory	PCC	0	0	3	3	1.5
8.	24EE6202	Embedded System Laboratory	ESC	0	0	3	3	1.5
9.	24PD6201	NCC/NSS/NSO*#	-	2	0	0	0	2*#
			Total	**18**	**0**	**10**	**28**	**23**

***# Guidelines for evaluation are provided in detail in the Regulation/Syllabus. The grade earned by the students will be recorded in the Mark sheet, however the same not be considered for the computation of CGPA.**

SEMESTER VII

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24HS7101	Professional Ethics and Human Values	HSMC	2	0	0	2	2
2.	24EEPEXX	Professional Elective VI	PEC	3	0	0	3	3
3.	24EEPEXX	Professional Elective VII	PEC	3	0	2	5	4
4.	24EEPEXX	Professional Elective VIII	PEC	3	0	2	5	4
5.	24OXXXXX	Open elective -III	OEC	3	0	0	3	3
6.	24EE7501	Mini Project	EEC	0	0	4	4	2
7.	24IS7201	Internship[##]	EEC	-	-	-	-	1
8.	24CA7201	Case Study[***]	EEC	-	-	-	-	1
			Total	**14**	**0**	**8**	**22**	**20**

[##]**Students should undergo Internship for a period of 2- 4 weeks during 6th Semester vacation.**

[***]**Students should perform case study during 6th Semester vacation.**

SEMESTER VIII

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24EE8501	Project Work	EEC	0	0	20	20	10
			Total	**0**	**0**	**20**	**20**	**10**

BASIC SCIENCE COURSES (BSC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24MU1101	Matrices and Calculus	BSC	3	1	0	4	4
2.	24PH1101	Engineering Physics	BSC	3	0	2	5	4
3.	24CY1101	Engineering Chemistry	BSC	3	0	2	5	4
4.	24MU2101	Statistics and Numerical Methods	BSC	3	1	0	4	4
5.	24PH2101	Material Science	BSC	3	0	0	3	3
6.	24MU3102	Transforms and Complex Functions	BSC	3	1	0	4	4
7.	24CY4101	Environmental Science and Engineering	BSC	2	0	0	2	2
							Total	**25**

ENGINEERING SCIENCE COURSES (ESC)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24GE1101	Problem Solving and Python Programming	ESC	3	0	2	5	4
2.	24GE1201	Professional Development	ESC	0	0	4	4	2
3.	24GE2101	Engineering Graphics	ESC	2	0	4	6	4
4.	24GE2102	Fundamental of Building and Mechanical Science	ESC	3	0	2	5	4
5.	24GE2201	Engineering Practice Laboratory	ESC	0	0	4	4	2
6.	24EE3105	Data Structures using C & C++	ESC	3	0	2	5	4
7.	24EE4202	Instrumentation and PLC Laboratory	ESC	0	0	3	3	1.5
8.	24EE6202	Embedded System Laboratory	ESC	0	0	3	3	1.5
							Total	**23**

HUMANITIES, SOCIAL SCIENCES AND MANAGEMENT COURSES (HSMC)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24HS1101	Professional English	HSMC	3	0	2	5	4
2.	24GE1102	Heritage of Tamils – தமிழர் மரபு	HSMC	1	0	0	1	1
3.	24HS2101	Writing Skills for Professionals / Language Elective	HSMC	3	0	0	3	3
4.	24GE2103	Tamils and Technology தமிழரும் தொழில்நுட்பமும்	HSMC	1	0	0	1	1
5.	24HS7101	Professional Ethics and Human Values	HSMC	2	0	0	2	2
							Total	**11**

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24GE4201	Technical Seminar	EEC	0	0	2	2	1
2.	24EE7201	Mini Project	EEC	0	0	4	4	2
3.	24IS7201	Internship	EEC	-	-	-	-	1
4.	24CA7201	Case Study	EEC	-	-	-	-	1
5.	24EE8501	Project Work	EEC	0	0	20	20	10
							Total	**15**

PROFESSIONAL CORE COURSES (PCC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24EE2102	Circuit Analysis	PCC	3	0	2	5	4
2.	24EE3101	Electromagnetic Theory	PCC	3	0	2	5	4
3.	24EE3102	DC Machines and Transformers	PCC	3	0	0	3	3
4.	24EE3103	Analog Electronics	PCC	3	0	2	5	4
5.	24EE3104	Transmission and Distribution	PCC	3	0	2	5	4
6.	24EE4101	Power System Analysis	PCC	3	0	2	5	4
7.	24EE4102	AC Machines	PCC	3	0	0	3	3
8.	24EE4103	Digital Electronics	PCC	3	0	2	5	4
9.	24EE4105	Measurement and Instrumentation	PCC	3	0	2	5	4
10.	24EE5101	Renewable Energy Resources	PCC	3	0	0	3	3
11.	24EE5102	Control Systems	PCC	3	0	2	5	4
12.	24EE4103	Power Electronics	PCC	3	0	2	5	4
13.	24EE6101	Protection and Switchgear	PCC	3	0	0	3	3
14.	24EE6102	Microprocessor, Microcontroller and Embedded Systems	PCC	3	0	2	5	4
15.	24EE6103	Power system operation and Control	PCC	3	0	2	5	4
16.	24EE3201	DC Machines and Transformers Laboratory	PCC	0	0	3	3	1.5

17.	24EE3202	Electrical Workshop	PCC	0	0	3	3	1.5
18.	24EE4201	AC Machines Laboratory	PCC	0	0	3	3	1.5
19.	24EE5201	Renewable Energy Resources Laboratory	PCC	0	0	3	3	1.5
20.	24EE5201	Electrical Estimation and Costing Laboratory	PCC	0	0	3	3	1.5
21.	24EE6201	Power System Simulation Laboratory	PCC	0	0	3	3	1.5
							Total	**65**

PROFESSIONAL ELECTIVES COURSES (PEC)

SEMESTER IV & V, PROFESSIONAL ELECTIVE I & II

POWER SYTEMS

S. NO.	COURSECODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24EEPE01	Flexible AC Transmission Systems	PEC	3	0	0	3	3
2.	24EEPE02	High Voltage DC Transmission	PEC	3	0	0	3	3
3.	24EEPE03	Restructured Power Systems	PEC	3	0	0	3	3
4.	24EEPE04	Power Quality	PEC	3	0	0	3	3
5.	24EEPE05	Smart Grid	PEC	3	0	0	3	3
6.	24EEPE06	Power System Transients	PEC	3	0	0	3	3
7.	24EEPE07	High Voltage Engineering	PEC	3	0	0	3	3
8.	24EEPE08	Distribution Generation and Microgrid	PEC	3	0	0	3	3

SEMESTER V & VI, PROFESSIONAL ELECTIVE III & IV

RENEWABLE ENERGY SYSTEMS

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24EEPE09	Converters for Renewable Energy Systems	PEC	3	0	0	3	3

2.	24EEPE10	Power Electronics for Renewable Energy Systems	PEC	3	0	0	3	3
3.	24EEPE11	Solar Energy Conversion System	PEC	3	0	0	3	3
4.	24EEPE12	Wind Energy Conversion System	PEC	3	0	0	3	3
5.	24EEPE13	Design and Modelling of Renewable Energy Systems	PEC	3	0	0	3	3
6.	24EEPE14	Hybrid Energy Technology	PEC	3	0	0	3	3
7.	24EEPE15	Energy Management and Auditing	PEC	3	0	0	3	3
8.	24EEPE16	Design of Electrical Apparatus	PEC	3	0	0	3	3

SEMESTER VI & VII, PROFESSIONAL ELECTIVE V & VI
ADVANCED ELECTRICAL ENGINEERING

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PERWEEK	CREDITS
				L	T	P		
1.	24EEPE17	Soft Computing Techniques in Electrical Engineering	PEC	3	0	0	3	3
2.	24EEPE18	Artificial Intelligence and Machine Learning in Electrical Engineering	PEC	3	0	0	3	3
3.	24EEPE19	Electrical Drives	PEC	3	0	0	3	3
4.	24EEPE20	Analysis of Electrical Machines	PEC	3	0	0	3	3
5.	24EEPE21	Special Electrical Machines	PEC	3	0	0	3	3
6.	24EEPE22	Utilization and Conservation of Electrical Energy	PEC	3	0	0	3	3
7.	24EEPE23	Embedded Processors	PEC	3	0	0	3	3
8.	24EEPE24	Digital Signal Processing	PEC	3	0	0	3	3

SEMESTER VII, PROFESSIONAL ELECTIVE VII & VIII

ELECTRIC VEHICLE

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24EEPE25	Electric Vehicle Architecture	PEC	3	0	2	5	4
2.	24EEPE26	Design of Motor and Power Converters For Electric Vehicles	PEC	3	0	2	5	4
3.	24EEPE27	Electric Vehicle Design, Mechanics and Control	PEC	3	0	2	5	4
4.	24EEPE28	Design of Electric Vehicle Charging System	PEC	3	0	2	5	4
5.	24EEPE29	Testing of Electric Vehicles	PEC	3	0	2	5	4
6.	24EEPE30	SMPS and UPS	PEC	3	0	2	5	4
7.	24EEPE31	Intelligent Control of Electric Vehicles	PEC	3	0	2	5	4
8.	24EEPE32	Multi Level Converters	PEC	3	0	2	5	4

MANDATORY COURSES (MC)

MANDATORY COURSES I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24MC3101	Legal System of India	MC	3	0	0	3	0
2.	24MC3102	IPR and Patent Drafting	MC	3	0	0	3	0
3.	24MC3103	Literary Forms and Techniques	MC	3	0	0	3	0
4.	24MC3104	Disaster Risk Reduction and Management	MC	3	0	0	3	0
5.	24MC3105	Film Appreciation	MC	3	0	0	3	0
6.	24MC3106	Women and Gender Studies	MC	3	0	0	3	0

MANDATORY COURSES II

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS PERWEEK	CREDITS
				L	T	P		
1.	24MC5101	Food and Nutrition	MC	3	0	0	3	0
2.	24MC5102	Design Thinking	MC	3	0	0	3	0
3.	24MC5103	History of Science and Technology in India	MC	3	0	0	3	0
4.	24MC5104	Political and Economic Thought for a Humane Society	MC	3	0	0	3	0
5.	24MC5105	State, Nation Building and Politics in India	MC	3	0	0	3	0
6.	24MC5106	Industrial Safety	MC	3	0	0	3	0

OPEN ELECTIVE COURSES (OEC)

OPEN ELECTIVE I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24OCI101	Estimation and Costing of Building	OEC	3	0	2	5	4
2.	24OCI102	Quality assessment of Building Materials	OEC	3	0	2	5	4
3.	24OCI103	Project Management	OEC	3	0	2	5	4
4.	24OCI104	Building planning using Vaastu Sastra	OEC	3	0	2	5	4
5.	24OAI101	Web technology	OEC	3	0	2	5	4
6.	24OAI102	Object oriented programming	OEC	3	0	2	5	4
7.	24OAI103	Computational data analytics	OEC	3	0	2	5	4
8.	24OAI104	Networking concepts	OEC	3	0	2	5	4
9.	24OMI101	Internal Combustion Engines	OEC	3	0	2	5	4
10.	24OMI102	Testing of Engineering Materials	OEC	3	0	2	5	4
11.	24OMI103	Industrial Layout Design and Safety	OEC	3	0	2	5	4
12.	24OMI104	Product Design and Process Development	OEC	3	0	2	5	4

13.	24OBI101	Digital Signal Processing	OEC	3	0	2	5	4
14.	24OBI102	IoT and Sensors Types	OEC	3	0	2	5	4
15.	24OBI103	Medical Diagnostic and Therapeutic Equipments	OEC	3	0	2	5	4
16.	24OBI104	Biomedical Instrument and Design	OEC	3	0	2	5	4

OPEN ELECTIVE II

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24OCT201	Building Planning and Approval	OEC	3	0	0	3	3
2.	24OCT202	Energy Efficient Building	OEC	3	0	0	3	3
3.	24OCT203	Environmental Impact Assessment	OEC	3	0	0	3	3
4.	24OCT204	Rehabilitation of Structures	OEC	3	0	0	3	3
5.	24OCT205	Drinking water supply and Treatment	OEC	3	0	0	3	3
6.	24OCT206	Project Scheduling and Optimization using CPM and PERT Techniques	OEC	3	0	0	3	3
7.	24OAT201	Principles of programming languages	OEC	3	0	0	3	3
8.	24OAT202	Information security management	OEC	3	0	0	3	3
9.	24OAT203	Human computer interaction	OEC	3	0	0	3	3
10.	24OAT204	Computer application in agricultures	OEC	3	0	0	3	3
11.	24OAT205	Mobile computing	OEC	3	0	0	3	3
12.	24OAT206	Object oriented analysis and design	OEC	3	0	0	3	3
13.	24OMT201	Bioenergy Conversion Technologies	OEC	3	0	0	3	3
14.	24OMT202	Automotive Materials, Components, Design and Testing	OEC	3	0	0	3	3

15.	24OMT203	Green Manufacturing Design and Practices	OEC	3	0	0	3	3
16.	24OMT204	Semiconductor Manufacturing	OEC	3	0	0	3	3
17.	24OMT205	Future Energy Resources and Mobility	OEC	3	0	0	3	3
18.	24OMT206	Failure Analysis and NDT Techniques	OEC	3	0	0	3	3
19.	24OBT201	Hospital Management	OEC	3	0	0	3	3
20.	24OBT202	Assist Devices	OEC	3	0	0	3	3
21.	24OBT203	Robotics in Medicine	OEC	3	0	0	3	3
22.	24OBT204	DSP Architecture	OEC	3	0	0	3	3
23.	24OBT205	Image Processing	OEC	3	0	0	3	3
24.	24OBT206	Wireless Sensor Networks	OEC	3	0	0	3	3

SUMMARY

S.No.	Subject Area	Credits per Semester								Credits Total
		I	II	III	IV	V	VI	VII	VIII	
1.	Basic Science Course (BSC)	12	7	4	2	0	0	0	0	25
2.	Engineering Science Courses (ESC)	6	10	4	1.5	0	1.5	0	0	23
3.	Humanities, Social Sciences and Management Courses (HSMC)	5	4	0	0	0	0	2	0	11
4	Employability Enhancement Courses (EEC)	-	-	0	1	0	0	4	10	15
5.	Professional Core Courses (PCC)	-	4	18	16.5	14	12.5	0	0	65
6.	Professional Elective Courses (PEC)	-	-	0	3	6	6	11	0	26
7.	Mandatory Courses (MC)	-	-	0	0	0	0	0	0	0
8.	Open Elective Courses (OEC)	-	-	0	0	4	3	3	0	10
Total Credit		23	25	26	24	24	23	20	10	**175**

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 175

24HS1101 **PROFESSIONAL ENGLISH** **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To enable the students to learn the fundamentals of English grammar.
- To develop the ability to write complex texts and essays that are relevant to authentic contexts.
- To present their opinions through letters and reports that will be relevant for their future endeavours.

UNIT I FUNDAMENTALS & SUMMATION **9**

Grammar & Vocabulary: Parts of Speech, Articles, Pronoun, Homonyms & Homophones, Word Formation (Prefix and Suffix). **Listening:** Telephonic Conversations - different viewpoints on a topic.**Speaking:**Self-Introduction Conversation - politeness strategies; asking for information to fill details in a form **Reading:** Reading biographies, travelogues, newspaper reports. **Writing**: Report writing (Accident report, Survey Report), Checklist.

UNIT II PROBLEM SOLVING & RECOMMENDATIONS **9**

Grammar & Vocabulary: Abbreviations & Acronyms, Tenses, Subject -Verb Agreement, Active, Passive and Impersonal Passive Voice. **Listening:** Listening to anecdotes, stories & event narration.**Speaking:** Narrating personal experiences/ events, Extempore, Story-Telling. **Reading:** Reading Editorials; and Opinion Blogs. **Writing**: Letter Writing (Complaint Letter, Response to complaint), Recommendations.

UNIT III DESCRIPTION OF A PROCESS OR PRODUCT AND USAGE OF IMPERATIVE **9**

Grammar & Vocabulary: Adjective, Degrees of Comparison, Imperative and Gerund, One Word Substitution. **Listening:** Classroom Lecture, advertisements about products.**Speaking –** Picture description; giving instruction to use the product; presenting a product. **Reading:** Reading advertisements, gadget reviews; user manuals. **Writing**: Instructions, Process and Product Description.

UNIT IV DRAFTING AND RESUME MAKING **9**

Grammar &Vocabulary: Collocations, Conjunction, Framing Question Tags/ "Wh" questions. **Listening:** TED talks, educational videos. **Speaking –** Small Talk; Mini presentations and making recommendations. **Reading**: Reading brochures (technical context). **Writing:** Email writing and Email etiquette- Job Application Letter and Resume.

UNIT V EXPRESSING IDEAS **9**

Grammar &Vocabulary: Discourse Markers, Cause and Effect words, Modal verbs, Spotting Errors. **Listening:** Panel Discussions, listening to debates.**Speaking:** Group discussions, Debates and Expressing opinions & Role play. **Reading:** Reading Newspaper articles; Journal reports. **Writing:** Essay writing (Narrative, Descriptive), Reading Comprehension, Transcoding (Bar chart, Pie chart, Table).

TOTAL: 45 PERIODS

LIST OF ACTIVITIES

1. Self-Introduction-Politeness Strategies.
2. Extempore.
3. Story Telling.
4. Picture Description.
5. Product Description.
6. Presentations.
7. Group Discussion.
8. Role-Play.
9. Debates and Expressing Opinions.
10. Narrating Personal Experiences.
11. Reading Biographies, Travelogues.
12. Reading Advertisements, User Manuals.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Understand the basic grammatical structures and use them in right context.
CO2: Write complaint letters and recommendations with utmost accuracy.
CO3: Describe about products and processes clearly.
CO4: Write a job application letter and resume without flaws.
CO5: Speak fluently and interpret information presented in tables, charts and other graphic forms.

TEXT BOOKS

1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, 2020.
2. Dr S Gunasekaran, "A Workbook of Professional English", Vishnu Prints Media,2021.
3. Meenakshi Raman & Sangeeta Sharma, "Technical Communication – Principles and Practices",Oxford Univ. Press, 2022.

REFERENCE BOOKS

1. Raymond Murphy, "Essential English Grammar", 2nd Edition, Cambridge University Press, 2024.
2. Brain Chanen, "IB English A: Language and Literature", Oxford Publications, 2019.
3. Phil Williams, "Advanced Writing Skills for Students of English", Goodwill Publishing House, 2022.
4. Stella Cortrell, "The Study Skills Handbook", Red Globe Press, 2019.
5. Adrian Wall, "English for Academic Correspondence and Socializing", Springer Publications, 2017.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO2	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO3	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO4	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO5	-	-	-	-	-	-	-	2	2	2	2	2	2	-
AVG	-	-	-	-	-	-	-	2	2	2	2	2	2	-

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

24MU1101 MATRICES AND CALCULUS **L T P C**
3 1 0 4

COURSE OBJECTIVES

- To familiarize the students with Eigen values and Eigen vectors to reduce the quadratic form to canonical form.
- To familiarize the students with differential calculus and functions of several variables.
- To make the students to solve the problems on integration and multiple integration.

UNIT I MATRICES **9+3**

Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigenvectors – Cayley-Hamilton theorem(without proof) – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms .

UNIT II DIFFERENTIAL CALCULUS **9+3**

Limit of a function – Continuity – Derivatives – Differentiation rules (sum, product, quotient, chain rules) – Implicit differentiation – Logarithmic differentiation – Applications: Maxima and Minima of functions of one variable.

UNIT III FUNCTIONS OF SEVERAL VARIABLES **9+3**

Partial differentiation – Homogeneous functions and Euler's theorem (without proof) – Jacobians – Taylor's series for functions of two variables – Applications: Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT IV INTEGRAL CALCULUS **9+3**

Definite and Indefinite integrals – Substitution rule – Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions – Improper integrals.

UNIT V MULTIPLE INTEGRALS **9+3**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

TOTAL: 60 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Apply matrix algebra methods for solving various application problems.
CO2: Apply differential calculus methods in solving various application problems.
CO3: Apply the differential calculus ideas on several variable functions.
CO4: Apply different methods of integration in solving practical problems.
CO5: Apply multiple integral methods in solving areas, volumes and other practical problems.

TEXT BOOKS

1. T. Veerarajan, “Engineering Mathematics(Volume I & II)”,Mc Graw Hill Education, New Delhi,2018.
2. B. S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 45th Edition, 2024.
3. Erwin Kreyszig, “Advanced Engineering Mathematics”, Wiley India Pvt Ltd., New Delhi, 2015.

REFERENCE BOOKS

1. B.V .Ramana, "Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd., New Delhi, 2016.
2. John Bird, “Bird’s Higher Engineering Mathematics”, 9th Edition, Routledge Taylor and Fransis Group, 2021.
3. H.Anton, I.Bivens. I and S. Davis, “Calculus ", Wiley, 10th Edition, 2016.
4. R.K. Jain and S.R.K. Iyengar, “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 5th Edition, 2016.
5. G.B.Thomas, J.Hass and M.D.Weir, “Thomas Calculus ", 14th Edition, Pearson India, 2018.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	-	2	-	-	-	-	-	-	-	-	2	-
CO2	2	3	-	2	-	-	-	-	-	-	-	-	2	-
CO3	2	3	-	2	-	-	-	-	-	-	-	-	2	-
CO4	2	3	-	2	-	-	-	-	-	-	-	-	2	-
CO5	2	3	-	2	-	-	-	-	-	-	-	-	2	-
AVG	2	3	-	2	-	-	-	-	-	-	-	-	2	-

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

24PH1101 ENGINEERING PHYSICS **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To make the students to understand the properties of matter.
- To analysis the ultrasonic wave and laser with applications.
- To get knowledge on optical fibers and the importance of quantum theory.

UNIT I PROPERTIES OF MATTER **9**

Introduction – Elasticity – Hooke's Law –Stress –strain diagram – Types of modulus of elasticity –bending of beams – bending moment – cantilever : theory and experiment – uniform and non-uniform bending: theory and experiment – twisting couple – torsion pendulum: theory and experiment – I – shaped girders.

UNIT II ULTRASONICS AND BIO MEDICAL APPLICATIONS **9**

Introduction – Production of ultrasonics: magnetostriction effect and piezo electric effect – Velocity measurement: acoustic grating – Industrial applications: drilling, welding, soldering and cleaning –SONAR – Non Destructive testing – pulse echo system through transmission and reflection modes- A, B and C – scan displays, Clinical Applications -Sonograms.

UNIT III LASERS **9**

Introduction – Einstein's theory – Population inversion, pumping – Types of lasers; Nd-YAG Laser, He-Ne Laser,Semiconductor lasers (homo junction &hetero junction) – Industrial Applications-Lasers in welding, heat treatment, cutting.

UNIT IV FIBER OPTICS **9**

Principle and propagation of light in optical fibres – Acceptance angle and Numerical aperture-Types of optical fibres (material, refractive index, mode) – Optical Loss in optical fibre – attenuation, dispersion, bending – Fibre optical communication system (Block diagram) – Endoscope.

UNIT V QUANTUM PHYSICS **9**

Black body radiation – Planck's theory (derivation) – Compton effect – Theory and experimental verification – Matter waves – Schrodinger's wave equation – Time independent and time dependent equations – Physical significance of wave function–Transmission Electron microscope –Scanning electron microscope.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Determination of rigidity modulus – Torsion pendulum.
2. Determination of unknown mass of a body for known rigidity modulus – Torsion pendulum.
3. Determination of Young's modulus by non – uniform bending method.
4. Determination of unknown mass of a body for known Young's modulus by non – uniform bending method.
5. Determination of Young's modulus by uniform bending method.
6. Determination of unknown mass of a body for known Young's modulus by uniform

bending method.

7. Determination of wavelength of Laser by diffraction grating method.
8. Determination of thickness of material using Air wedge.
9. Determination of width of the groove in a CD using Laser Diffraction.
10. Determination of Compressibility of given liquid using Ultrasonic interferometer.
11. Simple harmonic oscillations of cantilever.
12. Determination of unknown mass of a body for known Young's modulus by cantilever simple harmonic oscillations.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Gain knowledge on basics of properties of matter.
CO2: Acquire knowledge on magnetic ultrasonic waves and its applications.
CO3: Demonstrate the strong fundamental knowledge in Laser.
CO4: Acquire knowledge on function of fiber optical devices and its applications.
CO5: Understand the concepts of quantum physics.

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, 2018.
3. Arthur Beiser, Shobhit Mahajan Sand Rai Choudhury, "Concepts of Modern Physics", McGraw-Hill (Indian Edition), 2017.

REFERENCE BOOKS

1. Serway R A & Jewett J W, "Physics for Scientists and Engineers", Cengage Learning, 2016.
2. Tipler P A & Mosca G, "Physics for Scientists and Engineers with Modern Physics", W.H.Freeman, 2017.
3. K Thyagarajan & A Ghatak, "Lasers: Fundamentals and Applications", Laxmi Publications, (Indian Edition), 2019.
4. D. Halliday, R. Resnick and J Walker, "Principles of Physics", Wiley (Indian Edition), 2015.
5. Pandey B K & Chaturvedi S "Engineering Physics", Cengage Learning India.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	3	-	-	-	-	-	-	-	3	2	-
CO2	3	2	3	2	-	-	-	-	-	-	-	3	2	-
CO3	3	2	2	2	-	-	-	-	-	-	-	2	2	-
CO4	3	2	3	2	-	-	-	-	-	-	-	2	2	-
CO5	3	2	3	2	-	-	-	-	-	-	-	3	2	-
AVG	3	2	2.8	2.8	-	-	-	-	-	-	-	2.6	2	-

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

24CY1101 ENGINEERING CHEMISTRY **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To familiarize students about the treatment of boiler feed water.
- To gain the knowledge about the various types of batteries and fuels.
- To understand the properties of Engineering materials and Nanomaterials.

UNIT I WATER TECHNOLOGY **9**

Hardness of water- Types - Boiler troubles - Scale - Sludge- Caustic embrittlement- Priming and Foaming-Softening of boiler feed water- Internal conditioning (phosphate, calgon and carbonate conditioning) - External conditioning-Ion Exchange process-Zeolite process.

UNIT II ENERGY STORAGE **9**

Batteries-Types of batteries-Primary battery-Dry cell, Secondary battery- Lead acid battery and Lithium-ion-battery-Fuel cells - H_2-O_2fuel cell-E-Vehicles -Advantages of E-Vehicles.

UNIT III ENGINEERING MATERIALS **9**

Refractories - classification - properties and applications of refractories - Abrasives - properties and Applications of abrasives - Cement - composition of cement - setting and hardening of cement - Glass - Manufacture - Types of glass and its uses.

UNIT IV NANOCHEMISTRY **9**

Nanomaterials - Distinction between Nanoparticles, Molecules and Bulk materials - Types of Nanomaterials - Nanoparticle - Nanowire and Nanotube - Preparation of Nanomaterials - sol-gel- solvothermal Methods and Applications of Nanomaterials in Agriculture and Medicine field.

UNIT V FUELS **9**

Fuels - Coal - Analysis of coal (Proximate Analysis)-Refining of Petroleum - Fractional Distillation - Manufacture of metallurgical coke (Otto Hoffmann method) -Manufacture of synthetic petrol (Bergius process) - Power alcohol – Biodiesel.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Estimation of total, temporary and permanent Hardness of the sample water by EDTA method.
2. Estimation of strength of given Hydrochloric acid using pH meter.
3. Estimation of strength of given Hydrochloric acid using conductivity meter.
4. Determination of strength of acids in a mixture of acids using conductivity meter.
5. Estimation of amount of $BaCl_2$ present in the given solution using Std.Na_2SO_4 using conductivity meter.
6. Estimation of iron content of the given solution using potentiometer.
7. Estimation of amount of Cl^- ion present in the given solution by Argentometric method.

8. Determination of alkalinity of the water sample using HCl with Na_2CO_3 as the primary standard.
9. Prepare Na_2CO_3 as primary standard and using it to estimate the acidity present in the given water sample.
10. Estimation of copper content of the given solution by EDTA method.
11. Determination of Dissolved oxygen content of water sample by Winkler's method.
12. Preparation of Biodiesel by using vegetable oil.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Assess water impurities, determining hardness and eliminating substances responsible for hardness.

CO2: Identify diverse energy resources and effectively apply them in various sectors of the energy industry.

CO3: Assess engineering materials that meet industry specifications and requirements.

CO4: Identify and apply basic concepts of Nano science and technology in designing the synthesis of Nano materials for Engineering and Technology.

CO5: Recommend suitable fuels for engineering processes and applications.

TEXT BOOKS

1. P C Jain and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company(P) Ltd, New Delhi , 17th Edition, 2022.
2. Friedrich Emich, "Engineering Chemistry", Scientific International Pvt. Ltd.,New Delhi, 2017.
3. S S Dara, "A text book of Engineering Chemistry", S Chand Publishing, 12th Edition, 2018.

REFERENCE BOOKS

1. Hammer Sr and Hammer Jr,"Water and waste water technology", Pearson Education India, 7th Edition, 2015.
2. Nihal Kularatna and Kosala Gunawardane," Energy Storage Devices for Renewable Energy-based Systems, Academic Pr, 2nd Edition, 2021.
3. Kenneth G Budinski, Michael K Budinski, "Engineering Materials", Pearson, 9th Edition, 2016.
4. Chattopadhyay K K, "Introduction to Nanoscience and Nanotechnology", Prentice Hall India Learning Private Limited, 2021.
5. James G Speight, "Handbook of Natural Gas Analysis", Wiley, 1st Edition, 2018.

Mapping of COs with POs & PSOs

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	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	2	2	-	2	-	-	-	-	-	2	2	-
CO2	2	2	2	2	-	2	-	-	-	-	-	2	2	-
CO3	2	2	2	2	-	2	-	-	-	-	-	2	2	-
CO4	2	2	2	2	-	2	-	-	-	-	-	2	2	-
CO5	2	2	2	2	-	2	-	-	-	-	-	2	2	-
AVG	2	2	2	2	-	2	-	-	-	-	-	2	2	-

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

24GE1101 PROBLEM SOLVING AND PYTHON PROGRAMMING **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To understand the basics of algorithmic problem solving.
- To learn to solve problems using Python conditionals and loops.
- To define Python functions and use function calls to solve problems.

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING **9**

Fundamentals of Computing – Identification of Computational Problems – Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flowchart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guessan integer number in a range, Towers of Hanoi.

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS **9**

Python interpreter and interactive mode, debugging; values and types: int, float, Boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS, STRINGS **9**

Conditionals: Boolean values and operators, conditional (if), alternative (if – else), chained conditional (if el if – else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES **9**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNITV FILES, MODULES, PACKAGES **9**

Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter‘s age validation, Marks range validation (0-100).

TOTAL: 45 PERIODS

LIST OF PROGRAMS

1. Calculate the GCD of two numbers.
2. Find the square root of an integer using Newton‘s method.
3. Find power of a number using Exponential operator.
4. Find the maximum of a list of numbers.
5. Develop a program to search the given numbers using linear search and binary search.
6. Develop a program that sorts a list by implementing selection sort, insertion sort.
7. Develop a program that sorts a list by implementing merge sort.
8. Program to print n prime numbers.
9. Find multiplication of two matrix.
10. Programs that take command line arguments (word count).
11. Find the most frequent words in a text read from a file.
12. Simulate elliptical orbits and bouncing ball using Py game.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Develop algorithmic solutions to simple computational problems.

CO2: Write simple Python programs using conditionals, loops and functions for solving problems.

CO3: De compose a Python program into functions.

CO4: Represent compound data using Python lists, tuples, and dictionary e set c.

CO5: Read and write data from / to files in Python programs.

TEXT BOOKS

1. Allen B Downey, “Think Python: How to Think like a Computer Scientist”, 2nd edition, O‘Reilly Publishers, 2016.
2. Karl Beecher, “Computational Thinking: A Beginner's Guide to Problem Solving and Programming”, 1st Edition, BCS Learning & Development Limited,2017.
3. Eric Matthes, “Python Crash Course: Python for beginners”, 3rd Edition, No Strach Press Limited, 2024.

REFERENCE BOOKS

1. Paul Deitel and Harvey Deitel, “Python for Programmers, Pearson Education”, 1st edition, 2021.
2. G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.

3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021.
4. Eric Matthes, "Python Crash Course, A Hands – on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
5. Martin C Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.

Mapping of COs with POs & PSOs

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	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	2	3	-	-	-	-	-	-	-	2	-
CO2	3	3	3	2	3	-	-	-	-	-	-	-	2	-
CO3	3	3	3	2	3	-	-	-	-	-	-	-	2	-
CO4	3	3	3	2	3	-	-	-	-	-	-	-	2	-
CO5	3	3	3	2	3	-	-	-	-	-	-	-	2	-
AVG	3	3	3	2	3	-	-	-	-	-	-	-	2	-

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

24GE1101 தமிழர் மரபு **L T P C**
1 0 0 1

பாடத்தின்நோக்கங்கள்

- மாணவர்கள் மொழி மற்றும் இலக்கியம் பற்றி கற்றறிதல்.
- தமிழர்களின் பாரம்பரிய மரபு மற்றும் நாட்டுப்புற கலைகளை அறிந்து கொள்ளுதல்.
- தமிழர்களின் திணைக்கோட்பாடுகள் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு பற்றி அறிந்து கொள்ளுதல்.

அலகு I மொழி மற்றும் இலக்கியம் **3**

இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி-தமிழ் செவ்விலக்கியங்கள் -சங்க இலக்கியத்தின்சமயச் சார்பற்ற தன்மை– சங்கஇலக்கியத்தில் பகிர்தல் அறம் -திருக்குறளில் மேலாண்மைக் கருத்துக்கள் -தமிழ்க் காப்பியங்கள் -தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் -பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் -சிற்றிலக்கியங்கள் -தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வரலாற்றில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகுII மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள்வரை – சிற்பக்கலை **3**

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள்,பொம்மைகள் -தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் -குமரி முனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் –மிருதங்கம்,பறை, வீணை, யாழ் , நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீரவிளையாட்டுகள் **3**

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து , ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின்விளையாட்டுகள்.

அலகு IV தமிழர்களின் திணைக்கோட்பாடு **3**

தமிழகத்தின் தாவரங்களும் விலங்குகளும் -தொல்காப்பியம் மற்றும் சங்கஇலக்கியத்தில் அகம் மற்றும் புறக்கோட்பாடுகள் – தமிழர்கள்போற்றியஅறக்கோட்பாடு -சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்க கால நகரங்களும் துறைமுகங்களும் - சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி -கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு Vஇந்தியதேசிய இயக்கம் மற்றும் இந்தியபண்பாட்டிற்குத் தமிழர்களின்பங்களிப்பு **3**

இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் -சுயமரியாதை இயக்கம்-இந்திய மருத்துவத்தில் , சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள்,கையெழுத்துப் படிகள் -தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL: 15 PERIODS

பாடநெறி முடிவுகள்

பாடதிட்டத்தைமுடித்தபிறகு, மாணவர்கள்செய்யகூடியவை:

CO1: செம்மொழிமற்றும்சமகாலபடைப்புகளில்கவனம்செலுத்தி, மொழிப்புலமைமற்றும்இலக்கியபகுப்பாய்வின்முக்கியத்துவத்தைகற்றறிந்தனர்.

CO2: தமிழ்இலக்கியத்தின்பாரம்பரியமரபுகலைகளைமாணவர்கள் அறிந்துகொண்டனர்.

CO3: சங்ககாலஇலக்கியங்களையும்இக்காலஇலக்கியகவிஞர்களின் தமிழையும்மாணவர்கள்அறிந்துகொண்டனர்.

CO4: தமிழ்இலக்கியத்தின்கலாச்சாரமற்றும்சமூகதாக்கங்களை அறிந்துகொண்டனர்.

CO5: பண்டைக்காலமக்களின்தமிழ்அடையாளம்மற்றும்கலாச்சார பாரம்பரியத்தைப் பற்றி கற்றறிந்தனர்.

பாட புத்தகங்கள்

1. கே கே பிள்ளை **"தமிழக வரலாறு - மக்களும் பண்பாடும்"** தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் கழகம்,2004.
2. முனைவர் இல சுந்தரம், "கணினித் தமிழ்" , விகடன் பிரசுரம், 2015.
3. டாக்டர். எஸ் வி சுப்ரமணியன், டாக்டர். கே டி திருநாவுக்கரசு, "தமிழர்களின் வரலாற்றுப் பாரம்பரியம் ", சர்வதேச தமிழாய்வு நிறுவனம்.

குறிப்பு புத்தகங்கள்

1. டாக்டர். சிங்காரவேலு, "தமிழர்களின்சமூகவாழ்க்கை", சர்வதேசதமிழாய்வுநிறுவனம்.
2. கீழடி"வைகைஆற்றின்கரையில்உள்ளசங்கநகரநாகரிகம்கூட்டு" தொல்லியல்துறை,தமிழ்நாடுபாடநூல்மற்றும்கல்விசேவைகள் கழகம், தமிழ்நாடு, 2015.
3. டாக்டர். கேகேபிள்ளை, "இந்தியவரலாறு" வெளியீடு ஆசிரியர்.
4. "பொருணைநாகரிகம்", தொல்லியல்துறை&தமிழ்நாடுபாடநூல்மற்றும்கல்விசேவைகள்க ழகம்.
5. ஆர்பாலகிருஷ்ணன், "வைகை, சிந்துநாகரிகத்தின்பயணம்" வெளியீடு– EMRL.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	2	-	2	-	-	-	-	2	-
CO2	-	-	-	-	-	2	-	2	-	-	-	-	2	-
CO3	-	-	-	-	-	2	-	2	-	-	-	-	2	-
CO4	-	-	-	-	-	2	-	2	-	-	-	-	2	-
CO5	-	-	-	-	-	2	-	2	-	-	-	-	2	-
AVG	-	-	-	-	-	2	-	2	-	-	-	-	2	-

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

24GE1201 PROFESSIONAL DEVELOPMENT **L T P C**
0 0 4 2

COURSE OBJECTIVES

- To be proficient in important Microsoft Office tools: MS WORD, EXCEL,POWERPOINT.
- To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the presentability and overall utility value of content.
- To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize, interlink, and utilizing many more critical features offered

MS WORD **15**

- Create and format a document.
- Working with tables.
- Working with Bullets and Lists.
- Working with styles, shapes, smart art, charts.
- Inserting objects, charts and importing objects from other office tools.
- Creating and Using document templates.
- Inserting equations, symbols and special characters.
- Working with Table of contents and References, citations.
- Insert and review comments.
- Create bookmarks, hyperlinks, endnotes footnote.
- Viewing document in different modes.
- Working with document protection and security.
- Inspect document for accessibility.

MS EXCEL **15**

- Create worksheets, insert and format data.
- Work with different types of data: text, currency, date, numeric etc.
- Split, validate, consolidate, Convert data.
- Sort and filter data.
- Perform calculations and use functions: (Statistical, Logical, Mathematical, date, Time etc.,).
- Work with Lookup and reference formulae.
- Create and Work with different types of charts.
- Use pivot tables to summarize and analysis data.
- Perform data analysis using own formulae and functions.
- Combine data from multiple worksheets using own formulae and built-in functions to generate results.
- Export data and sheets to other file formats.
- Working with macros.
- Protecting data and Securing the workbook.

MS POWERPOINT **15**

- Select slide templates, layout and themes.
- Formatting slide content and using bullets and numbering.
- Insert and format images, smart art, tables, charts.
- Using Slide master, notes and handout master.

- Working with animation and transitions.
- Organize and Group slides.
- Import or create and use media objects: audio, video, animation.
- Perform slideshow recording and Record narration and create presentable videos.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Use MS Word to create quality documents, by structuring and organizing content.

CO2: Use MS Word for their day to day technical and academic requirements.

CO3: Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements.

CO4: Use MS EXCEL to visualize data for ease of understanding.

CO5: Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO2	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO3	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO4	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO5	-	-	-	-	-	-	-	2	2	2	2	2	2	-
AVG	-	-	-	-	-	-	-	2	2	2	2	2	2	-

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

24HS2101 WRITING SKILLS FOR PROFESSIONALS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To use appropriate language structures to write letters.
- To write reports and emails with ease.
- To think critically and write different types of essays.

UNIT I SELF EXPRESSION **9**

Grammar: Punctuation-Direct and Indirect Questions - Adverbs- Prepositions.**Vocabulary:** Commonly confused words. **Writing:** Extended Definitions- Letter to the Editor.

UNIT II FORMAL EXPRESSION 9

Grammar: Phrasal Verbs, Adverbs, Simple, Compound and Complex Sentences.**Vocabulary:** Synonyms & Antonyms. **Writing:** Email Writing (formal & informal) –Report Writing (Industrial Visit & Field Visit).

UNIT III CREATIVE EXPRESSION **9**

Grammar: Prepositional Phrases, Numerical Adjectives, Compound Nouns.**Vocabulary:** British and American words. **Writing:** Compare and Contrast Essay, SOP.

UNIT IV EXPRESSION OF IDEAS **9**

Grammar: Direct and Indirect Speech, Relative Pronoun.**Vocabulary:** Idioms & phrases. **Writing:** Asking for information and making suggestions- Report Writing on College Event.

UNIT V PROFESSIONAL EXPRESSIONS **9**

Grammar: Fixed and Semi- fixed - Content vs Function words. **Vocabulary:** Jumbled Sentences. **Writing:** Accepting/ Declining an Offer/ invitation-Note- Making, Argumentative Essay.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Enhance their grammatical competency for flawless writing.

CO2: Write reports, emails meeting professional expectations.

CO3: Use grammar to form correct sentences with maximum accuracy.

CO4: Present their ideas and opinions in a planned and logical manner.

CO5: Write essays on various topics.

TEXT BOOKS

1. English for Engineers & Technologists, Orient Blackswan Private Ltd. Department of English, Anna University, 2020.
2. English for Science & Technology Cambridge University Press, 2021.
3. Communication Skills for Professionals, Nira Konar Second Edition, PHI Learning Pvt. Ltd, 2021.

REFERENCE BOOKS

1. William Zinsser Paperback,"On Writing Well", Perennial Publishers, 2016.
2. D S Paul,"Advanced Writing Skills", Good will Publishing House, 2022.
3. Matthew T Zakaria, "Successful Writing Skills", Commonwealth Publishers, 2022.
4. G S Hook, "Effective Communication" (Updated version 2nd edition), Sannainvest Ltd., 2021.
5. Alan Baker,"Improve Your Communication Skills", Kogan Publishers, 2019.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO2	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO3	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO4	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO5	-	-	-	-	-	-	-	2	2	2	2	2	2	-
AVG	-	-	-	-	-	-	-	2	2	2	2	2	2	-

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

24MU2101 STATISTICS AND NUMERICAL METHODS **L T P C**
3 1 0 4

COURSE OBJECTIVES

- To understand the concept of Correlation, Regression, Testing of hypothesis and design of experiments.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To understand the concept of numerical methods for solving differentiation and integration equations.

UNIT I CORRELATION AND REGRESSION **9+3**

Correlation – Coefficient of Correlation – Rank Correlation – Regression – Estimation of Regression lines.

UNIT II TESTING OF HYPOTHESIS & DESIGN OF EXPERIMENTS **9+3**

Sampling distributions – Small samples – t-test – Tests for single mean and difference of means – F-test – Tests for single variance and equality of variances – One way and two-way classifications – Completely randomized design – Randomized block design – Latin square design.

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS **9+3**

Solution of Algebraic and Transcendental equations – Newton Raphson method – Solution of linear system of equations – Gauss elimination method – Pivoting – Gauss Jordan method – Inverse of Matrix by Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel – Eigen values of a matrix by Power Method.

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION **9+3**

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS **9+3**

Single step methods : Taylor's series method – Euler's method – Modified Euler's method – Fourth order Runge-Kutta method for solving first order differential equations – Multi step methods: Milne's and Adam's – Bash forth predictor corrector methods for solving first order differential equations.

TOTAL: 60 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Apply the correlation and regression equations for engineering problems.

CO2: Apply the concept of testing of hypothesis for small samples in real life problems and classifications of design of experiments in the field of agriculture.

CO3: Apply the numerical methods to solve the algebraic, transcendental and linear system of equations.

CO4: Apply interpolation techniques and numerical methods to solve the derivatives and integrals.

CO5: Apply various numerical methods for solving ordinary differential equations.

TEXT BOOKS

1. Gupta S.C., and KapoorV. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
2. Gupta S.P., "Statistical Method", Sultan Chand & Sons, New Delhi, 46th Edition, 2019.
3. Grewal B. S., and Grewal J. S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.

REFERENCE BOOKS

1. Spiegel M.R., Schiller J., and Srinivasan R.A., "Schaum's easy Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 4th Edition, 2020.
2. Devore J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 9th Edition, 2020.
3. Johnson R. A., Miller I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, 9th Edition, 2020.
4. Burden R.L and Faires J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
5. Jain M.K., Iyengar S.R.K. and Jain R.K., "Numerical Methods",New international Publishers, 8th Edition, 2022.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	-	2	-	-	-	-	-	-	-	-	2	-
CO2	2	3	-	2	-	-	-	-	-	-	-	-	2	-
CO3	2	3	-	2	-	-	-	-	-	-	-	-	2	-
CO4	2	3	-	2	-	-	-	-	-	-	-	-	2	-
CO5	2	3	-	2	-	-	-	-	-	-	-	-	2	-
AVG	2	3	-	2	-	-	-	-	-	-	-	-	2	-

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

24PH2101 MATERIALS SCIENCE **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the properties of conducting and semiconducting materials.
- To acquire knowledge on magnetic and dielectric materials with their applications.
- To get an idea of nano structures and basics of quantum computing.

UNIT I CONDUCTINGMATERIALS **9**

Conductors – classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals.

UNIT II SEMICONDUCTINGMATERIALS **9**

Intrinsic semiconductor – intrinsic carrier concentration derivation – Fermi level – electrical conductivity – band gap determination – derivation of carrier concentration in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration – Hall effect –Determination of Hall coefficient – Applications.

UNIT III MAGNETIC MATERIALS **9**

Origin of magnetic moment–Bohr magnet on– properties of Dia,Para and Ferro magnetic materials– Domain theory –Hysteresis–soft and hard magnetic materials–anti – ferromagnetic materials– Ferrites and its applications.

UNIT IV DIELECTRIC MATERIALS **9**

Electrical susceptibility – dielectric constant– electronic, ionic, orientational and space charge polarization–frequency and temperature dependence of polarization – internal field – Claussius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – ferro electricity and applications.

UNIT V NANO DEVICES AND QUANTUM COMPUTING **9**

Introduction – quantum confinement – quantum structures: quantum wells, wires and dots – Tunneling – Coulomb blockade – Single electron phenomena: single electron transistor – Quantum system for information processing – quantum states – classical bits – quantum bits – CNOT gate – advantage of quantum computing over classical computing.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Gain knowledge on electrical and thermal properties of conducting materials.

CO2: Get adequate knowledge on charge carrier's distribution in different types of semiconductors.

CO3: Get the necessary understanding of functioning of Magnetic materials.

CO4: Get the necessary understanding of functioning of dielectric materials.

CO5: Gain knowledge on new engineering materials and their preparation methods.

TEXT BOOKS

1. S.O. Kasap, "Principles of Electronic Materials and Devices", Mc-Graw Hill, 2018.
2. Jasprit Singh, "Semiconductor Optoelectronics: Physics and Technology", Mc-Graw Hill India, 2019.
3. Parag K. Lala, "Quantum Computing: A Beginner's Introduction", McGraw-Hill Education, Indian Edition, 2020.

REFERENCE BOOKS

1. R.Balasubramaniam, Callister's,"Materials Science and Engineering". Wiley Indian Edition, 2015.
2. Wendelin Wright and Donald Askeland, "Essentials of Materials Science and Engineering", CL Engineering, 2015.
3. Charles Kittel, "Introduction to Solid State Physics", Wiley India Edition, 2019.
4. Mark Fox, "Optical Properties of Solids", Oxford Univ. Press, 2021.
5. B.Rogers, J.Adams and S.Pennathur, "Nanotechnology: Understanding Small Systems", CRC Press, 2017.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	2	-	-	-	-	-	-	-	-	2	-
CO2	3	2	3	2	-	-	-	-	-	-	-	-	2	-
CO3	3	2	2	2	-	-	-	-	-	-	-	-	2	-
CO4	3	2	3	2	-	-	-	-	-	-	-	-	2	-
CO5	3	2	3	2	-	-	-	-	-	-	-	-	2	-
AVG	3	2	2.8	2	-	-	-	-	-	-	-	-	2	-

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

24GE2101 ENGINEERING GRAPHICS **L T P C**
2 0 4 4

COURSE OBJECTIVES

- Drawing engineering curves, freehand sketch of simple objects and orthographic projections.
- Drawing Projection, section and development of solids.
- Drawing isometric and perspective projections of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination)

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 FREEHAND SKETCHING **6+12**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles – Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12

Orthographic projection – principles – Principal planes – First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes – Determination of true lengths and true inclinations by rotating line method. Projection of planes (polygonal and circular surfaces) inclined to one principal plane by rotating object method.

UNIT III PROJECTION OF SOLIDS 6+12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method.

UNIT IV ROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 6+12

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

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+12

Principles of isometric projection — isometric scale - isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

TOTAL: 90 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Construct the conic curves, involutes and cycloid.
CO2: Solve practical problems involving projection of line and plane surfaces.
CO3: Understand the orthographic, isometric and perspective projections of simple solids
CO4: Understand the development of section of solids and development of surfaces.
CO5: Understand the isometric and perspective projections.

Publication of Bureau of Indian Standards

1. IS10711—2001: Technical products Documentation—Size and layout of drawing sheets.
2. IS9609 (Parts0&1)—2001: Technical products Documentation—Lettering.
3. IS10714 (Part20)—2001 & SP46—2003: Lines for technical drawings.
4. IS11669—1986&SP46—2003: Dimensioning of Technical Drawings.
5. IS15021 (Parts1to4)—2001: Technical drawings—Projection Methods.

TEXT BOOKS

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2019.
2. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
3. Parthasarathy, N. S. and Vela Murali, "Engineering Drawing", Oxford University Press, 2015.

REFERENCE BOOKS

1. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.
2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I & II combined), Subhas Stores, Bangalore, 2007.
4. 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.
5. Shah M B, and Rana B C, "Engineering Drawing", Pearson, 2nd Edition, 2009.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	3	2	-	-	-	-	2	2	-	-	2	-
CO2	2	3	3	2	-	-	-	-	2	2	-	-	2	-
CO3	2	3	3	2	-	-	-	-	2	2	-	-	2	-
CO4	2	3	3	2	-	-	-	-	2	2	-	-	2	-
CO5	2	3	3	2	-	-	-	-	2	2	-	-	2	-
AVG	2	3	3	2	-	-	-	-	2	2	-	-	2	-

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

24GE2102 FUNDAMENTALS OF BUILDING AND MECHANICAL SCIENCES **L T P C 3 0 2 4**

COURSE OBJECTIVES

- To provide the basic knowledge, concepts and specialized sub-disciplines of Civil and Mechanical Engineering.
- To introduce fundamental principles of surveying, building materials, and construction techniques.
- To impart knowledge on power plants, internal combustion engines, refrigeration, and air conditioning systems.

UNIT I OVERVIEW OF CIVIL ENGINEERING **5**

Civil Engineering contributions to the welfare of Society - Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering – National building code – terminologists: Plinth area,

Carpet area, Floor area, Buildup area, Floor space index - Types of buildings: Residential buildings, Industrial buildings.

OVERVIEW OF MECHANICAL ENGINEERING 4

Overview of Mechanical Engineering - Mechanical Engineering Contributions to the welfare of Society –Specialized sub disciplines in Mechanical Engineering – Manufacturing, Automation, Automobile and Energy Engineering - Interdisciplinary concepts in Mechanical Engineering.

UNIT II SURVEYING AND CIVIL ENGINEERING MATERIALS 9

Surveying: Objects – Classification – Principles – Measurements of Distances and angles – Leveling – Determination of areas– Contours. Civil Engineering Materials: Bricks – Stones – Sand – Cement – Concrete – Steel - Timber – Modern Materials, Thermal and Acoustic Insulating Materials, Decorative Panels, Water Proofing Materials. Modern uses of Gypsum, Pre-fabricated Building component (brief discussion only).

UNIT III BUILDING COMPONENTS AND INFRASTRUCTURE 9

Building plans – Setting out of a Building - Foundations: Types of foundations - Bearing capacity and settlement – Brick masonry – Stone Masonry – Beams – Columns – Lintels – Roofing – Flooring – Plastering. Types of Bridges and Dams – Water Supply Network - Rain Water Harvesting – Solid Waste Management - Introduction to Highways and Railways - Introduction to Green Buildings.

UNIT IV INTERNAL COMBUSTION ENGINES AND POWER PLANTS 9

Classification of Power Plants- Working principle of steam, Gas, Diesel, Hydro -electric and Nuclear Power plants- Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines. Working principle of Boilers-Turbines Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps, Concept of hybrid engines. Industrial safety practices and protective devices.

UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM 9

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system–Layout of typical domestic refrigerator–Window and Split type room Air conditioner. Properties of air - water mixture, concepts of psychometric and its process.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

Basic Mechanical Laboratory: 15

1. Study of IC Engines, Components.
2. Study of Steam Generators and Turbines.
3. Valve Timing and Port Timing Diagrams.
4. Determination of Viscosity –Red Wood Viscometer.
5. Determination of Flash Point and Fire Point.
6. Izod Impact Test.
7. Rockwell Hardness Test.

Basic Civil Laboratory **15**

I. TESTS ON CEMENT

a. Determination of fineness of cement.
b. Determination of consistency of cement.
c. Determination of specific gravity of cement.
d. Determination of initial and final setting time of cement.

II. TESTS ON FINE AGGREGATE AND COURSE AGGREGATE

a. Determination of specific gravity and water absorption of fine aggregate.
b. Determination of grading of fine aggregate.
c. Determination of aggregate crushing value of coarse aggregate.
d. Determination of specific gravity and water absorption of coarse aggregate.

III. TESTS ON BRICKS

a. Determination of compressive strength of bricks.
b. Determination of water absorption of bricks.
c. Determination of efflorescence of bricks.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Understand the role of Civil and Mechanical Engineering in societal development.
CO2: Recognize different types of building materials and their modern applications.
CO3: Comprehend the principles and methods used in surveying and leveling.
CO4: Explain the working principles of internal combustion engines and power plants.
CO5: Understand the refrigeration, air conditioning systems, and psychrometric processes.

TEXT BOOKS

1. Satheesh Gopi, “Basic Civil Engineering”, Pearson India, 2009.
2. Pravin Kumar, “Basic Mechanical Engineering”, Pearson Education India, 2013.
3. G Shanmugam and M S Palanichamy, “Basic Civil and Mechanical Engineering”, McGraw Hill Education; First edition, 2018.

REFERENCE BOOKS

1. Palanikumar K, “Basic Mechanical Engineering”, ARS Publications, 2018.
2. Ramamrutham S, “Basic Civil Engineering”, Dhanpat Rai Publishing Co.(P) Ltd,2013.
3. Seetharaman S, “Basic Civil Engineering”, Anuradha Agencies, 2005.
4. Shantha Kumar SRJ, “Basic Mechanical Engineering”, Hi-tech Publications, Mayiladuthurai, 2000.
5. D Natarajan, Basic Civil and Mechanical Engineering, Anuradha Publications, 2013.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	3	-	-	-	-	-	-	-	-	-	2	-
CO2	2	3	3	-	-	-	-	-	-	-	-	-	2	-
CO3	2	3	3	-	-	-	-	-	-	-	-	-	2	-
CO4	2	3	3	-	-	-	-	-	-	-	-	-	2	-
CO5	2	3	3	-	-	-	-	-	-	-	-	-	2	-
AVG	2	3	3	-	-	-	-	-	-	-	-	-	2	-

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

24EE2102 CIRCUIT ANALYSIS **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To impart knowledge on solving circuits using network theorems.
- To introduce the concepts of resonance and transient response in circuits.
- To analyze the three phase AC circuits.

UNIT I BASIC CIRCUITS ANALYSIS **9**

Fundamentals concepts of R, L and C Elements-Energy Sources- Ohm's Law -Kirchhoff 's Laws – DC Circuits – Resistors in series and parallel circuits - A.C Circuits – Average and RMS Value -Mesh current and node voltage methods of analysis D.C and A.C Circuits. Network reduction: voltage and current division, source transformation – star-delta conversion

UNIT II NETWORK REDUCTION AND THEOREMS **9**

Network Theorems – Superposition, Thevenin's and Norton's Theorem – Maximum power transfer theorem – Reciprocity Theorem – Millman's theorem.

UNIT III TRANSIENT RESPONSE ANALYSIS **9**

Introduction – Laplace transforms and inverse Laplace transforms- standard test signals – Transient response of RL, RC and RLC circuits using Laplace transform for Source free, Step input and Sinusoidal input.

UNIT IV RESONANCE AND COUPLED CIRCUITS **9**

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

UNIT V THREE PHASE CIRCUITS **9**

Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced and unbalanced – phasor diagram of voltages and currents – power measurement in three phase circuits– Power Factor Calculations.

TOTAL:45 PERIODS

LIST OF EXPERRIMENTS

1. Simulation and experimental verification of finding equivalent resistance.
2. Simulation and experimental verification of DC electrical circuit problems using Kirchoff's law.
3. Simulation and experimental verification of AC electrical circuit problems using Kirchoff's law.
4. Simulation and experimental verification of electrical circuit problems using Thevenin's theorem.
5. Simulation and experimental verification of electrical circuit problems using Norton'stheorem.
6. Simulation and experimental verification of electrical circuit problems using Superposition theorem.
7. Simulation and experimental verification of electrical circuit problems using Reciprocity theorem.
8. Simulation and experimental verification of electrical circuit problems using Maximum Power transfer theorem.
9. Simulation and Experimental validation of transient response of RLC circuits.
10. Simulation and Experimental validation of frequency response of RLC circuits.
11. Simulation and experimental verification of three phase balanced and unbalanced star connected circuits.
12. Simulation and experimental verification of three phase balanced and unbalanced delta connected circuits.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Analyze the circuit parameters using circuit laws.
CO2: Apply network theorems for solving simple DC and AC circuits.
CO3: Analyze the transient behavior of RLC circuits.
CO4: Analyze the frequency response of series and parallel RLC circuits.
CO5: Compute power, line/phase voltage and currents of the given three phase circuits.

TEXT BOOKS

1. Sudhakar A and Shyam Mohan SP, "Circuits and Networks Analysis and Synthesis", McGraHill, 2015.
2. Chakrabarti A, "Circuits Theory (Analysis and synthesis), Dhanpat Rai & Sons, New Delhi, 2020.
3. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits",Second Edition, McGraw Hill, 2019.

REFERENCE BOOKS

1. William H. HaytJr, Jack E. Kemmerly and Steven M. Durbin, "Engineering CircuitsAnalysis",McGraw Hill publishers, 9th edition, 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. Allan H. Robbins, Wilhelm C. Miller, “Circuit Analysis Theory and Practice”, Cengage Learning India, 2013.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	3	2	3	-	-	-	-	-	-	-	3	-
CO2	2	3	3	2	3	-	-	-	-	-	-	-	3	-
CO3	2	3	3	2	3	-	-	-	-	-	-	-	3	-
CO4	2	3	3	2	3	-	-	-	-	-	-	-	3	-
CO5	2	3	3	2	3	-	-	-	-	-	-	-	3	-
AVG	2	3	3	2	3	-	-	-	-	-	-	-	3	-

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

24GE2103 தமிழரும் தொழில்நுட்பமும் **L T P C**
1 0 0 1

பாடத்தின்நோக்கங்கள்

- மாணவர்கள்நெசவுமற்றும்பானைத்தொழில்நுட்பத்தைக்கற்றறிதல்
- கட்டிட மற்றும் உற்பத்தித் தொழில்நுட்பத்தை அறிந்து கொள்ளுதல்
- வேளாண்மை நீர்பாசனம்மற்றும்அறிவியல் தமிழ் கணினித் தமிழ் தொழில்நுட்பத்தை அறிந்து கொள்ளுதல்

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 வீட்டுப்பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமானப் பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லப்புரச் சிற்பங்களும் கோயில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபட்டுத் தலங்கள் - நாயக்கர் காலக் கோயில்கள் -மாதிரி கட்டமைப்புகள் பற்றி அறிதல் -மதுரை மீனாட்சி அம்மன் ஆலயம்

மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் -பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ - சரோசெனிக் கட்டிடக்கலை.

அலகு III உற்பத்தித் தொழில்நுட்பம் 3

கப்பல் கட்டும் கலை - உலோகவியல் -இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல் -எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் -நாணயங்கள் அச்சடித்தல் -மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் -சுடுமண் மணிகள் -சங்கு மணிகள் -எலும்புத் துண்டுகள் -தொல்லியல் சான்றுகள் -சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு VI வேளாண்மை மற்றும் நீர்பாசனத் தொழில்நுட்பம் 3

அணை, ஏரி, குளம் , மதகு -சோழர்காலக் குமிழித் தூம்பின் முக்கியத்துவம் -கால்நடை பராமரிப்பு -கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் -வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு -மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவு சார் 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

பாட நெறிமுடிவுகள்

பாடதிட்டத்தைமுடித்தபிறகு, மாணவர்கள்செய்யகூடியவை:

CO1: மாணவர்கள்நெசவுமற்றும்பானைத்தொழில்நுட்பத்தைக்கற்ற றிந்தனர்.

CO2: கட்டிடத்தொழில்நுட்பமுக்கியத்துவத்தைஅறிந்துகொண்டனர்.

CO3: உற்பத்தித்தொழில்நுட்பத்தைகற்றறிந்தனர்.

CO4: வேளாண்மைமற்றும்நீர்பாசனம்தொழில்நுட்பங்களைதெரிந்து கொண்டனர்.

CO5: அறிவியல்தமிழ்மற்றும்கணித்தமிழ்தொழில்நுட்பத்தைஅறிந் துகொண்டனர்.

பாட புத்தகங்கள்

1. கே கே பிள்ளை "தமிழக வரலாறு - மக்களும் பண்பாடும்", தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் கழகம், 2004.
2. முனைவர் இல சுந்தரம், "கணினித் தமிழ்",விகடன் பிரசுரம்,2015.

3. டாக்டர். எஸ் வி சுப்ரமணியன், டாக்டர். கேடி திருநாவுக்கரசு, "தமிழர்களின் வரலாற்றுப் பாரம்பரியம் ", சர்வதேச தமிழாய்வு நிறுவனம்.

குறிப்பு புத்தகங்கள்

1. டாக்டர்சிங்காரவேலு, "தமிழர்களின் சமூக வாழ்க்கை", சர்வதேச தமிழாய்வு நிறுவனம்.
2. கீழடி "வைகை ஆற்றின் கரையில் உள்ள சங்க நகரநாகரிகம் கூட்டு "தொல்லியல் துறை & தமிழ்நாடு பாடநூல் மற்றும் கல்வி சேவைகள் கழகம், தமிழ்நாடு,2015.
3. டாக்டர். கேகேபிள்ளை, "இந்தியவரலாறு"வெளியீடு ஆசிரியர்.
4. "பொருணைநாகரிகம்", தொல்லியல் துறை, தமிழ்நாடு பாடநூல் மற்றும் கல்விசேவைகள் கழகம்.
5. ஆர். பாலகிருஷ்ணன், "வைகை, சிந்து நாகரிகத்தின் பயணம்" வெளியீடு(EMRL).

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	2	-	2	-	-	-	-	2	-
CO2	-	-	-	-	-	2	-	2	-	-	-	-	2	-
CO3	-	-	-	-	-	2	-	2	-	-	-	-	2	-
CO4	-	-	-	-	-	2	-	2	-	-	-	-	2	-
CO5	-	-	-	-	-	2	-	2	-	-	-	-	2	-
AVG	-	-	-	-	-	2	-	2	-	-	-	-	2	-

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

24GE2201 ENGINEERING PRACTICES LABORATORY **L T P C**
0 0 4 2

COURSE OBJECTIVES

- To develop practical skills in handling and assembling various components used in household plumbing, woodworking, welding, and electronic circuits.
- To provide hands-on experience in operating basic tools and equipment essential for engineering practices.
- To provide hands-on experience in domestic wiring procedures practically.

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES **15**

PLUMBING WORK

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in-household.

b) Preparing plumbing line sketches.
c) Laying pipe connection to the suction side of a pump, delivery side of a pump and pipes of different materials: Metal, plastic and flexible pipes used in house hold appliances.

WOOD WORK EXCERSIES

a) Excises on sawing and planning of woods
b) Prepare joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.
c) Studying joints in door panels, wooden furniture and common industrial trusses using models.

PART II ELECTRICAL ENGINEERING PRACTICES **15**

a) Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin sockets
b) Staircase wiring
c) Fluorescent Lamp wiring with introduction to CFL and LED types.
d) Energy meter wiring and related calculations/ calibration
e) Study of Iron Box wiring and assembly
f) Study of Fan Regulator (Resistor type and Electronic type)

GROUP – B (MECHANICAL & ELECTRONICS)

PART III MECHANICAL ENGINEERING PRACTICES **15**

WELDING WORK:

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

BASIC MACHINING WORK:

a) Turning (simple).
b) Drilling and Tapping.

SHEET METAL WORK

a) Making of a square tray

STUDY AND ASSEMBLE THE FOLLOWING:

a) Assembling a centrifugal pump.
b) Assembling a household mixer.
c) Assembling an air conditioner.

FOUNDRY WORK

a) Demonstrating of basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES **15**

a) Soldering simple electronic circuits and checking continuity.
b) Assembling and testing electronic components on a small PCB.
c) Study an element of smart phone.
d) Assembly and dismantle of LED TV.

e) Assembly and dismantle of computer.

f) Assembly and dismantle of laptop.

TOTAL: 60 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Proficiently connect and troubleshoot plumbing systems using various pipe fittings and materials.

CO2: Demonstrate competence in woodworking techniques including sawing, planing and joint preparation.

CO3: Understand and execute electrical wiring tasks, including switchboard installations and appliance connections.

CO4: Gain practical skills in welding, machining, sheet metal work, and foundry operations.

CO5: Assemble and test electronic devices such as PCBs, smart phones, LED TVs, and computers, enhancing their understanding of electronic assembly and testing procedures.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	2	2	-	-	-	2	-	-	2	2	-
CO2	3	3	3	2	2	-	-	-	2	-	-	2	2	-
CO3	3	3	3	2	2	-	-	-	2	-	-	2	2	-
CO4	3	3	3	2	2	-	-	-	2	-	-	2	2	-
CO5	3	3	3	2	2	-	-	-	2	-	-	2	2	-
AVG	3	3	3	2	2	-	-	-	2	-	-	2	2	-

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

24MU3102 TRANSFORMS AND COMPLEX FUNCTIONS **L T P C**

3 1 0 4

COURSE OBJECTIVES

- To acquaint the student with Fourier, transform techniques used in wide variety of situations.
- To gain knowledge on Z transform and Laplace transform techniques for discrete time Systems.
- To develop an understanding of the standard techniques of complex variable theory in Particular analytic function and its mapping property.

UNIT I FOURIER TRANSFORMS **9+3**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT II Z TRANSFORMS AND DIFFERENCE EQUATIONS 9+3

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

UNITIII LAPLACETRANSFORM 9+3

Laplace transform – Sufficient condition for existence – Transform of elementary functions – Basic properties – Transforms of derivatives and integrals of functions - Derivatives and integrals of transforms - Transforms of unit step function and impulse functions – Transform of periodic functions. Inverse Laplace transform -Statement of Convolution theorem – Initial and final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

UNIT IVANALYTIC FUNCTIONS 9+3

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

UNIT VCOMPLEX INTEGRATION 9+3

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real Integrals – Applications of circular contour and semicircular contour (with poles NOT on real axis).

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

CO1: Apply Fourier transform technique to engineering problems.

CO2: Apply the Z- Transform and PDE techniques for discrete time systems engineering applications.

CO3: Solve Laplace transform problems associated with engineering applications.

CO4: Apply analytical function for mapping of electrical engineering problems.

CO5: Apply the PDE to solve the boundary value problems.

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", 44thEdition, Khanna Publishers, Delhi, 2018.
3. 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. Ray Wylie. C and Barrett.L.C, "Advanced Engineering Mathematics" Tata Mc Graw Hill Education Pvt Ltd, 6th Edition, New Delhi, 2012.
2. Datta.K.B., "Mathematical Methods of Science and Engineering", Cengage Learning India Pvt Ltd, Delhi, 2013
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2007.
4. Sankara Rao. K, Introduction To Partial Differential Equations, Prentice Hall of India Pvt.Ltd, New Delhi, 1997.
5. Andrews L.C. and Shivamoggi, B., "Integral Transforms for Engineers", Prentice Hall of India Pvt. Ltd., New Delhi, 2003.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	-	-	-	-	-	-	-	-	-	-	2	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	2	-
CO3	2	3	-	-	-	-	-	-	-	-	-	-	2	-
CO4	2	3	-	-	-	-	-	-	-	-	-	-	2	-
CO5	2	3	-	-	-	-	-	-	-	-	-	-	2	-
AVG	2	3	-	-	-	-	-	-	-	-	-	-	2	-

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

24EE3101 ELECTROMAGNETIC THEORY **L T P C**
3 0 2 3

COURSE OBJECTIVES

- To introduce the basic mathematical concepts related to electromagnetic vector fields, Electrostatic fields, electric potential, energy density and their applications.
- To learn about Magneto static fields, magnetic flux density, vector potential and its applications.
- To impart knowledge on the concepts of Electromagnetic waves and characterizing parameters.

UNIT I ELECTROSTATICS I **9**

Sources, effects and exposure limits of electromagnetic fields, Coordinate systems, Vector calculus-Gradient, Divergence and Curl, theorems and applications, Coulomb's Law – Electric field intensity –Electric Field due to discrete and continuous charges – Gauss's law and applications.

UNIT II ELECTROSTATICS II **9**

Electric potential – Electric fields and equipotential plots, Uniform and Non-Uniform fields, Utilization factor – Electric field in free space, conductors, dielectric -Dielectric polarization – Dielectric strength, Electric fields in multiple dielectrics – Boundary conditions, capacitance, Energy density, Poisson's and Laplace's equations – solutions by Direct Integration method, Applications.

UNIT III MAGNETOSTATICS **9**

Lorentz force, magnetic field intensity (H) – Biot– Savart's Law - Ampere's Circuit Law- Magnetic field intensity due to solenoid and circular ring– Magnetic flux density (B) – B in free space, conductor, magnetic materials –Magnetization, Magnetic field in multiple media – Boundary conditions, Scalar and vector potential, Magnetic force, Torque, Inductance and mutual inductance, Energy density, Applications.

UNIT IV ELECTRODYNAMIC FIELDS **9**

Magnetic Circuits - Faraday's law – Transformer and motional EMF – Displacement current - Maxwell's equations (differential and integral form) – Time varying potential – Relation between field theory and circuit theory, Applications – Relation between Electric field intensity and Magnetic field intensity can be included.

UNIT V ELECTROMAGNETIC WAVES **9**

Electromagnetic Wave Generation and Wave equations – Wave parameters, velocity, intrinsic impedance, propagation constant – Waves in free space, lossless and lossy dielectrics, conductors-skin depth, Pointing vector, Plane wave reflection and refraction – Standing Wave, Applications.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Electric Field pattern between two circular electrodes.
2. Electric Field pattern between parallel conductors.
3. Electric Field and potential inside the parallel plate capacitor.
4. Measurement of Magnetic field of the coil.
5. Verification of Electromagnetic Induction.
6. EM wave transmission and reflection.
7. Measurement of Magnetic field force on a current carrying conductor.
8. Determination of Di-electric constant of a given Di-electric material.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Describe the coordinate systems and vector calculus applicable to electric and magnetic fields.

CO2: Calculate and analyze electrostatic fields with practical applications.

CO3: Compute and analyze magneto static fields with practical applications.

CO4: Explain different methods of E.M.F. generation and analyze Maxwell's equations.

CO5: Describe the concept of electromagnetic waves and characterizing parameters.

TEXT BOOKS

1. Mathew N. O. Sadiku, S.V.Kulkarni,'Principles of Electro magnetics', 6th Edition, Oxford University Press, 2015, Asian Edition.
2. Bhag Singh Guru and Hüseyin R. Hiziroglu "Electromagnetic field theory fundamentals", Cambridge University Press; Second Revised Edition, 2009.
3. Ashutosh Pramanik, 'Electromagnetism – Theory and Applications', PHI Learning Private Limited, New Delhi, Second Edition-2008.

REFERENCE BOOKS

1. Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Third Edition (Schaum's Outline Series), Tata McGraw Hill, 2010.
2. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', Tata McGraw Hill, 8th Revised edition, 2012.
3. Kraus and Fleisch, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 2017.
4. Karl E. Lonngren, Sava V. Savov, Randy J. Jost, 'Fundamentals of Electromagnetics with MATLAB", 2nd Edition, PHI Learning Pvt. Ltd., 2009.
5. Ashutosh Pramanik, 'Electromagnetism – Theory and Applications', PHI Learning Private Limited, New Delhi, Second Edition-2009

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	1	2	3	2	1	3	3	2	2	2	2	2
CO2	3	3	1	2	3	3	2	3	3	2	2	2	2	2
CO3	3	3	1	2	3	3	2	3	3	2	2	2	2	2
CO4	3	3	2	2	3	2	2	1	3	2	2	2	2	1
CO5	3	3	2	2	3	2	1	1	3	2	2	2	2	1
AVG	3	3	1.4	2	3	2.4	1.6	1.2	3	2	2	2	2	1.6

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

24EE3102 DC MACHINES AND TRANSFORMERS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the concept of electromechanical energy conversion system.
- To learn construction, operation, performance characteristics and testing of DC machines and transformers.
- To deliberate the working of auto transformer and three phase transformers.

UNIT I ELECTROMECHANICAL ENERGY CONVERSION **9**

Magnetic circuits – Laws governing magnetic circuits – Flux linkage, Inductance and energy Statically and Dynamically Induced EMF - Torque – Properties of magnetic materials, Hysteresis and Eddy current losses- AC excitation, introduction to permanent magnets.

UNIT II DC GENERATORS **9**

Principle of operation-constructional details- armature windings and its types- EMF equation, armature reaction- demagnetizing and cross magnetizing Ampere turns- compensating winding- commutation- methods of improving commutation- interpoles- OCC and load characteristics- Parallel operation- equalizing connections- Applications.

UNIT III DC MOTORS **9**

Principle of operation- significance of back emf- torque equations and power developed by

armature- speed control of DC motors- starting methods of DC motors- load characteristics of DC motors- losses and efficiency in DC machine- condition for maximum efficiency. Testing of DC Machines: Brake test, Swinburne's test, Hopkinson's test, Field test, Retardation test, Separation of core losses-applications of DC motors.

UNIT IV SINGLE PHASE TRANSFORMER 9

Construction and principle of operation- equivalent circuit- phasor diagrams-testing - polarity test- open circuit and short circuit tests - voltage regulation - losses and efficiency - all day efficiency - back-to back test- Pseudomonas test- separation of core losses- parallel operation of single-phase transformers - applications of single-phase transformer.

UNIT V AUTOTRANSFORMER AND THREE PHASE TRANSFORMER 9

Construction and working of auto transformer-comparison with two winding transformers- Tertiary winding - applications of autotransformer- Three Phase Transformer- Construction, types of connections and their comparative features- Scott connection- applications of Scott connection.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Analyze magnetic circuits and compute torque, EMF, and inductance in energy conversion systems.

CO2: Explain the construction, operation, and characteristics of DC generators

CO3: Explain the construction, operation, and characteristics of DC generators.

CO4: Illustrate the construction, testing and performance of single-phase transformers

CO5: Compare the construction, working, and applications of autotransformers and three-phase transformers.

TEXT BOOKS

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
2. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, Third Edition (2017).
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.

REFERENCE BOOKS

1. H. Cotton, "Electrical Technology", CBS Publishers and Distributors,2018.
2. A. E. Clayton and N. N. Hancock, "Performance and Design of DC machines", CBS Publishers and Distributors, 2018
3. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
4. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education,2010.
5. Parker Smith, N.N., 'Parker Smith's Problems in Electrical Engineering', 9th Edition, CBS Publishers and Distributers, 9th Edition, 2003.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	1	3	2	-	-	2	-	-	2	2	3	-
CO2	3	3	1	3	3	-	-	2	-	-	2	2	3	1
CO3	3	3	1	3	3	-	-	2	-	-	2	2	3	1
CO4	3	3	1	3	3	-	-	2	-	-	2	2	3	-
CO5	3	3	1	3	3	-	3	2	-	-	2	2	3	1
AVG	3	3	1	3	3	-	3	2	-	-	2	2	3	1

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

24EE3103 ANALOG ELECTRONICS **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To understand the structure of basic electronic devices and their characteristics.
- To explore the characteristics of amplifier gain and frequency response.
- To learn about Op-amp based circuits, its applications and special ICs.

UNIT I ELECTRONIC DEVICES AND THEIR CHARACTERISTICS **9**

PN junction diodes - Zener diode –structure, operation and V-I characteristics: drift and diffusion current, transient capacitance –BJT: structure- operation and characteristics-biasing- Introduction to JFET-MOSFET and UJT – Applications.

UNIT II AMPLIFIER CIRCUITS **9**

BJT small signal model –Analysis of CE, CB, CC amplifier, Gain and Frequency response Differential Amplifier - Two-stage amplifier-Common mode and Differential mode analysis Current mirror circuits.

UNIT III OPAMP AND CHARACTERISTICS **9**

Ideal OPAMP characteristics, DC characteristics, AC characteristics, Voltage-series feedback: non inverting amplifier and voltage -shunt feedback: inverting amplifier-Frequency response of OPAMP Basic applications: inverting, non- inverting and differential amplifier circuits, Adder-subtractor circuits -Differentiator and integrator circuits.

UNIT IV APPLICATION OF OPAMPS **9**

Instrumentation amplifiers, First-order and Second order active filters, Comparators and multi-vibrators, Waveform generators, Clippers and Clampers, Peak detector, D/A converters (Weighted resistance type and R-2R ladder type), A/D converters, Successive Approximation types and Sigma-Delta type).

UNIT V SPECIAL ICS **9**

555 Timer circuit: Functional block diagram, characteristics and applications – Astable and monostable multivibrator -566 Voltage Controlled Oscillator circuits – PLL.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Characteristics of PN junction diode.
2. Characteristics of BJT – CB, CE, CC
3. Op-Amp based amplifier circuits Inverting and Non-inverting amplifier.
4. Op-Amp based Differential amplifier/Instrumentation amplifier.
5. Design of Adder-subtractor circuits using Op-Amp.
6. Square wave and Tri-angular wave oscillator.
7. Op-Amp based Wien bridge and RC oscillator.
8. 555 – timer IC based astable multi-vibrator.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Describe the structure and underlying semiconductor physics concepts.
CO2: Analyze various amplifier configurations focusing on gain and frequency response.
CO3: Explain the characteristics and basic applications of OPAMPs
CO4: Design the analog electronic circuits using OPAMPs
CO5: Explain the operation and applications of special ICs like 555 Timer, 566 VCO and PLL in various electronic circuits.

TEXT BOOKS

1. David A bell, " Electronic circuits" , Oxford University Press, 2011.
2. Ramakant A Gayakwad, " Op-amps and Linear Integrated Circuits", IV edition, Pearson Education/PHI, 2009.
3. D. Roy Choudary, S.B. Jain, " Linear Integrated Circuits", Third edition, New Age publishers,2014.

REFERENCE BOOKS

1. Millman and Halkias, "Integrated Electronics", McGraw Hill Publications, 2010.
2. Muhammad H. Rashid, "Linear Integrated Circuits", Cengage Learning, 2014.
3. Donald A Neamen, "Electronic Circuits", McGraw Hill, 6th Edition, 2007.
4. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", McGraw Hill, 4th Edition, 2014.
5. Floyd, Buchla, "Fundamentals of Analog Circuits", Pearson, 2013.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	2	3	3	1	-	-	2	-	-	1	3	-
CO2	2	1	2	3	3	1	-	-	2	-	-	1	3	-
CO3	2	1	2	3	3	1	-	-	2	-	-	1	3	-
CO4	2	1	2	3	3	1	-	-	2	-	-	1	3	-
CO5	2	1	2	3	3	1	-	-	2	-	-	1	3	-
AVG	2	1	2	3	3	1	-	-	2	-	-	1	3	-

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

24EE3104 TRANSMISSION AND DISTRIBUTION **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To impart knowledge about the configuration of the electrical power systems, performance analysis of transmission lines.
- To learn about different insulators and underground cables.
- To understand the mechanical design and methods of grounding.

UNIT I STRUCTURE OF POWER SYSTEM **9**

Structure of electric power system: generation, transmission and distribution; Choice of transmission voltage, overhead and underground systems, Types of AC and DC distributors– distributed and concentrated loads–voltage tolerances– Comparison of EHVAC and HVDC transmission - Introduction to FACTS devices.

UNIT II TRANSMISSION LINE PARAMETERS **9**

Parameters of single and three phase transmission lines with single and double circuits - Resistance, inductance and capacitance of solid, stranded and bundled conductors, conductor types – Symmetrical and unsymmetrical spacing and transposition-application of self and mutual GMD- skin and proximity effects-Effects of earth on capacitance of transmission line - interference with neighboring communication circuits, corona discharge.

UNIT III MODELLING AND PERFORMANCE OF TRANSMISSION LINES **9**

Classification of lines–short line, medium line and long line-Evaluation of A,B,C,D constants- equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance and surge impedance loading; transmission efficiency and voltage regulation, real and reactive power flow in lines, Power-circle diagrams, methods of voltage control-Ferranti effect, Charging current and losses in an open circuited line.

UNIT IV INSULATORS AND CABLES **9**

Main components of overhead lines-Insulators-Types, voltage distribution in insulator string, improvement of string efficiency, Underground cables-Types of cables, insulation materials, Parameters of cable, Grading of cables, Capacitance of 3-core cable, heating, thermal resistance of cables.

UNIT V MECHANICAL DESIGN OF LINES AND GROUNDING **9**

Mechanical design of transmission line, sag and tension calculations for different weather conditions, Tower spotting, Types of towers, Sub-station Layout (AIS, GIS), Methods of grounding.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Calculate the parameters of single-phase transmission line.
2. Calculate the parameters of three phase transmission line.
3. Determine the ABCD constant for transmission line.
4. Calculate the corona loss of transmission line.

5. Calculation of sag & tension of transmission line.
6. Calculation of string efficiency of insulator of transmission line.
7. Simulate the Ferranti effect in transmission line.
8. Calculation of parameter of underground cables.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Explain the structure of power systems and analyze the choice of transmission voltage levels.
CO2: Compute the transmission line parameters for different configurations.
CO3: Model transmission line and to determine the performance of line.
CO4: Evaluate the insulators, underground cables, and methods to improve the cable performance.
CO5: Design the mechanical aspects of transmission lines and grounding systems.

TEXT BOOKS

1. S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt. Ltd, New Delhi, 2008.
2. B.R. Gupta,' Power System Analysis and Design', S. Chand, New Delhi, Fifth edition 2005-08.
3. J.Brian, Hardy and Colin R.Bayliss'Transmission and Distribution in Electrical Engineering', Newnes, Fourth Edition,2012

REFERENCE BOOKS

1. R.K.Rajput, 'Power System Engineering' Laxmi Publications (P) Ltd, New Delhi, 2006
2. D.P.Kothari, I.J.Nagarath, 'Power System Engineering' Tata Mc Graw -Hill Publishing Company limited, New Delhi, 2007.
3. C.L.Wadhwa, 'Electrical Power Systems', New Academic Science Ltd, 2009.
4. Luces M.Fualkenberry ,Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 2007.
5. Hadi Saadat, 'Power System Analysis, 'PSA Publishing; Third Edition, 2010.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	1	2	-	-	1	-	-	2	-
CO2	3	2	2	-	-	1	2	-	-	1	-	-	2	3
CO3	3	2	2	-	-	1	2	-	-	1	-	-	2	3
CO4	3	2	2	-	-	1	2	-	-	1	-	-	2	-
CO5	3	2	2	-	-	1	2	-	-	1	-	-	2	-
AVG	3	2	2	-	-	1	2	-	-	1	-	-	2	3

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

24EE3105 DATA STRUCTURES USING C & C++ **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To understand the concepts of ADTs.
- To understand linear data structures – lists, stacks and queues.
- To understand non-linear data structures - trees

UNIT I C PROGRAMMING DUNDAMENTALS **9**

Variables– Operations– Expressions and Statements– Conditional Statements– Functions– Recursive Functions– Arrays– Single and Multi-Dimensional Arrays.

UNIT II C PROGRAMMING ADVANCED FEATURES **9**

Structures– Union– Enumerated Data Types– Pointers: Pointers to Variables, Arrays and Functions– File Handling– Preprocessor Directives**.**

UNIT III ABSTRACT DATA TYPES **9**

Abstract Data Types (ADTs) - ADTs and classes - Introduction to OOP - Classes - Inheritance - Namespaces - Shallow and deep copying - Introduction to analysis of algorithms - Asymptotic notations - Divide & conquer - Recursion - Analyzing recursive algorithms.

UNIT IV LINEAR AND NON-LINEAR DATA STRUCTURES USING C++ **9**

Abstract Data Types (ADTs) – List ADT – Array-Based Implementation – Linked List – Doubly Linked Lists – Circular Linked List – Stack ADT – Implementation of Stack – Applications – Queue ADT – Trees – Binary Trees – Tree Traversals –Binary Search Tree - Hashing - Hash Functions – Separate Chaining – Open Addressing – Linear Probing– Quadratic Probing**.**

UNIT V SEARCHING AND SORTING USING C++ **9**

Insertion Sort – Quick Sort – Heap Sort – Merge Sort –Linear Search – Binary Search.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Array implementation of Stack, Queue and Circular Queue ADTs using C.
2. Implementation of Single Linked List using C.
3. Linked list implementation of Stack and Linear Queue ADTs using C.
4. Implementation of Evaluating Postfix Expressions, Infix to Postfix conversion using C++.
5. Implementation of Prim's Algorithm using C++.
6. Implementation of Linear Search and Binary Search using C++.
7. Implementation of Insertion Sort,Merge Sort and Selection Sort using C++ .
8. Implement of Open Addressing (Linear Probing and Quadratic Probing) using C++.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Develop C programs for any real world/technical application.

CO2: Apply advanced features of C in solving problems.

CO3: Implement linear and non-linear data structure operations.

CO4: Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval.

CO5: Design, implement and analyze efficient tree structures to meet requirements such as searching, indexing and sorting.

TEXT BOOKS

1. Mark Allen Weiss,"Data Structures & Algorithms Analysis in C", Second Edition,Pearson Education,2023.
2. Reema Thareja, "Programming in C", 2nd Edition, Oxford University Press, 2011.
3. Pradip Dey and Manas Ghosh, "Programming in C", 2nd Edition, Oxford University Press, 2011.

REFERENCE BOOKS

1. Brain W. Kernighan, Rob Pike "The Practice of Programming", Pearson Education, 2022.
2. Paul J.Deitel, Harvey Deitel "C How to Program", Seventh Edition,Pearson Education, 2013.
3. Santhosh Kumar Mishra, "The Art of Data Structures and Algorithms: The Utltimate Quick reference guide, Kindle Edition, 2023.
4. Ellis Horowitz, Sartaj Sahni and Susan Anderson "Fundamentals of Data Structures", Galgotis, 2008.
5. Jean-Paul Tremblay and Paul G. Sorenson – An introduction to Data Structure with Applications,Second Edition, Tata Mc Graw-Hill,2017.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	2	3	2	1	-	-	-	2	1	3	1	2	1
CO2	1	3	3	1	2	-	-	-	2	2	2	1	1	3
CO3	2	2	2	3	3	-	-	-	3	2	1	1	1	2
CO4	1	2	1	3	1	-	-	-	3	2	1	1	1	2
CO5	3	3	1	2	3	-	-	-	3	3	1	3	2	1
AVG	1.8	2.4	2	2.2	2	-	-	-	2.6	2	1.6	1.4	1.4	1.8

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

24EE3201 DC MACHINES AND TRANSFORMERS LABORATORY **L T P C**
0 0 3 1.5

COURSE OBJECTIVES

- To expose students to determine the characteristics of DC machines and transformers through practical experiments.
- To provide hands-on experience that allows students to evaluate the performance parameters of DC machines and transformers.
- To encourage students to conduct suitable tests to assess and analyze the functionality and performance of DC machines and transformers.

LIST OF EXPERIMENTS

1. Open circuit and load characteristics of DC shunt generator.
2. Load characteristics of DC compound generator with differential and cumulative connections.
3. Load test on DC shunt motor.
4. Load test on DC compound motor.
5. Load test on DC series motor.
6. Swinburne's test and speed control of DC shunt motor.
7. Load test on single-phase transformer and three phase transformers.
8. Open circuit and short circuit tests on single phase transformer.
9. Sumpner's test on single phase transformers.
10. Separation of no-load losses in single phase transformer.
11. Study of DC Motor starters.
12. Study the three phase transformer connections.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Construct the circuit with appropriate connections for the given DC machine/transformer.

CO2: Experimentally determine the characteristics of different types of DC machines.

CO3: Demonstrate the speed control techniques for a DC motor for industrial applications.

CO4: Identify suitable methods for testing of transformer and DC machines.

CO5: Predetermine the performance parameters of transformers and DC motor.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	1	1	1	-	-	1	-	-	-	1	3	2
CO2	3	3	1	1	1	-	-	1	-	-	-	1	3	1
CO3	3	3	1	1	1	-	-	1	-	-	-	1	3	1
CO4	3	3	1	1	1	-	-	1	-	-	-	1	3	3
CO5	3	3	1	1	1	-	-	1	-	-	-	1	3	3
AVG	3	3	1	1	1	-	-	1	-	-	-	1	3	3

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

24EE3202 ELECTRICAL WORKSHOP **L T P C**
0 0 3 1.5

COURSE OBJECTIVES

- To experimentally analyze the performance of an induction motor using DOL and Star-Delta starters.
- To develop accurate and efficient winding diagrams for various three-phase and single-phase cage induction motors based on specified parameters.
- To design armature windings for an automobile dynamo and a single-phase transformer to understand winding configurations and manufacturing considerations.

LIST OF EXPERIMENTS

1. Connect the given gauge single phase Induction motor through DOL starter and testing.
2. Connect the given gauge Induction motor through Star-Delta starter and testing.
3. Connect the given gauge Three phase Induction motor through DOL starter and testing.
4. Develop a winding diagram for three phase, 50 Hz,440V,1440 rpm,36 slots single layer cage induction motor stator winding.
5. Develop a winding diagram for three phase, 50 Hz, 440V, 960 rpm,36 slots double layer cage induction motor stator winding. (Full Pitched)
6. Develop a winding diagram for three phase, 50 Hz, 440V, 2850 rpm,24 slots double layer cage induction motor stator winding. (Short Chorded)
7. Develop a winding diagram for three phase,50 Hz,440V,1440 rpm,36 slots double layer cage induction motor stator winding.
8. Develop a winding diagram for single phase, 50 Hz,230V,1440 rpm,36 slots cage induction motor stator winding.
9. Develop a Automobile dynamo armature winding.
10. Develop a winding for single phase, 30 KVA transformer.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Demonstrate the differences in performance, starting torque, and efficiency when using DOL versus Star-Delta starters for induction motors.

CO2: Develop and interpret winding diagrams for various types of cage induction motors, including single-layer, double-layer, full-pitched and short-chorded configurations.

CO3: Apply theoretical concepts to practical winding design, ensuring optimal performance and adherence to motor specifications.

CO4: Designing armature windings for automotive dynamos and transformer windings tailored to specific voltage and power ratings.

CO5: Test, analyze, and validate the performance of motors and windings, ensuring compliance with desired operational parameters.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	1	1	1	-	-	1	-	-	-	1	3	2
CO2	3	3	1	1	1	-	-	1	-	-	-	1	3	1
CO3	3	3	1	1	1	-	-	1	-	-	-	1	3	1
CO4	3	3	1	1	1	-	-	1	-	-	-	1	3	3
CO5	3	3	1	1	1	-	-	1	-	-	-	1	3	3
AVG	3	3	1	1	1	-	-	1	-	-	-	1	3	3

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

24EE4101 POWER SYSTEM ANALYSIS **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To understand the need for operational studies and apply iterative techniques for power flow analysis.
- To carry out short circuit studies for power system during symmetrical fault.
- To study about the various methods for analyzing power system stability.

UNITI POWER SYSTEM OVERVIEW **9**

Need for system planning and operational studies - Power scenario in India - Power system components - Single line diagram - per unit quantities - p.u. impedance diagram - p.u. reactance diagram - Bus admittance matrix - Formation of bus admittance matrix.

UNITII POWER FLOW ANALYSIS **9**

Significance of Power Flow Analysis in planning and operation- Formulation of Power Flow problem - Bus classification - Power flow solution using Gauss-Seidel method - - Power Flow Solution by Newton-Raphson method.

UNIT III SYMMETRICAL FAULT ANALYSIS **9**

Importance of short circuit studies - Symmetrical short circuit analysis using Thevenin's theorem - Bus Impedance matrix by building algorithm - Symmetrical fault analysis through bus impedance matrix - Post fault bus voltages - Fault level current limiting reactors.

UNIT IV UNSYMMETRICAL FAULT ANALYSIS **9**

Symmetrical components - Sequence impedances –-Analysis of unsymmetrical faults: single-line- to ground, line-to-line and double-line-to-ground - Sequence impedance and Sequence network.

UNIT V STABILITY ANALYSIS **9**

Importance of stability studies-Classification of power system stability –Single Machine Infinite Bus system: Development of swing equation - solution of the swing equation - Equal area criterion - Critical clearing angle and time – Methods of improving transient stability.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Construction of Single Line Diagram
2. Formation of bus admittance matrix
3. Solving power flow problem using Gauss-Seidel method
4. Solving power flow problem using N-R method.
5. Formation of Bus impedance matrix.
6. Symmetric short circuit analysis.
7. Unsymmetrical Fault analysis.
8. Transient Stability analysis of Single Machine Infinite Bus (SMIB) system.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Model the per unit system and formulate the bus admittance matrices.

CO2: Apply Gauss-Seidel and Newton-Raphson methods to solve power flow problems for system planning and operation.

CO3: Analyze symmetrical faults using Thevenin's theorem and bus impedance matrices.

CO4: Compute sequence impedances and analyze the unsymmetrical faults using symmetrical components.

CO5: Evaluate system stability using the swing equation and equal area criterion.

TEXT BOOKS

1. John J. Grainger, William D. Stevenson, 'Power System Analysis', Mc Graw Hill Education (India) Private Limited, New Delhi, 2015.
2. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw-Hill Education, Second Edition, 2008.
3. Arthur R. Bergen, 'Power System Analysis', Pearson Education India, 2nd Edition, 2009.

REFERENCE BOOKS

1. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.
2. Pai M A, 'Computer Techniques in Power System Analysis', Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.
3. J.Duncan Glover, Mulukutla S.Sarma, Thomas J. Overbye,' Power System Analysis & Design', Cengage Learning, Fifth Edition, 2012.
4. Gupta B.R., 'Power System - Analysis and Design', S. Chand Publishing, 2001.
5. Kundur P., 'Power System Stability and Control', Tata McGraw Hill Education Pvt. Ltd., New Delhi,10th reprint, 2010.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	1	1	-	-	-	1	-	-	1	3	-
CO2	3	2	2	1	1	-	-	-	1	-	-	1	3	-
CO3	3	2	2	1	1	-	-	-	1	-	-	1	3	-
CO4	3	2	2	1	1	-	-	-	1	-	-	1	3	-
CO5	3	2	2	1	1	-	-	-	1	-	-	1	3	-
AVG	3	2	2	1	1	-	-	-	1	-	-	1	3	-

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

24CY4101 ENVIRONMENTAL SCIENCE AND ENGINEERING **L T P C**
2 0 0 2

COURSE OBJECTIVES

- To introduce the fundamental ideas of environment and interrelationship between living organism.
- To impart knowledge on pollution and perspectives on renewable resources.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials.

UNIT I ENVRONMENT AND BIODIVERSITY **6**

Definition - scope and importance of environment. Eco-system 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 – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In- situ and ex-situ.

UNIT II NATURAL RESOURCES **6**

Forest resources: deforestation, timber extraction, mining, dams and their effects on forests and tribal people. Water resources: over-utilization of surface and ground water. Mineral resources: environmental effects of extracting and using mineral resources. Food resources: World food problems, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.

UNIT III ENVIRONMENTAL POLLUTION **6**

Causes, Effects and Preventive measures of Water, Soil and Air Pollution. Environmental protection acts [Environment Act, Air Act, Water Act]. Disaster management: causes - effects - control measures of floods – earthquake.

UNIT IV NON-CONVENTIONAL ENERGY **6**

Energy management and conservation, New Energy Sources: Solar energy,Wind energy, Biomass energy, Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT V SUSTAINABILITY MANAGEMENT **6**

Sustainable development, Unsustainability to sustainability, GDP, Carbon Credit, Carbon Footprint, Zero waste and R concept, Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports, Green Engineering.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Understand the functions of environment, ecosystems and biodiversity.

CO2: Examine the relationship between natural resources and their environment.

CO3: Identify the causes, effects of environmental pollution.

CO4: Recognize the sources of Non-conventional energy.

CO5: Understand the needs of sustainable development and green materials.

TEXT BOOKS

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition,New Age International Publishers,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

REFERENCE BOOKS

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38th Edition 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
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 & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	-	-	-	-	3	-	-	-	-	-	2	-
CO2	2	2	-	-	-	-	3	-	-	-	-	-	2	-
CO3	2	2	-	-	-	-	3	-	-	-	-	-	2	-
CO4	2	2	-	-	-	-	3	-	-	-	-	-	2	-
CO5	2	2	-	-	-	-	3	-	-	-	-	-	-	-
AVG	2	2	-	-	-	-	3	-	-	-	-	-	2	-

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

24EE4102 AC MACHINES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To impart knowledge on construction and performance of synchronous generators.
- To study about construction, principle of operation and performance of induction machines.
- To acquire knowledge on construction, principle of operation and performance of single phase induction motors ,special machines.

UNIT I SYNCHRONOUS GENERATOR **9**

Construction ,Principle and types – EMF equation – Armature reaction – Voltage Regulation – EMF,MMF,ZPF,ASA methods – Two Reaction theory - Slip test- Synchronizing and Parallel operation.

UNIT II PULSATING AND REVOLVING MAGNETIC FIELDS **9**

Principle of operation-Starting Methods-Synchronous machines on infinite bus bar-Phasor diagram-V and inverted V curve-Hunting and its suppression methods-Use of Damper winding-Synchronous Condenser.

UNIT III THREE INDUCTION MOTOR **9**

Construction, Types and Principle of operation- Torque Equation-Characteristics-Equivalent Circuit-Crawling and Cogging-Losses and Efficiency – No load and Blocked rotor test-Separation of No load losses – Circle Diagram**.**

UNIT IV STARTING AND SPEED CONTROL METHODS OF THREE PHASE INDUCTION MOTOR **9**

Need for starters – Types of starters – Speed control Methods- Voltage, Frequency Control-V/F Control-Pole changing method- Rotor resistance control-Slip power recovery scheme-Braking Methods.

UNIT V SINGLE PHASE INDUCTION MOTORS AND SPECIAL ELECTRIC MOTORS **9**

Single phase Induction motor-Construction, Principle of operation- Double field revolving theory-Types of single phase induction motor, Construction, Types, Principle of operation-BLDC motor, Hysteresis Motor – Reluctance motor – AC series motor.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain the construction, operation and voltage regulation methods of synchronous generators.

CO2: Analyze synchronous machine behavior on infinite bus bars using phasor diagrams.

CO3: Derive the torque equation and equivalent circuit of three-phase induction motors.

CO4: Compare starting and speed control methods for three-phase induction motors.

CO5: Describe the working principles of single-phase induction motors and special electric motors.

TEXT BOOKS

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, Third Edition (Adapted Indian Edition).
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.

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1. M. G. Say, "Performance and Design of AC machines", CBS Publishers, 2002.
2. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.
3. I. J. Nagrath and D.P. Kothari, "Electric Machine", McGraw Hill Education, 2010.
4. M.N. Bandyo padhyay,Electrical Machines Theory and Practice, PHI Learning PVT LTD., New Delhi,2011.
5. B.R. Gupta, 'Fundamental of Electric Machines' New age International Publishers, 3rd Edition, Reprint 2015.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	-	3	2	1	1	-	2	-	-	-	-	-	3
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CO3	3	-	3	3	1	3	-	-	-	-	3	3	-	3
CO4	3	-	3	3	1	3	-	-	-	-	3	3	-	3
CO5	3	-	3	3	1	3	-	-	-	-	3	3	-	3
AVG	2.8	-	3	2.8	1	2.6	-	2	-	-	3	3	-	3

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

24EE4103 DIGITAL ELECTRONICS **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To study various number systems and to simplify the mathematical expressions using Boolean functions.
- To study implementation of combinational, synchronous and asynchronous sequential logic circuits.
- To learn logic families and digital circuits using VHDL.

UNIT I BOOLEAN ALGEBRA AND COMBINATIONAL CIRCUITS **9**

Number system, error detection, corrections & codes conversions, Boolean algebra: De-Morgan's theorem, switching functions and minimization using K-maps & Quine McCuskey method.

UNIT II DESIGN OF COMBINATIONAL LOGIC CIRCUITS **9**

Design of adder, subtractor, comparators, code converters, encoders, decoders, multiplexers and demultiplexers, Realisation of Boolean Functions using MSI devices, memories and PLA.

UNIT III DESIGN OF SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Flip flops-- SR, D, JK and T, shift registers, counters, state assignments analysis and design of synchronous sequential circuits, state diagram; state reduction.

UNIT IV DESIGN OF ASYNCHRONOUS SEQUENCTIAL CIRCUITS 9

Asynchronous sequential logic circuits-Transition table, flow table – race conditions – circuits with latches, analysis of asynchronous sequential logic circuits – introduction to design – implication table.

UNIT V LOGIC FAMILIES AND DIGITAL CIRCUITS USING VHDL 9

Logic families: RTL ad DTL circuits, TTL ECL NMOS and CMOS -Introduction to VHDL. Design– Adder/subtractor circuit using adder ICs, concept of carry look ahead, hardware multiplier circuit, Design with Multiplexers / Demultiplexers.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Verification of logic gates.
2. Design of combinational logic circuits using K-Map.
3. Design of Adder& Subtractor circuits using digital ICs.
4. Encoders and Decoders.
5. Multiplexer and demultiplexer circuit.
6. Verification of SR, D, JK and T flipflops.
7. Verification of 4 types of shift registers.
8. Multiplexer and demultiplexer circuit using VHDL.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Simplify logic expressions using Boolean algebra theorems and K-map techniques
CO2: Design combinational circuits using Boolean functions and MSI devices.
CO3: Develop synchronous sequential systems with flip-flops and state diagrams.
CO4: Analyze asynchronous sequential circuits, race conditions and latches using flow table.
CO5: Create digital designs using logic families and VHDL fundamentals

TEXT BOOKS

1. Morris Mano.M, 'Digital Logic and Computer Design', Prentice Hall of India, 3rd Edition, 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, 2015.

REFERENCE BOOKS

1. Tocci R.J., Neal S. Widmer, 'Digital Systems: Principles and Applications', Pearson Education Asia,2014.
2. Donald P Leach, Albert Paul Malvino, GoutamSha, 'Digital Principles and Applications', TataMcGraw Hill, 7th Edition, 2010.
3. Charles H. Roth, Jr, 'Fundamentals of Logic Design', Jaico Books, 4th Edition, 2002.
4. William I. Fletcher, "An Engineering Approach to Digital Design", Prentice- Hall of India, 1980.
5. Floyd T.L., "Digital Fundamentals", Charles E. Merril publishing company, 1982.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	1	3	-	-	1	-	-	-	-	3	-
CO2	3	3	3	1	3	-	-	1	-	-	-	-	3	-
CO3	3	3	3	1	3	-	-	1	-	-	-	-	3	-
CO4	3	3	3	1	3	-	-	1	-	-	-	-	3	-
CO5	3	3	3	1	3	-	-	1	-	-	-	-	3	-
AVG	3	3	3	1	3	-	-	1	-	-	-	-	3	-

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

24EE4104 MEASUREMENT AND INSTRUMENTATION **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To educate the fundamental concepts of measurements and analog instruments.
- To infer the importance of various bridge circuits used with measuring instruments.
- To summarize the overall measurement and instrumentation with the knowledge on digital instrumentation principles and PLC programming.

UNIT I MEASUREMENT CONCEPTS AND ANALOG INSTRUMENTS **9**

Instruments: classification, applications –Elements of a generalized measurement system - Static and dynamic characteristics - Errors in measurement -Statistical evaluation of measurement data. Classification of instruments –moving coil and moving iron meters – Induction type, dynamometer type meters –Energy meter –Mega Ohm Meter - Instrument transformers (CT & PT).

UNIT II SENSORS AND TRANSDUCERS **9**

Principles: Resistive –Inductive –Capacitive - Magnetic sensing - Piezoelectric effects –Light -Temperature based sensing, Classification of transducers –Measurement of pressure, temperature, displacement, flow, angular velocity –Digital transducers –Smart Sensors, Actuators: Principle –Classification: Pneumatic, mechanical, electrical, magnetic and thermal –applications.

UNIT III AC/DC BRIDGES AND INSTRUMENTATION AMPLIFIERS 9

Wheatstone bridge, Kelvin double bridge Maxwells, Hay, Wien and Schering bridge –Errors and compensation in A.C. bridges Instrumentation Amplifiers.

UNIT IV DIGITAL INSTRUMENTATION 9

A/D converters: types and characteristics –Sampling, Errors- Measurement of voltage, Current, frequency and phase - D/A converters: types and characteristics- DSO- Data Loggers –Instrument standards.

UNIT V PLC AND VIRTUAL INSTRUMENTATION 9

Evolution of PLC –Sequential and Programmable controllers –Architecture –Programming of PLC –Functional blocks –Communication Networks for PLC. Introduction to Virtual Instrumentation (VI) –Architecture –Programming –Front Panel and Block diagram –Data flow programming –G programming concepts –Control structures –Error handling –String controls –File I/O VIs and functions.

TOTAL: 45 PERIODS

LAB EXPERIMENTS

1. Calibration of thermocouple for temperature measurement.
2. Calibration of Pressure Gauges.
3. Calibration of strain gauge for temperature measurement.
4. Study and calibration of a rotameter for flow measurement.
5. Study and Calibration of LVDT transducer for displacement.
6. Characteristics of photo diode and photo transistor.
7. Study and calibration of Instrument transformers.
8. Study of characteristics of Optical Sensors

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Classify measurement instruments and analyze their static/dynamic characteristics.

CO2: Select appropriate sensors/transducers for measuring physical quantities like pressure and temperature.

CO3: Apply bridge circuits for precise resistance/inductance/capacitance measurements.

CO4: Utilize digital instruments for measuring electrical parameters and understanding conversion techniques.

CO5: Program PLC systems and implement virtual instrumentation using data flow concepts

TEXT BOOKS

1. A.K. Sawhney, Puneet Sawhney ‘A Course in Electrical & Electronic Measurements & Instrumentation’, Dhanpat Rai and Co, New Delhi, 18th Edition 2015.
2. H.S. Kalsi, ‘Electronic Instrumentation and Measurements’, Tata McGraw-Hill, New Delhi, 2019.
3. Albert D. Helfrick & William D. Cooper, “Modern Electronic Instrumentation and Measurement Techniques”, Prentice Hall India Learning Private Limited, 1992.

REFERENCE BOOKS

1. M.M.S. Anand, 'Electronics Instruments and Instrumentation Technology', Prentice Hall India, New Delhi, 2009.
2. Carr, 'Elements of Electronic Instrumentation and Measurement', Pearson Education India, New Delhi, 2011.
3. W.Bolton, Programmable Logic Controllers, 5th Edition, Elseiver, 2010.
4. R.B. Northrop, 'Introduction to Instrumentation and Measurements', Taylor & Francis, New Delhi,2008.
5. Dag H. Hanssen, Programmable Logic Controllers, A Practical Approach to IEC 61131-3 using CODESYS, John Wiley & Sons Ltd., 2015.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	-	-	-	-	2	-	-	-	3	3	3
CO2	3	3	3	3	-	-	-	-	3	-	3	3	3	3
CO3	3	3	3	3	3	-	-	-	3	-	3	3	3	3
CO4	3	3	3	3	3	-	-	2	3	-	3	3	3	3
CO5	3	3	3	3	3	-	-	-	3	-	3	3	3	3
AVG	3	3	3	2.4	1.8	-	-	2	2.4	-	3	3	3	3

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

24EE4201 AC MACHINES LABORATORY **L T P C**

0 0 3 1.5

COURSE OBJECTIVES

- To understand and analyze the methods of regulating three-phase alternators, including EMF, MMF, ZPF, and ASA approaches.
- To evaluate the performance characteristics and parameters of three-phase and single-phase induction motors through various load and no-load tests.
- To determine the impedance components, losses, and equivalent circuit parameters of induction motors and alternators for performance analysis.

LIST OF EXPERIMENTS

1. Regulation of three phase alternator by EMF and MMF methods.
2. Regulation of three phase alternator by ZPF and ASA methods.
3. Regulation of three phase salient pole alternator by slip test.
4. Measurements of negative sequence and zero sequence impedance of alternators.
5. V and Inverted V curves of Three Phase Synchronous Motor.
6. Load test on three-phase induction motor.
7. No load and blocked rotor tests on three-phase induction motor. (Determination of Equivalent circuit parameters).
8. Separation of No-load losses of three-phase induction motor.
9. Load test on single-phase induction motor.

10. No load and blocked rotor test on single-phase induction motor.
11. No load and blocked rotor test on single phase induction motor.
12. Study of induction motor starter.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Determine voltage regulation of three-phase alternator using EMF, MMF, ZPF, ASA methods and slip test.

CO2: Measure sequence impedances of alternator and plot V and inverted V curves of synchronous motors.

CO3: Determine equivalent circuit parameters of three-phase induction motors using no-load, blocked rotor and load tests.

CO4: Separate no-load losses and evaluate efficiency in three-phase induction motors.

CO5: Characterize the single-phase induction motors through load tests and parameter determination using No load and Blocked rotor test.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	-	3	-	-	-	3	-	-	1	3	2
CO2	3	3	2	-	3	-	-	-	3	-	-	1	2	2
CO3	3	3	2	-	3	-	-	-	3	-	-	1	2	2
CO4	3	3	2	-	3	-	-	-	3	-	-	1	2	2
CO5	3	3	3	-	3	-	-	-	3	-	-	1	3	3
AVG	3	2.8	2.2	-	3	-	-	-	3	-	-	1	2.2	2.2

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

24EE4202 INSTRUMENTATION AND PLC LABORATORY **L T P C**

0 0 3 1.5

COURSE OBJECTIVES

- To determine unknown resistance, inductance and capacitance using bridges.
- To determine power, power factor and energy consumed by the given load.
- To design PLC ladder logic program.

LIST OF EXPERIMENTS

1. To determine the value of unknown resistance using DC Bridges.
2. To determine the value unknown inductance Maxwell's Inductance Bridge.
3. To determine the value unknown capacitance using Schering Capacitance Bridge.
4. Instrumentation Amplifier.
5. Analog to Digital converter.
6. Digital to Analog Converter.
7. Measurement of Earth resistance using Megger.
8. Introduction to PLC trainer & its installation with PC.

9. Write and implement a simple ladder logic program using digital inputs and outputs for PLC.
10. Write and implement ladder logic program to on-off the DC motor using PLC.
11. Programming Logic Gates Functions in PLC.
12. Implementing Mathematical operations in PLC.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Measure unknown resistance, inductance, and capacitance using DC and AC bridge circuits.

CO2: Implement signal conditioning circuits using instrumentation amplifiers and data converters.

CO3: Determine earth resistance values using megger testing methods.

CO4: Configure PLC systems and establish communication with programming interfaces.

CO5: Develop ladder logic programs for motor control and traffic light systems using PLCs

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	2	2	3	1	-	-	1	-	1	2	3	2
CO2	2	2	3	2	2	1	-	-	1	-	1	2	2	2
CO3	2	3	1	2	1	1	-	-	1	-	1	1	1	1
CO4	3	2	1	1	2	1	-	-	1	-	1	1	1	1
CO5	2	1	2	3	3	1	-	-	1	-	1	1	2	1
AVG	3	2.2	1.8	2	2.2	1	-	-	1	-	1	1.3	1.8	1.4

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

24GE4201 TECHNICAL SEMINAR **L T P C**
0 0 2 1

COURSE OBJECTIVES

- To gain knowledge on literature survey in a selected area of study.
- To know an academic document from the literate and to give a presentation about it.
- To prepare a technical report.

COURSE SUMMARY

The course 'Technical Seminar' is anticipated to support a B.E./B.Tech graduate to read, understand, present and prepare report of an academic document. The learner shall search in the literature including peer reviewed journals, conference, books, project reports etc., and identify an appropriate paper/thesis/report in her/his area of interest, in consultation with her/his Technical seminar coordinator/guide. This course can help the learner to experience how a presentation can be made about a selected academic document and also empower her/him to prepare a technical report.

GENERAL GUIDELINES

1. The Department shall form an Internal Evaluation Committee (IEC) for the seminar for that program as the Chairperson/Chairman and seminar coordinator & seminar guide as members.
2. During the seminar presentation of a student, all members of IEC shall be present.
3. Formation of IEC and guide allotment shall be completed within a week after the University examination (or last working day) of the previous semester.
4. Guide shall provide required input to their students regarding the selection of topic/ paper.

Choosing a seminar topic: The topic for a UG seminar should be current and broad based rather than a very specific research work. It's advisable to choose a topic for the Seminar to be closely linked to the final year project area. Every member of the project team could choose or be assigned Seminar topics that covers various aspects linked to the Project area.

- A topic/paper relevant to the discipline shall be selected by the student during the semester break.
- Topic/Paper shall be finalized in the first week of the semester and shall be submitted to the IEC.
- The IEC shall approve the selected topic/paper by the second week of the semester.
- Accurate references from genuine peer reviewed published material to be given in the report and to be verified.

Evaluation pattern (Only internal evaluation)

Guide: (i) 20 marks (Background Knowledge – 10 & Relevance of the paper/topic selected – 10).

Seminar Coordinator: 20 marks (Seminar Diary – 10 (Each student shall maintain a seminar diary and the guide shall monitor the progress of the seminar work on a weekly basis and shall approve the entries in the seminar diary during the weekly meeting with the student), Attendance – 10).

Presentation: 40 marks to be awarded by the IEC (Clarity of presentation – 10, Interactions – 10 (to be based on the candidate's ability to answer questions during the interactive session of her/his presentation), Overall participation – 10 (to be given based on her/his involvement during interactive sessions of presentations by other students), Quality of the slides – 10).

Report: 20 marks to be awarded by the IEC (check for technical content, overall quality, templates followed, adequacy of references etc.).

COURSE OUTCOMES

CO1: Identify academic documents from the literature which are related to her/his areas of interest.

CO2: Read and apprehend an academic document from the literature which is related to her/ his areas of interest.

CO3: Prepare a presentation about an academic document.

CO4: Give a presentation about an academic document.

CO5: Prepare a technical report.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	-	-	2	-	-	-	-	2	-	3	-	-
CO2	3	2	-	-	-	-	-	-	-	2	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	2	-	3	-	-
CO4	3	3	-	-	2	-	-	-	-	2	-	3	-	-
CO5	3	3	-	-	2	-	-	-	-	2	-	3	-	-
AVG	2.8	2.6	-	-	2	-	-	-	-	2	-	3	-	-

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

24EE5101 RENEWABLE ENERGY RESOURCES SOURCES **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To Provide knowledge about various renewable energy sources.
- To enable students to understand PV and wind energy system
- To understand the geothermal energy conversion and hydrogen as renewable energy Source.

UNIT I ENERGY SOURCES **9**

Introduction to conventional, non-conventional energy sources. Renewable energy scenario in India and in global. Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment-Importance of renewable energy sources.

UNIT II SOLAR ENERGY **9**

Basic principle of solar energy, solar radiation, solar collectors, Introduction to Photovoltaic cells, PV module and PV array- V-I and P-V characteristics- Maximum power point tracking system.

UNIT III WIND ENERGY **9**

Basic principles, Nature of the wind – wind power derivation – factors influencing wind - components of Wind Energy Conversion System (WECS), Horizontal axis and Vertical Axis WECS.

UNIT IV GEOTHERMAL AND OCEAN ENERGY **9**

Geo-Thermal Energy: Introduction, sources, Geo-Thermal Energy conversion, Energy from the oceans: Introduction, ocean-thermal electrical conversion (OTEC), open and closed cycles. Tidal energy principles, single and double basin arrangements, wave energy conversion devices.

UNIT V FUELCELLS AND HYDROGEN ENERGY **9**

Introduction, principle of fuel cells, Types of fuel cells. Hydrogen as a renewable energy source, fuel for vehicles, Hydrogen production- direct electrolysis of water, thermal decomposition of water, biological and biochemical methods of hydrogen production.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Compare conventional and renewable energy sources with emphasis on environmental impacts.

CO2: Analyze solar energy systems including PV characteristics and MPPT techniques Point tracking in the PV system.

CO3: Evaluate wind energy systems and components of WECS.

CO4: Examine geothermal and ocean energy conversion technologies.

CO5: Assess fuel cell technologies and hydrogen production methods.

TEXT BOOKS

1. Godfrey Boyle, "Renewable energy", Oxford University Press in association with the Open University, 2004.
2. Rai. G.D, "Non-conventional energy sources", Khanna publishes, 1993.
3. Rai. G.D," Solar energy utilization", Khanna publishes, 1993.

REFERENCE BOOKS

1. Shobh Nath Singh, 'Non-conventional Energy resources' Pearson Education ,2015.
2. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
3. Gray, L. Johnson, "Wind energy system", prentice hall of India, 1995.
4. B.H. Khan, " Non-conventional Energy sources", , Mc Graw-hill, 2nd Edition, 2009.
5. Chetan Singh Solanki "Renewable Energy Technologies", Prentice Hall India Learning Private Limited, 2008.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	-	2	2	2	1	-	-	-	-	2	2	3	1
CO2	3	-	2	3	3	3	-	-	-	-	2	2	3	1
CO3	3	-	2	3	3	3	-	-	-	-	2	2	3	1
CO4	3	-	2	3	3	2	-	-	-	-	2	2	3	1
CO5	3	-	2	2	2	2	-	-	-	-	2	2	3	1
AVG	**3**	**-**	**2**	2.6	2.6	**2.2**	**-**	**-**	**-**	**-**	**2**	**2**	3	1

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

24EE5102 CONTROL SYSTEMS **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To make the students to analyze the stability of linear systems in the time domain and frequency domain.
- To develop linear models: mainly state variable model and Transfer function model.
- To make the students to design compensator based on the time and frequency domain specifications.

UNIT I MODELING OF LINEAR TIME INVARIANT SYSTEM **9**

Open loop and Closed loop systems –Feedback control system characteristics –First principle modeling: Mechanical, Electrical and Electromechanical systems –Transfer function representations - Block diagram and Signal flow graph.

UNIT II TIME DOMAIN ANALYSIS **9**

Standard test inputs –Time responses –Time domain specifications –Stability analysis: Concept of stability –Routh Hurwitz stability criterion –Root locus: Construction and Interpretation. Effect of adding poles and zeros.

UNIT III FREQUENCY DOMAIN ANALYSIS **9**

Frequency domain specifications, Bode plot, Polar plot and Nyquist plot - Introduction to closed loop Frequency Response.

UNIT IV STATE VARIABLE ANALYSIS **9**

State variable formulation –Non uniqueness of state space model –State transition matrix –Eigen values –Eigen vectors - Free and forced responses for Time Invariant Systems –Controllability –Observability.

UNIT V DESIGN OF FEED BACK CONTROL SYSTEM **9**

Design specifications –Lead, Lag and Lag-lead compensators using Root locus and Bode plot –PID controller-Design using reaction curve and Ziegler-Nichols technique- PID control in State Feedback form.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Mathematical modelling and analysis of Mechanical and Electrical systems using transfer function approach.
2. Time domain analysis of second order system .
3. Root locus technique based stability analysis.
4. Frequency response and stability analysis using Bode plot and Polar Plot.
5. Mathematical modelling and analysis of Mechanical and Electrical systems using state space approach.
6. Test of controllability and observability of a state space model
7. Design of compensators using Bode plot.
8. Design of P, PI, PD and PID controllers and evaluation of closed loop system performance for a second order system.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Model linear time-invariant systems using transfer functions and block diagrams.
CO2: Analyze system stability and transient response using time-domain techniques.
CO3: Plot frequency response characteristics using Bode,Polar and Nyquist methods.
CO4: Formulate system dynamics in state-space representation.
CO5: Design feedback compensators using root-locus and frequency-domain techniques

TEXT BOOKS

1. Nagrath.I.J&Gopal.M, "Control Systems Engineering", New Age International Pvt. Ltd., 7th Edition, 2021.
2. Katsuhiko Ogata, "Modern Control Engineering", Pearson, 5 th Edition, 2015.
3. Gopal.M, "Control Systems Engineering", New Age International Pvt.Ltd., 7th Edition, 2021.

REFERENCE BOOKS

1. Richard C.Dorf and Bishop, R.H., "Modern Control Systems", Education Pearson, 13th Edition, 2017.
2. John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Taylor & Francis Reprint 2009.
3. FaridGolnaraghi& Benjamin C. Kuo, "Automatic Control System", Wiley, 9th Edition, 2010.
4. NPTEL Video Lecture Notes on "Control Engineering" by Prof.S.D.Agashe, IIT Bombay.
5. Gopal.M, "Control Systems Engineering", New Age International Pvt.Ltd., 7th Edition, 2021.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	3		-	-	3	-	-		3	2
CO2	3	3	2	-	3	-	-	-	3	-	-	1	2	2
CO3	3	3	2	-	3	-	-	-	3	-	-	1	2	2
CO4	3	3	2	-	3	-	-	-	3	-	-	1	2	2
CO5	3	3	3	-	3	-	-	-	3	-	-	1	3	3
AVG	3	2.8	2.2	-	3	-	-	-	3	-	-	1	2.4	2.2

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

24EE5103 POWER ELECTRONICS AND DRIVES **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To understand different types of power semiconductor devices and their dynamic characteristics.
- To understand the operation, characteristics and performance parameters of single three phase rectifiers.
- To study the operation of AC voltage controller and various configurations of AC voltage controller.

UNIT I SWITCHING POWER SUPPLIES **9**

IGBT, MOSFET: dynamic behaviour - driver and snubber circuits -low power high switching frequency switching Power supplies, buck, boost, buck-boost converters – Isolated topologies – resonant converters switching loss calculations and thermal design.

UNIT I SINGLE PHASE RECTIFIERS **9**

Power Diode – half wave rectifier – mid-point secondary transformer based full wave rectifier – bridge rectifier - distortion factor - LC filters – SCR-Two transistor analogy-based turn- ON, Controlled converters (1 pulse, 2 pulse) displacement factor – ripple and harmonic factor effect of source inductance, inverter angle limit.

UNIT II THREE PHASE RECTIFIERS **9**

Three phase diode rectifiers – Concern for power quality, Controlled converters (3 pulse, 6 pulse) Computation of performance parameters.

UNIT IV INVERTERS **9**

Single phase half bridge and full bridge inverters - VSI – single phase and three phase inverters square wave operation) - Voltage control of inverters single, multi pulse, sinusoidal, space vector modulation techniques– various harmonic elimination techniques-CSI.

UNIT V AC PHASE CONTROLLERS **9**

TRIAC triggering concept with positive and negative gate pulse triggering, TRIAC based phase controllers various configurations for SCR based single and three phase controllers.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Characteristics of SCR.
2. Simulation of Single and three Phase Rectifiers.
3. Experimental verification of transfer characteristic of AC to DC half and fully controlled converter.
4. Experimental verification of transfer characteristic of MOSFET based Step down and step up Choppers.
5. Characteristics of MOSFET and IGBT.
6. Simulation of Switching Power Supplies.
7. Experimental verification of transfer characteristics of AC Phase Controllers.
8. Simulation of AC phase voltage controllers.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Analyze switching power supplies including buck/boost converters and resonant topologies.
CO2: Design single-phase rectifiers with LC filters and evaluate performance factors.
CO3: Calculate performance parameters for three-phase rectifiers.
CO4: Design inverter circuits using various modulation techniques.
CO5: Develop AC phase controllers using TRIAC and SCR-based configurations.

TEXT BOOKS

1. Ned Mohan, T.M.Undeland, W.P.Robbins, ”Power Electronics: Converters, applications and design”, John Wiley and Sons, 3rd Edition (reprint), 2009.
2. Rashid M.H., Power Electronics Circuits, Devices and Applications, Prentice Hall India, 3rd Edition, New Delhi, 2004.

3. R. Krishnan, 'Electric Motor Drives – Modeling, Analysis and Control', Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.

REFERENCE BOOKS

1. Cyril.W.Lander, Power Electronics, McGraw Hill International, Third Ed., 1993.
2. P.S.Bimbhra, Power Electronics, Khanna Publishers, Third Edition 2003.
3. PhilipT.Krein, Elements of Power Electronics, Oxford University Press, 2013.
4. P.C.Sen, Power Electronics, Tata McGraw-Hill, 30th reprint, 2008.
5. Sundareswaran K, "elementary concepts of Power Electronic Drives", CRC Press,2019.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	2	-	-	2	2	1	-	1	2	3
CO2	3	2	2	1	2	-	-	2	2	1	-	1	2	3
CO3	3	2	2	1	2	1	-	2	2	1	-	1	2	3
CO4	3	2	2	-	2	1	-	2	2	1	-	1	2	3
CO5	3	2	2	-	2	1	-	2	2	1	-	1	2	3
AVG	3	2	2	1	2	1	-	2	2	1	-	1	2	3

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

24EE5201 RENEWABLE ENERGY SYSTEMS LABORATORY **L T P C**
0 0 3 1.5

COURSE OBJECTIVES

- To train the students in Renewable Energy Sources and technologies.
- To provide adequate inputs on a variety of issues in harnessing Renewable Energy.
- To recognize current and possible future role of Renewable energy sources.

LAB EXPERIMENTS

1. Simulation of Solar PV Energy System.
2. Experiment on "VI-Characteristics and Efficiency of 1kWp Solar PV System".
3. Experiment on "Shadowing effect & diode-based solution in 1kWp Solar PV System".
4. Experiment on performance assessment of standalone 1KWp solar power system
5. Experiment on performance assessment of grid connected 1KWp solar power system
6. Simulation of Wind Energy Generator.
7. Experiment on Performance assessment of micro–Wind Energy Generator.
8. Simulation of Hybrid (Solar-Wind) Power System.
9. Experiment on Performance Assessment of Hybrid (Solar-Wind) Power System
10. Experiment on Performance Assessment of 100W Fuel Cell.
11. Study of Fuel cells and their Characteristics.
12. Integration of Renewable Energy with the Grid (Microgrid Simulaiton)

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Simulate renewable energy systems including solar PV, wind, hybrid, and hydro power.

CO2: Measure VI characteristics and evaluate efficiency of solar PV systems.

CO3: Analyze shadow effects and diode-based mitigation in solar PV arrays

CO4: Assess performance of standalone, grid-connected, and hybrid power systems.

CO5: Evaluate micro-wind generators and fuel cell systems experimentally.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	3	3	-	-	2	-	-	-	3	-	-
CO2	3	3	3	3	3	-	-	2	-	-	-	3	-	-
CO3	3	3	3	3	3	-	-	2	-	-	-	3	-	-
CO4	3	3	3	3	3	-	-	2	-	-	-	3	-	-
CO5	3	3	3	3	3	-	-	2	-	-	-	3	-	-
AVG	3	3	3	3	3	-	-	2	-	-	-	3	-	-

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

24EE5202 ELECTRICAL ESTIMATION LABORATORY **L T P C**

0 0 3 1.5

COURSE OBJECTIVES

- To apply standard practices and procedures for electrical installation.
- To familiarize with the procedures for preparing estimates and tendering.
- To plan for establishment of electrical equipments in the premises.

LIST OF EXPERIMENTS

1. Basic concepts of standardization and Electrical Installation.
2. Estimation of House wiring.
3. Estimation of pump set wiring.
4. Estimation of Street light.
5. Estimation for small scale industries.
6. Draw plan of electrical installation scheme for given 1BHK apartment unit
7. Draw plan of electrical installation scheme for given small factory / industrial unit
8. Draw plan of electrical installation scheme for given HT (11kV) connection
9. Draw plan of electrical installation scheme for given LT (415V) line connection
10. Draw plan of public lighting installation scheme of given premises.

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1: Prepare the quotation and tender for the purchase of electrical equipment and materials.

CO2: Interpret the salient features of National Electrical Code and other relevant national standards applicable for electrical installations in India.

CO3: Estimate wiring requirements for residential, agricultural, and industrial systems
CO4: Develop detailed wiring diagram for house building electrification
CO5: Develop proposals/single line diagrams for electrical installations in specified premises

REFERENCES

1. Is 18732:2023 Guide for implementation of Electrical Installation Standards in Buildings.
2. Is 1646:2022 Fire Safety of Buildings (General): Electrical Installations.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	3	3	-	-	2	-	-	-	3	-	-
CO2	3	3	3	3	3	-	-	2	-	-	-	3	-	-
CO3	3	3	3	3	3	-	-	2	-	-	-	3	-	-
CO4	3	3	3	3	3	-	-	2	-	-	-	3	-	-
CO5	3	3	3	3	3	-	-	2	-	-	-	3	-	-
AVG	3	3	3	3	3	-	-	2	-	-	-	3	-	-

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

24EE6101 PROTECTION AND SWITCHGEAR **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the significance of protection, protection schemes and role of earthing.
- To study the characteristics, functions and application areas of various relays.
- To acquire practical knowledge about common faults in power system apparatus and applying suitable protective schemes.

UNIT I PROTECTIVE SCHEMES **9**

Significance and need for protective schemes-Nature, causes and consequence of faults-Buchholz relay -zones of protection- essential qualities of protection-Power system Grounding and Methods of Grounding.

UNIT II ELECTROMAGNETIC RELAYS **9**

Basic requirements of protective relaying – Classification and Operating principles of relays-R-X diagram – Universal Torque equation - Electromagnetic Relays – Overcurrent, Directional, Distance, Differential, Negative sequence relays and Under frequency relays.

UNIT III APPARATUS PROTECTION **9**

Application of instrument transformers in protection schemes – Protection of transformer, generator, motor, bus bars and transmission line.

UNIT IV STATIC RELAYS AND NUMERICAL PROTECTION **9**

Static relays – Phase, Amplitude Comparators – Synthesis of various relays using Static

comparators. Block diagram of Numerical relays – Over current protection, transformer differential protection, distant protection of transmission lines.

UNIT V CIRCUIT BREAKERS **9**

Physics of arcing phenomenon and arc interruption - DC and AC circuit breaking – re-striking voltage and recovery voltage - RRRV - current chopping - interruption of capacitive and inductive currents, resistance switching- Types of circuit breakers – air blast, oil, SF6 and vacuum circuit breakers – comparison of different circuit breakers.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain protective schemes, fault characteristics, and grounding methods in power systems.

CO2: Analyze electromagnetic relay operation principles and their applications.

CO3: Design the protection schemes for transformers, generators, and transmission lines.

CO4: Implement static and numerical relay-based protection systems.

CO5: Compare the various circuit breakers and analyze arc interruption phenomena.

TEXT BOOKS

1. Sunil S.Rao, Switchgear and Protection, Khanna publishers, New Delhi, 2008.
2. Y.G.Paithankar and S.R.Bhide, Fundamentals of power system protection, Second Edition,Prentice Hall of India Pvt. Ltd., New Delhi – 2010.
3. RavindraP.Singh, "Switchgear and Power System Protection " PHI Learning Private Ltd., New Delhi 2009.

REFERENCE BOOKS

1. Badri Ram ,B.H.Vishwakarma, Power System Protection and Switchgear, New Age InternationalPvt Ltd Publishers, Second Edition 2011.
2. B.Rabindranath and N.Chander, Power System Protection and Switchgear, New Age International (P) Ltd., First Edition 2011.
3. M.L.Soni, P.V.Gupta, U.S.Bhatnagar, A.Chakrabarti, A Text Book on Power System Engineering,Dhanpat Rai & Co., 1998.
4. C.L.Wadhwa, Electrical Power Systems, 6th Ed., New Age International (P) Ltd.
5. RavindraP.Singh, "Switchgear and Power System Protection " PHI Learning Private Ltd., New Delhi 2009.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	-	-	2	-	-	-	-	-	-	-	3	3
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	3
CO3	3	3	2	2	2	1	2	-	-	-	-	-	3	3
CO4	3	3	2	2	2	1	2	-	-	-	1	-	3	3
CO5	3	3	2	2	-	1	-	-	-	-	1	-	3	3
AVG	3	3	2	2	2	1	2	-	-	-	1	-	3	3

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

24EE6102 MICROPROCESSORS AND MICROCONTROLLERS **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To study the addressing modes & instruction set of 8085.
- To learn instruction set, peripheral/interfacing ICs and simple program writing in assembly languages.
- To learn architecture of 8051 and advanced microprocessors.

UNIT I INTRODUCTION TO 8085 MICROPROCESSOR **9**

Functional block diagram –Memory interfacing –I/O ports and data transfer concepts – Timing Diagram –Interrupt structure.

UNIT II 8085 INSTRUCTION SET AND PROGRAMMING **9**

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

UNIT III INTERFACING BASICS AND ICS **9**

Study of Architecture and programming of ICs: 8255 PPI, 8259 PIC, 8251 USART, 8279 Key board display controller and 8254 Timer/ Counter –Interfacing with 8085 - A/D and D/A converter interfacing.

UNIT IV INTRODUCTION TO 8051 MICROCONTROLLER **9**

Functional block diagram - Instruction format and addressing modes –Interrupt structure – Timer –I/O ports –Serial communication, Simple programming- key board and display interface –Temperature control system - stepper motor control - Usage of IDE for assembly language programming.

UNIT V BASICS OF EMBEDDED SYSTEMS **9**

Definition and characteristics - Embedded systems design process- Processor architectures - Memory organization and Types-Peripherals – RTOS - IDE.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Simple arithmetic operations with 8085: addition/subtraction/multiplication /division.
2. Simple arithmetic operations with 8085: /multiplication /division.
3. Programming with control instructions using 8085: Increment/Decrement, Ascending / Descending order, Maximum/Minimum of numbers
4. Code conversions using 8085: Hex / ASCII / BCD.
5. Simple arithmetic operations with 8051: addition/subtraction/multiplication /division.
6. Simple arithmetic operations with 8051: multiplication/division.

7. Programming with control instructions using 8051: Increment/Decrement, Ascending / Descending order/ Maximum/ Minimum of numbers.
8. Code Conversions using 8051: Hex / ASCII / BCD.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Explain the 8085 architecture, memory interfacing and interrupt structure.
CO2: Develop assembly language programs using 8085 instruction set and addressing modes.
CO3: Interface the peripheral ICs (8255, 8259, ADC/DAC) with 8085 microprocessors.
CO4: Program 8051 microcontroller for I/O, serial communication, and motor control.
CO5: Design embedded systems using RTOS concepts and processor architectures.

TEXT BOOKS

1. Ramesh S. Gaonkar, 'Microprocessor Architecture Programming and Application', Penram International (P) ltd., Mumbai, 5th edition, 2008.
2. Muhammad Ali Mazidi& Janice GilliMazidi, 'The 8051 Micro Controller and Embedded Systems', Pearson Education, 2007.
3. Kenneth Ayala, "The 8051 Microcontroller", Cengage Learning India, 2007, 3rd Edition.

REFERENCE BOOKS

1. Douglas V. Hall, "Micro-processors &Interfacing". Tata McGraw Hill 2nd edition, 2009.
2. Krishna Kant, "Micro-processors & Micro-controllers", Prentice Hall of India, 2007.
3. Embedded Systems: Architecture, Programming & Design, Raj Kamal, 2008, Tata McGraw Hill.
4. Mike Predko, "8051 Micro-Controller", McGraw Hill, 2009.
5. D. V. Hall, Microprocessors and Interfacing, TMGH, 2nd Edition 2006.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	-	-	2	-	-	-	-	-	-	-	3	3
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	3
CO3	3	3	2	2	2	1	2	-	-	-	-	-	3	3
CO4	3	3	2	2	2	1	2	-	-	-	1	-	3	3
CO5	3	3	2	2	-	1	-	-	-	-	1	-	3	3
AVG	3	3	2	2	2	1	2	-	-	-	1	-	3	3

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

24EE6103 POWER SYSTEM OPERATION AND CONTROL **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To impart knowledge on significance of power system operation and control.
- To understand about Real power– frequency control and reactive power– voltage control.
- To understand generation scheduling and economic operation of power system SCADA and its application for real time operation and control of power systems.

UNIT I INTRODUCTION **9**

National and Regional load dispatching centers in Indian grid –necessity of voltage and frequency regulation-Basics of P-F and Q-V Control Loops-System load variation, Economics of Generation-load curves, Load Duration Curve, Important terms of Generating plant - load forecast, Curve fitting techniques (Exponential curve and Quadratic Curve)-Deregulations-Electrical energy Tariff.

UNIT II REAL POWER - FREQUENCY CONTROL **9**

Basics of speed governing mechanisms and modeling- - Load Frequency Control (LFC) of single area system - static and dynamic analysis - speed regulation of two generators in parallel - tie line modeling - block diagram representation of two area system - static and dynamic analysis - tie line with frequency bias control – State variable model.

UNIT III REACTIVE POWER – VOLTAGE CONTROL **9**

Basics of Generation and absorption of reactive power– Automatic Voltage Regulator (AVR) – brushless AC excitation system – block diagram representation of AVR loop- static and dynamic analysis – stability compensation –Methods of reactive power control- tap changing transformer, SVC and STATCOM.

UNIT IV ECONOMIC OPERATION OF POWER SYSTEM **9**

Statement of economic dispatch problem - Incremental cost curve - optimal operation of thermal units without and with transmission losses (no derivation of transmission loss coefficients) - lambda-iteration method - base point and participation factors method. Statement of Unit Commitment (UC) problem - constraints on UC problem - solution of UC problem using priority list- Comparison between Unit commitment and Economic Load Dispatch.

UNIT V COMPUTER CONTROL OF POWER SYSTEM **9**

State estimation – measurements and errors - weighted least square estimation - State transition diagram showing various operating states. Need of computer control of power system –Energy Management System- Energy control centers and functions –System hardware configurations and Functions of SCADA – Introduction to PMU's.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Tariff Calculation
2. Load forecasting using curve fitting techniques.
3. Simulation of Load Frequency Control of single area system.
4. Simulation of Load Frequency Control of Two area system.
5. Stability analysis of AVR
6. Economic Dispatch problem.(It should be reframed)
7. Unit Commitment problem.
8. State estimation using weighted least square estimation technique.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Analyze power system operation concepts including load forecasting, tariff structures, and deregulation.

CO2: Model load-frequency control systems for single-area and two-area power systems.

CO3: Design automatic voltage regulator systems and reactive power compensation methods.

CO4: Optimize power generation with economic dispatch and unit commitment solutions.

CO5: Evaluate state estimation techniques and SCADA applications in power system.

TEXT BOOKS

1. Olle.I.Elgerd, 'Electric Energy Systems theory - An introduction', McGraw Hill Education Pvt. Ltd.,New Delhi, 34th reprint, 2010.
2. Allen. J. Wood and Bruce F. Wollen Berg, 'Power Generation, Operation and Control', John Wiley& Sons, Inc., 2016.
3. Mohammad Shahidehpour, Muwaffaq Alomoush, Marcel Dekker, "Restructured Electrical power systems: operation, trading and volatility" Pub., 2001.

REFERENCE BOOKS

1. Robert Miller and James Malinowski, 'Power system Opeartion', McGraw Hill Education Pvt. Ltd.,New Delhi, 2009.
2. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata Mcgraw-Hill Education, Second Edition, 2008.
3. Hadi Saadat, 'Power System Analysis', McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint,2010.
4. Kundur P., 'Power System Stability and Control, McGraw Hill Education Pvt. Ltd., New Delhi,10th reprint, 2010.
5. C.L.Wadhwa, Electrical Power Systems, 3rd Edn, New Age International Publishing Co., 2001.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	2	1	1	-	-	-	1	-	-	1	3	-
CO2	3	1	2	1	1	-	-	-	1	-	-	1	3	-
CO3	3	1	2	1	1	-	-	-	1	-	-	1	3	-
CO4	3	1	2	1	1	-	-	-	1	-	-	1	3	-
CO5	3	1	2	1	1	-	-	-	1	-	-	1	3	-
AVG	3	1	2	1	1	-	-	-	1	-	-	1	3	-

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

24EE6201 POWER SYSTEM SIMULATION LABORATORY **L T P C**

0 0 3 1.5

COURSE OBJECTIVES

- To analyze and understand the fundamental electrical behaviors of power systems through power flow, short circuit, and stability studies.
- To evaluate the starting performance of motors and optimize power factor correction
- To design and implement protection and control strategies, including relay coordination and voltage/frequency regulation, for reliable micro grid operation.

LIST OF EXPERIMENTS

1. Load Flow analysis using Gauss Seidel Method using Mi Power.
2. Implementation of Newton- Raphson Load Flow Analysis using Mi Power .
3. Analysis of Single- Line to Ground Fault using Mi power.
4. Analysis of Line- Line to Ground Fault using Mi power.
5. Evaluation of Double Line to Ground Faculties in Electrical Networks using Mi power.
6. Stability Analysis.
7. Motor Starting Analysis.
8. Power Factor Correction Studies.
9. Relay Coordination study.
10. Voltage and Frequency regulation of autonomous microgrid.
11. Virtual Synchronous Generator for autonomous microgrid.
12. Performance analysis of overcurrent relay.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Perform power system studies including load flow, short circuit, and stability analysis.

CO2: Analyze motor starting characteristics and their system impacts.

CO3: Design power factor correction schemes for improved system efficiency.

CO4: Coordinate protective relay settings for power system protection.

CO5: Implement voltage/frequency regulation and virtual synchronous generator techniques in microgrids

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	1	-	3	1	1	-	-	1	1	1	2	-
CO2	2	2	1	-	3	1	1	-	-	1	1	1	2	-
CO3	2	2	1	-	3	1	1	-	-	1	1	1	2	-
CO4	2	2	1	-	3	1	1	-	-	1	1	1	2	-
CO5	2	2	1	-	3	1	1	-	-	1	1	1	2	-
AVG	2	2	1	-	3	1	1	-	-	1	1	1	2	-

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

24EE6202 EMBEDDED SYSTEMS LABORATORY **L T P C**

0 0 2 1.5

COURSE OBJECTIVES

- To understand and implement duty cycle control techniques for DC-DC converters and PWM generation for inverter applications.
- To develop skills in sensing and measuring parameters such as speed and current in motor control systems.
- To design and interface various display and waveform generation modules for effective system monitoring and control.

LIST OF EXPERIMENTS

1. Interfacing ADC with 8085.
2. Interfacing DAC with 8085
3. Interfacing ADC with 8051.
4. Interfacing DAC with 8051
5. Interfacing of stepper motor using 8085.
6. Interfacing of stepper motor using 8051
7. Interfacing of traffic light control using 8085.
8. Interfacing of traffic light control using 8051.
9. Study of ARM evaluation system.
10. Interfacing real time clock and serial port using ARM.
11. Interfacing keyboard and LCD using ARM.
12. Interfacing EPROM and interrupt using ARM.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Examine the ARM evaluation system architecture and components.
CO2: Connect data conversion modules including ADC and DAC.
CO3: Operate input/output devices like LEDs, keyboards, and LCD displays.
CO4: Control electromechanical systems using stepper motors and sensors.
CO5: Establish wireless communication via Zigbee protocol implementation.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	3	1	3	-	-	-	3	2	1	2	2	2
CO2	2	2	3	1	3	-	-	-	3	2	1	2	2	2
CO3	2	2	3	1	3	-	-	-	3	2	1	2	2	2
CO4	2	2	3	1	3	-	-	-	3	2	1	2	2	2
CO5	2	2	3	1	3	-	-	-	3	2	1	2	2	2
AVG	2	2	3	1	3	-	-	-	3	2	1	2	2	2

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

24PD6201 NCC/NSS/NSO **L T P C**
2 0 0 2

All students shall enroll on admission in any one of the personality and character development program. NCC/NSS/NSO/YRC/SPORTS is a mandatory requirement and undergo training / conduct activities for about 80 hours and attend a camp of about seven days. The training shall include classes on hygiene and health awareness and also training in first aid. Alternately activities of science, literature and arts also help for personality and character development. The training activities will normally be during week end sand the camp will normally be during vacation period. A certificate will be given by the authorities concerned and duly forwarded by the Head of the Department to the Controller of Examinations for the purpose of record and scrutiny. No fee shall be charged for all these activities.

(OR)

Enroll as a student member of a recognized professional society/other bodies such as

- Student Chapters of Institution of Engineers (India)/ISTE/ Department Association
- Student Chapters of other Professional bodies like ICI, IEEE, SAE, ASHRAE, CSI, IEI, IIC, IGS, IETE, IWS etc. Students will have activities to improve technical skills, innovative skills, and career development

24HS7101 PROFESSIONAL ETHICS IN ENGINEERING **L T P C**
2 0 0 2

COURSE OBJECTIVES

- To enable the students to create an awareness on professional ethics
- To Impart Moral and Social Values.
- To learn the moral leadership and corporate responsibility.

UNIT I SOCIAL ETHICS **6**

Application of ethical reasoning to social problems – Gender bias and issues –Social discrimination – Constitutional protection and policies – Inclusive practices. Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT II ENGINEERING ETHICS **6**

Senses of Engineering Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy –

Models of professional roles – Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III SCIENTIFIC ETHICS **6**

Transparency and Fairness in scientific pursuits – Scientific inventions for the betterment of society - Unfair application of scientific inventions – Role and Responsibility of Scientist in the modern society.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS **6**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES **6**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Describe the human values with regard to the individual lifestyle for the society.

CO2: Explain the role of ethics to the engineering field.

CO3: Describe how engineering is applied in association with ethics based on engineering experimentation.

CO4: Explain the engineering ethics-based safety, responsibilities and rights.

CO5: Discuss the global issues of professional ethics in engineering.

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, “Ethics in Engineering”. McGraw-Hill, New York, 2005.
2. Edmund G Seebauer and Robert L Barry, Fundamentals of Ethics for Scientists and Engineers‖, Oxford University Press, Oxford, 2001.
3. Charles B. Fleddermann, ―Engineering Ethic, Pearson Prentice Hall, New Jersey, 2004.

REFERENCE BOOKS

1. Luke W. Galen “The Nonreligious: Understanding Secular People and Societies”,Oxford University Press,2016.
2. Bullivant, Stephen; Lee, Lois, “Secularism: A Dictionary of Atheism”, Oxford University Press, 2016.
3. Soumitro Banerjee, “Research Methodology for Natural Sciences”, IISc Press, January 2022.
4. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2014.

5. Laura P. Hartman and Joe Desjardins, ―Business Ethics: Decision Making for Personal Integrity and Social Responsibility‖ Mc Graw Hill education, India Pvt. Ltd.,New Delhi, 2013.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	-	2	-	3	3	-	3	-	-
CO2	-	-	-	-	-	-	2	-	3	3	-	3	-	-
CO3	-	-	-	-	-	-	2	2	**3**	3	-	3	-	-
CO4	-	-	-	-	-	-	2	2	**3**	3	-	3	-	-
CO5	-	-	-	-	-	-	2	2	**3**	3	-	3	-	-
AVG	-	-	-	-	-	-	2	2	3	3	-	3	-	-

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

24EE7501 MINI PROJECT **L T P C**

0 0 4 2

COURSEOBJECTIVES

- Identifying problem and developing the structured methodology to solve the identified problem in the industry or research problem at research Institution or college.
- Conducting experiments, analyze and discuss the test results, and make conclusions.
- Preparing project reports and presentation.

The students shall individually / or as group work on a specific topic approved by the Department. The student can select any topic which is relevant to his/her specialization of the programme. The student should continue the work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work, results and discussion, conclusion and references should be prepared as per the format prescribed by the University and submitted to the Head of the department. The students will be evaluated based on the report and viva-voce examination by a panel of examiners as per the Regulations.

TOTAL: 60 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Formulate a problem/create new product/process.

CO2: Analyze the identified problem.

CO3: Design and conduct experiments to find solution.

CO4: Analyze the results and provide solution for the identified problem.

CO5: Preparing of project report and presentation

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	2	3	3	3	1	-	1	2	-	1	1	1	1
CO2	2	2	3	3	3	1	-	1	2	-	1	1	1	1
CO3	2	2	3	3	3	1	-	1	2	-	1	1	1	1
CO4	2	2	3	3	3	1	-	1	2	-	1	1	1	1
CO5	2	2	3	3	3	1	-	1	2	-	1	1	1	1
Avg.	**2**	**2**	**3**	**3**	**3**	**1**	-	**1**	**2**	-	**1**	**1**	**1**	**1**

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

24IS7201 INTERNSHIP **L T P C**
0 0 0 1

COURSE OBJECTIVES

- Students acquire practical knowledge through hands-on experience in an area of modern industries
- Gain real-world experience in the profession and enables correlation of classroom learning
- To experience the career development goals involve exploring the duties and qualifications of different careers.

COURSE DESCRIPTION

The purpose of the Internship Education Program is to provide each student practical experience in a standard work environment. An internship is an integral part of engineering education. It provides real-world experience in the profession; enables correlation of classroom learning with applications in industry; broadens understanding of the types of employment available in the field; helps the student discover individual interests; builds resume credentials; and develops relationships with industrial companies.

MONITORING OF INTERNSHIP

Documents required after the internship

1. Final report with full details of internship activities and contents learned during the entire period of internship.
2. Students shall maintain a day-to-day record of their engagement for the period of training. This will be recorded in an authorized diary to be counter signed by the concern authority at the each day and the same diary shall be submitted to the internship co-ordinator.
3. At the end of the training period, a student shall produce a certificate of satisfactory completion of training.

The final report should address the following:

- Projects and duties performed during the Internship.
- Learning that occurred as a result of the internship, in regard to
- The engineering profession.
- The particular industry.

- The organization/company.
- The technical skills developed.
- The individual interests and preferences discovered.
- Suggestions.
- Goals and plans regarding future professional development.

EVALUATION PROCEDURE

The weightage as follows

1. Internship final report : 30%
2. Authorized diary : 30%
3. Oral presentation through PPT : 40%

COURSE OUTCOMES

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

CO1: Apply appropriate workplace behaviors in a professional setting.

CO2: Demonstrate content knowledge appropriate to job assignment.

CO3: Exhibit evidence of increased content knowledge gained through practical experience.

CO4: Evaluate the internship experience in terms of their personal, educational and career needs.

CO5: Refine and clarify professional and career goals through critical analysis of the internship experience.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	2	3	-	-	-	-	2	-	-	-	-
CO2	3	2	2	2	3	-	-	-	-	2	-	-	-	-
CO3	3	2	2	2	3	-	-	-	-	2	-	-	-	-
CO4	3	2	2	2	3	-	-	-	-	2	-	-	-	-
CO5	3	2	2	2	3	-	-	-	-	2	-	-	-	-
AVG	3	2	2	2	3	-	-	-	-	2	-	-	-	-

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

24CA7201 CASE STUDY **L T P C**
0 0 0 1

COURSE OBJECTIVES

- To gain hands on industrial experience.
- To introduce industry problem solving skill.
- To familiarize the industrial operations.

The students should study at least two case studies during 6th Semester vacation and submit a details report not less than 20 pages with a copy of case study completion certificate from the Industry.

Part A: Case study on Industry Operation

The students should undergo case study on Industrial Operations.

- They should understand the company's structure, operational workflow, safety norms, and business model.
- Learn the specific department such as production, quality control, logistics, human recourses, turn-over and other major tools and softwares used by the industry.
- Students interact with industry experts, gather background information relevant to the industry.
- The students have to collect data, gather real-time processes, and analyze the challenges faced by the industry by using standard tools such as Fishbone diagrams, Pareto charts, or SWOT analysis.

Part B: Case study on Completed Project

The students should identify and select case study 2 as previously completed project relevant to their domain.

- Students should follow the work flow structure such as interacting with team leader or manager, identify and understand the problem, collect relevant data, analyze roots & methodology employed to complete the project and should understand the final outcome of the project.
- Students consolidate their findings and prepare a comprehensive report.

At the end of study,

The students should prepare a report not less than 20 pages and should include the copy of case study completion certificate in the report.

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Understand the industry operations.

CO2: Analyze and interpret industrial data.

CO3: Apply engineering principles to industry real time problems.

CO4: Collaborate effectively with industry experts and teams.

CO5: Communicate technical information clearly and professionally.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	3	-	-	-	-	2	2	2	2	-	-
CO2	3	3	2	3	3	-	-	-	2	2	2	2	-	-
CO3	3	3	2	3	3	-	-	-	2	2	2	2	-	-
CO4	2	2	-	-	-	-	-	-	2	2	2	2	-	-
CO5	2	2	-	-	3	-	-	-	2	2	2	2	-	-
AVG	2.6	2.6	2	3	3	-	-	-	2	2	2	2	-	-

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

24EE8501 PROJECT WORK **L T P C**

0 0 20 10

COURSE OBJECTIVES

- To learn methodology to select a good project and able to work in a team leading to development of hardware/software product.
- To prepare a good technical report. Gain Motivation
- To present the ideas behind the project with clarity.

A Project topic must be selected either from research literature or the students themselves may propose suitable topics in consultation with their guides. The aim of the project work is to deepen Comprehension of principles by applying them to a new problem which may be the design /fabrication of any power component / circuit / sensor / Activator / Controller, a research investigation, a computer or management project or a design problem. The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.

TOTAL: 300 PERIODS

COURSE OUTCOMES

CO1: Ability to identify, formulate, design, interprete, analyze and provide solutions to complex

CO2: Engineering and societal issues by applying knowledge gained on basics of science and Engineering.

CO3: Ability to choose, conduct and demonstrate a sound technical knowledge of their selected project topics in the field of power components, protection, high voltage, electronics, process automation, power electronics and drives instrumentation and control by exploring suitable engineering and IT tools.

CO4: Ability to understand, formulate and propose new learning algorithms to solve engineering and societal problems of moderate complexity through multidisciplinary projects commitment towards sustainable development.

CO5: Ability to demonstrate, prepare reports, communicate and work in a team as a member/leader by adhering to ethical responsibilities.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	3
CO2	-	-	-	-	3	3	-	-	-	-	-	-	3	
CO3	-	-	-	-			3		3	-	-	-	-	-
CO4	-	-	-	-				3	3	3	3			
CO5	-	-	-	-	-	-	-	-	-	-	-	3	3	3
AVG	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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

24EEPE01 FLEXIBLE AC TRANSMISSION SYSTEMS **L T P C**

3 0 0 3

COURSE OBJECTIVES

- Basic concept of Flexible AC transmission systems and FACTS controllers.
- The operation and control of SVC & TCSC and stability studies.
- The basic operation and control of voltage source converter based FACTS controllers.

UNIT I INTRODUCTION **9**

Reactive power control in electrical power transmission lines–loads and system compensation, Uncompensated transmission line–shunt and series compensation. Basic concepts of Static Var Compensator (SVC)–Thyristor Controlled Series Capacitor (TCSC) – Unified Power Flow Controller (UPFC).

UNIT II STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS **9**

Voltage control by SVC–Advantages of slope in dynamic characteristics–Influence of SVC on system voltage–Design of SVC voltage regulator–Modelling of SVC for power flow and fast transient stability–Applications: Enhancement of transient stability – Steady state power transfer –Enhancement of power system damping.

UNIT III THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS **9**

Operation of the TCSC–Different modes of operation–Modelling of TCSC, Variable reactance model–Modelling for Power Flow and stability studies. Applications: Improvement of the system stability limit–Enhancement of system damping.

UNIT IV VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS **9**

Static Synchronous Compensator (STATCOM)–Principle of operation–V-I Characteristics. Applications: Steady state power transfer-enhancement of transient stability-prevention of voltage instability. SSSC-operation of SSSC and the control of power flow–modelling of SSSC in load flow and transient stability studies.

UNIT V CO-ORDINATION OF FACTS CONTROLLERS **9**

Controller interactions–SVC–SVC interaction–Co-ordination of multiple controllers using linear control techniques –Control co-ordination using genetic algorithms.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Analyze the problems in AC transmission systems and understand the need for Flexible AC transmission systems

CO2: Analyze the operation and control of SVC and its applications to enhance the Stability and damping.

CO3: Analyze the different modes of operation TCSC and to model it for power flow and Stability studies.

CO4: Analyze basic operation and control of voltage source converter based FACTS. ers.

CO5: Analyze the interaction between the FACTS controllers.

TEXT BOOKS

1. R.Mohan Mathur,Rajiv K.Varma,"Thyristor–Based FACTS Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons,Inc, 2002.
2. Narain G.Hingorani, "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors, Delhi-110006,2011.
3. Kundur P.,"Power System Stability and Control", McGraw-Hill,1993.

REFERENCE BOOKS

1. K.R.Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Limited, Publishers, New Delhi, 2008.
2. A.T.John,"Flexible A.C.Transmission Systems",Institution of Electrical and Electronic Engineers (IEEE), 1999.
3. V.K.Sood, "HVDC and FACTS controllers–Applications of Static Converters in Power System",Kluwer Academic Publishers,2004.
4. X.P.Zhang, C.Rehtanz, B.Pal "Flexible AC Transmission System Modelling and Control" Springer,2006.
5. Flexible AC Transmission Systems: Modelling and Control, Xiao – Ping Zhang, Christian Rehtanz, Bikash Pal, Springer, 2012, First Indian Reprint, 2015.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	2	3	-	-	-	-	-	-	-	3	2
CO2	3	3	2	2	3	-	-	-	-	-	-	-	3	2
CO3	3	3	2	2	3	-	-	-	-	-	-	-	3	2
CO4	3	3	2	2	3	-	-	-	-	-	-	-	3	2
CO5	3	3	2	2	3	-	-	-	-	-	-	-	3	2
AVG	3	3	2	2	3	-	-	-	-	-	-	-	3	2

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

24EEPE02 HIGH VOLTAGE DIRECT CURRENT TRANSMISSION **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the evolution of HVDC Transmission and HVDC converters.
- To investigate the generation of harmonics, reactive power requirement, suitable filters and FACTS controllers.
- To perform load flow analysis of the AC/DC system including the HVDC link.

UNIT I INTRODUCTION **9**

DC Power transmission technology–Comparison of AC and DC transmission–Application of DC transmission–Description of HVDC transmission system–Planning for HVDC transmission–Modern trends in HVDC technology–DC breakers–Operating problems–HVDC transmission based on VSC –Types and applications of MTDC systems.

UNIT II ANALYSIS OF HVDC CONVERTERS **9**

Line commutated converter -Analysis of Graetz circuit with and without overlap -Pulse number–Choice of converter configuration – Converter bridge characteristics–Analysis of a 12 pulse converters– Analysis of VSC topologies and firing schemes.

UNIT III CONVERTER AND HVDC SYSTEM CONTROL **9**

Principles of DC link control–Converter control characteristics–System control hierarchy–Firing angle control– Current and extinction angle control–Starting and stopping of DC link – Power control –Higher level controllers –Control of VSC based HVDC link.

UNIT IV REACTIVE POWER AND HARMONICS CONTROL **9**

Reactive power requirements in steady state–Sources of reactive power–SVC and STATCOM–Generation of harmonics –Design of AC and DC filters– Active filters.

UNIT V POWER FLOW ANALYSIS IN DC SYSTEMS **9**

Per unit system for DC quantities–DC system model –Inclusion of constraints –Power flow analysis –case study.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Compare AC and DC transmission systems and analyze modern HVDC technologies.
CO2: Evaluate Graetz circuit operation and VSC topologies for HVDC converters.
CO3: Design control strategies for HVDC system operation and power regulation.
CO4: Develop reactive power compensation and harmonic mitigation solutions
CO5: Implement power flow analysis methods for DC systems..

TEXT BOOKS

1. Padiyar,K.R., "HVDC power transmission system", New Age International(P) Ltd., New Delhi, Second Edition,2010.
2. Edward Wilson Kimbark," Direct Current Transmission", Vol.I, Wiley inter science,NewYork, London, Sydney,1971.
3. C.L. Wadhwa, 'High voltage Engineering', New Age International Publishers, Third Edition, 2010.

REFERENCE BOOKS

1. Kundur P.,"Power System Stability and Control", McGraw-Hill,1993.
2. Colin Adamson and Hingorani NG," High Voltage Direct Current PowerTransmission", Garraway Limited, London, 1960.
3. Arrillaga.J.,"HighVoltageDirectCurrentTransmission",PeterPregrinus,London,1983
4. E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals', Newness Second Edition Elsevier , New Delhi, 2005.
5. Subir Ray, 'An Introduction to High Voltage Engineering', 2nd Edition, PHI Learning Private Limited, New Delhi, Second Edition, 2013.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	2	3	-	-	-	-	-	-	-	2	3
CO2	3	3	2	2	3	-	-	-	-	-	-	-	2	3
CO3	3	3	2	2	3	-	-	-	-	-	-	-	2	3
CO4	3	3	2	2	3	-	-	-	-	-	-	-	2	3
CO5	3	3	2	2	3	-	-	-	-	-	-	-	2	3
AVG	3	3	2	2	3	-	-	-	-	-	-	-	2	3

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

24EEPE03 RESTRUCTURED POWER SYSTEMS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To impart knowledge on fundamental concepts of restructuring of power, electricity act, various power reforms in India and congestion management.
- To analyze the concepts of location marginal pricing and financial transmission rights.
- To gain insight on the ancillary service management and pricing of transmission network.

UNIT I INTRODUCTION TO RESTRUCTURING OF POWER INDUSTRY **9**

Introduction: Deregulation of power industry, Restructuring process, Issues involved in deregulation, Deregulation of various power systems–Fundamentals of Economics: Consumer 96 behavior, Supplier behavior, Market equilibrium, Short and long run costs, Various costs of production– Market models: Market models based on Contractual

arrangements, Comparison of various market models, Electricity vis–a–vis other commodities, Market architecture, Case study.

UNIT II TRANSMISSION CONGESTION MANAGEMENT 9

Introduction: Definition of Congestion, reasons for transfer capability limitation, Importance of congestion management, Features of congestion management–Classification of congestion management methods–Calculation of ATC-Non market methods– Market methods–Nodal pricing–Inter zonal and Intra zonal congestion management–Price area congestion management– Capacityalleviation method.

UNIT III LOCATIONAL MARGINAL PRICES AND FINANCIAL TRANSMISSION RIGHT 9

Mathematical preliminaries:-Locational marginal pricing Lossless DCOPF model for LMP calculation Loss compensated DCOPF model for LMP calculation ACOPF model for LMP calculation–Financial Transmission rights–Risk hedging functionality Simultaneous feasibility test and revenue adequacy–FTR issuance process: FTR auction, FTR allocation–Treatment of revenue shortfall–Secondary trading of FTRs–Flow gate rights–FTR and market power FTR and merchant transmission investment.

UNIT IV ANCILLARY SERVICE MANAGEMENT AND PRICING OF TRANSMISSIONNETWORK 9

Introduction of ancillary services – Types of Ancillary services Classification of Ancillary services–Load generation balancing related services Voltage control and reactive power support devices–Black start capability service-How to obtain ancillary service –Co-optimization of energy and reserve services- International comparison Transmission pricing – Principles– Classification– Rolled in transmission pricing methods–Marginal transmission pricing paradigm–Composite pricing paradigm–Merits and demerits of different paradigm.

UNIT V REFORMS IN INDIAN POWER SECTOR 9

Introduction–Frame work of Indian power sector–Reform initiatives-Availability based tariff Electricity act 2003–Open access issues–Power exchange–Reforms in the near future.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain power system restructuring concepts and economic fundamentals of electricity markets.

CO2: Analyze transmission congestion management methods and available transfer capability calculations.

CO3: Calculate locational marginal prices and evaluate financial transmission rights mechanisms.

CO4: Assess ancillary services management strategies and transmission pricing paradigms.

CO5: Evaluate Indian power sector reforms including ABT, Electricity Act 2003, and power exchange developments

TEXT BOOKS

1. Mohammad Shahidehpour, Muwaffaq Alomoush, Marcel Dekker, "Restructured Electrical power systems: operation, trading and volatility" Pub., 2006.
2. Kankar Bhattacharya, Jaap E.Daadler, Math H.J.Boolen," Operation of Restructured Power Systems", Kluwer Academic Pub., 2001.
3. Mohammad Shahidehpour, and Muwaffaqalomoush, "Restructured electrical Power systems", Marcel Dekker, Inc. 2001.

REFERENCE BOOKS

1. SallyHunt, "Making competition work in electricity", John Willey and Sons Inc.2002
2. Steven Stoft, "Power system economics: designing markets for electricity", John Wiley &Sons, 2002.
3. Loi Lei Lai; "Power system Restructuring and Deregulation", John Wiley & Sons Ltd., England.
4. LINK: http://www.nptel.ac.in/syllabus/108101005/
5. Kankarbhattacharya, Math H.J. Bollen & Jaap E. Daalder, "Operation of Restructured Power Systems", Kluwer Academic Publishers, 2001.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	3	3	-	-	-	-	-	-	-	3	3
CO2	3	3	2	3	3	-	-	-	-	-	-	-	3	3
CO3	3	3	2	3	3	-	-	-	-	-	-	-	3	3
CO4	3	3	2	3	3	-	-	-	-	-	-	-	3	3
CO5	3	3	2	3	3	-	-	-	-	-	-	-	3	3
AVG	3	3	2	3	3	-	-	-	-	-	-	-	3	3

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

24EEPE04 POWER QUALITY **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understand the various power quality issues.
- To understand the concept of power and power factor in single phase and three phase systems supplying nonlinear loads.
- To understand the conventional compensation techniques used for power factor correction and load voltage regulation.

UNIT I INTRODUCTION **9**

Introduction – Characterization of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves – power quality problems: poor load power factor, Non linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards.

UNIT II ANALYSIS OF SINGLE PHASE AND THREE PHASE SYSTEM 9

Single phase linear and non linear loads –single phase sinusoidal, non sinusoidal source – supplying linear and nonlinear load – three phase Balance system – three phase unbalanced system – three phase unbalanced and distorted source supplying non linear loads – concept of pf – three phase three wire – three phase four wire system.

UNIT III CONVENTIONAL LOAD COMPENSATION METHODS 9

Principle of load compensation and voltage regulation – classical load balancing problem : open loop balancing – closed loop balancing, current balancing – harmonic reduction and voltage sag reduction analysis of unbalance – instantaneous of real and reactive powers – Extraction of fundamental sequence component from measured.

UNIT IV LOAD COMPENSATION USING DSTATCOM 9

Compensating single – phase loads – Ideal three phase shunt compensator structure – generating reference currents using instantaneous PQ theory – Instantaneous symmetrical components theory – Generating reference currents when the source is unbalanced – Realization and control of DSTATCOM- DSTATCOM in Voltage control mode.

UNIT V SERIES COMPENSATION OF POWER DISTRIBUTION SYSTEM 9

Rectifier supported DVR – Dc Capacitor supported DVR – DVR Structure – voltage Restoration – Series Active Filter – Unified power quality conditioner.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Classify power quality issues and interpret power quality standards for electrical systems.

CO2: Analyze the single-phase and three-phase systems with linear/nonlinear loads under balanced/unbalanced conditions.

CO3: Implement conventional load compensation methods for power factor correction and voltage regulation.

CO4: Design DSTATCOM-based solutions for load compensation.

CO5: Develop series compensation strategies using DVR and UPQC for power quality enhancement

TEXT BOOKS

1. Arindam Ghosh “Power Quality Enhancement Using Custom Power Devices”,Kluwer academic Publishers, 2002.
2. G.T.Heydt, “Electric Power Quality”, Stars in a Circle Publications, 1994 2nd Edition.
3. C. Sankaran, ‘Power Quality’, CRC press, Taylor & Francis group, 2002.

REFERENCE BOOKS

1. G.T. Heydt, 'Electric Power Quality', 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994).

2. M.H.J Bollen, 'Understanding Power Quality Problems: Voltage Sags and Interruptions', (NewYork: IEEE Press, 1999).
3. G.J.Wakileh, "Power Systems Harmonics – Fundamentals, Analysis and Filter Design," Springer 2007.
4. E.Aeha and M.Madrigal, "Power System Harmonics, Computer Modelling and Analysis, " WileyIndia, 2012.
5. R.S.Vedam, M.S.Sarma, "Power Quality – VAR Compensation in Power Systems," CRC Press 2013.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	3	-	-	-	-	-	-	-	3	3
CO2	3	2	2	-	3	-	-	-	-	-	-	-	3	3
CO3	3	2	2	-	3	-	-	-	-	-	-	-	3	3
CO4	3	2	2	-	3	-	-	-	-	-	-	-	3	3
CO5	3	2	2	-	3	-	-	-	-	-	-	-	3	3
AVG	3	2	2	-	3	-	-	-	-	-	-	-	3	3

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

24EEPE05 SMART GRID **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the evolution of Smart and Interconnected energy systems.
- To understand the various challenges and benefits of smart grid and the national and international initiatives taken.
- To understand the various computing technologies for Smart Operation of the Grid.

UNIT I INTRODUCTION **9**

Evolution of Energy Systems, Concept, Definitions and Need, Difference between Conventional & Smart Grid, Drivers, structures, functions, opportunities, challenges and benefits of Smart Grid, Basics of Microgrid, National and International Initiatives in Smart Grid.

UNIT II SMART METERING **9**

Introduction to Advanced Metering infrastructure (AMI) - drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Real time management and control, Phasor Measurement Unit (PMU).

UNIT III SMART GRID TECHNOLOGIES (Transmission) **9**

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, Wide area Monitoring, Protection and control.

UNIT IV SMART GRID TECHNOLOGIES (Distribution) 9

DMS, Volt/VAr control, Fault Detection, Isolation and service restoration, Outage management, High- Efficiency Distribution Transformers, Phase Shifting Transformers, Electric Vehicles.

UNIT V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS 9

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Computing technologies for Smart Grid applications (Web Service to CLOUD Computing), Role of big data and IoT, Cyber Security for Smart Grid.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Compare conventional and smart grid systems, analyzing their structures and benefits.

CO2: Implement advanced metering infrastructure for real-time grid monitoring and control.

CO3: Design smart transmission systems using automation and wide-area monitoring technologies.

CO4: Develop smart distribution solutions for outage management and voltage regulation.

CO5: Integrate computing technologies like IoT and cloud computing for smart grid applications

TEXT BOOKS

1. Stuart Borlase, “Smart Grids Advanced Technologies and Solutions”, Second Edition, CRC, 2018.
2. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, John Wiley, 2012.
3. James Momoh, Smart Grid Fundamentals of Design and Analysis, IEEE 2012.

REFERENCE BOOKS

1. Ahmed F. Zobaa, Trevor J. Bihl, Big data analytics in future power systems, 1st Edition, CRC press 2018.
2. C. Gungor et al., "Smart Grid Technologies: Communication Technologies and Standards," in IEEE Transactions on Industrial Informatics.
3. X. Fang, S. Misra, G. Xue and D. Yang, "Smart Grid — The New and Improved
4. Power Grid:A Survey," in IEEE Communications Surveys & Tutorials, vol. 14, no. 4, pp. 944-980, Fourth Quarter 2012. doi: 10.1109/SURV.2011.101911.00087.
5. Stuart Borlase, “Smart Grid - Infrastructure, Technology and Solutions”, CRC Press 2012.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
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CO3	3	3	2	3	3	-	-	-	-	-	-	-	3	3
CO4	3	3	2	3	3	-	-	-	-	-	-	-	3	3
CO5	3	3	2	3	3	-	-	-	-	-	-	-	3	3
AVG	3	3	2	3	3	-	-	-	-	-	-	-	3	3

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

24EEPE06 POWER SYSTEM TRANSIENTS **L T P C**

3 0 0 3

COURSE OBJECTIVES

- Generation of switching transients and their control using circuit – theoretical concept.
- Mechanism of lighting strokes and the production of lighting surges, propagation, reflection and refraction of travelling waves.
- Voltage transients caused by faults, circuit breaker action, load rejection on integrated power system.

UNIT I INTRODUCTION AND SURVEY **9**

Review and importance of the study of transients - causes for transients. RL circuit transient with sine wave excitation - double frequency transients - basic transforms of the RLC circuit transients. Different types of power system transients - effect of transients on power systems – role of the study of transients in system planning.

UNIT II SWITCHING TRANSIENTS **9**

Over voltages due to switching transients - resistance switching and the equivalent circuit for interrupting the resistor current - load switching and equivalent circuit - waveforms for transient voltage across the load and the switch - normal and abnormal switching transients. Current suppression - current chopping - effective equivalent circuit. Capacitance switching - effect of source regulation - capacitance switching with a restrike, with multiple restrikes. Illustration for multiple restriking transients - ferro resonance.

UNIT III LIGHTNING TRANSIENTS **9**

Review of the theories in the formation of clouds and charge formation - rate of charging of thunder clouds – mechanism of lightning discharges and characteristics of lightning strokes – model for lightning stroke - factors contributing to good line design - protection using ground wires - tower footing resistance - Interaction between lightning and power system.

UNIT IV TRAVELING WAVES ON TRANSMISSION LINE COMPUTATION OF TRANSIENTS **9**

Computation of transients - transient response of systems with series and shunt lumped parameters and distributed lines. Traveling wave concept - step response - Bewely's lattice diagram - standing waves and natural frequencies - reflection and refraction of waves.

UNIT V TRANSIENTS IN INTEGRATED POWER SYSTEM **9**

The short line and kilometric fault - distribution of voltages in a power system - Line dropping and load rejection - voltage transients on closing and reclosing lines – over voltage induced by faults -switching surges on integrated system Qualitative application of EMTP for transient computation.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Classify power system transients and analyze RLC circuit transients.

CO2: Evaluate switching transients including current chopping and capacitance switching effects.

CO3: Assess lightning transients and protection methods using ground wires.

CO4: Compute traveling wave transients using Bewley's lattice diagram.

CO5: Analyze integrated system transients during faults and switching operations

TEXT BOOKS

1. Allan Greenwood, 'Electrical Transients in Power Systems', Wiley Inter Science,New York, 2nd Edition, 1991.
2. Pritindra Chowdhari, "Electromagnetic transients in Power System", John Wileyand Sons Inc., Second Edition, 2009.
3. C.S. Indulkar, D.P.Kothari, K. Ramalingam, 'Power System Transients – A statistical approach', PHI Learning Private Limited, Second Edition, 2010.

REFERENCE BOOKS

1. M.S.Naidu and V.Kamaraju, 'High Voltage Engineering', McGraw Hill, Fifth Edition, 2013.
2. R.D. Begamudre, 'Extra High Voltage AC Transmission Engineering', Wiley Eastern Limited, 1986.
3. Y.Hase, Handbook of Power System Engineering," Wiley India, 2012.
4. J.L.Kirtley, "Electric Power Principles, Sources, Conversion, Distribution and use," Wiley,2012.
5. Akihiro ametani," Power System Transient theory and applications", CRC, 2013.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	3	3	-	-	-	-	-	-	-	3	3
CO2	3	3	2	3	3	-	-	-	-	-	-	-	3	3
CO3	3	3	2	3	3	-	-	-	-	-	-	-	3	3
CO4	3	3	2	3	3	-	-	-	-	-	-	-	3	3
CO5	3	3	2	3	3	-	-	-	-	-	-	-	3	3
AVG	3	3	2	3	3	-	-	-	-	-	-	-	3	3

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

24EEPE07 HIGH VOLTAGE ENGINEERING **L T P C**
3 0 0 3

COURSE OBJECTIVES

- Various types of over voltages in power system and protection methods and Generation of over voltages in laboratories.
- Measurement of over voltage and testing of power apparatus.
- Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.

UNIT I OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS **9**

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages – Reflection and Refraction of Travelling waves- protection against over voltages-Insulation Coordination.

UNIT II DIELECTRIC BREAKDOWN **9**

Properties of Dielectric materials - Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids,–Breakdown mechanisms in solid and composite dielectrics- Applications of insulating materials in electrical equipment.

UNIT III GENERATION AND MEASUREMENTS OF HIGH VOLTAGES AND HIGH CURRENTS **9**

Generation of High DC, AC, impulse voltages and impulse currents - Analysis of DC/AC and Impulse generator circuits - Tripping and control of impulse generators**,** Measurement of High voltages – High Resistance with series ammeter – Dividers - Resistance, Capacitance and Mixed dividers – Peak Voltmeter, Generating Voltmeters, Electrostatic Voltmeters.

UNIT IV HIGH VOLTAGE TESTING **9**

High voltage testing of electrical power apparatus- International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators, cables and transformers.

UNIT V HIGH VOLTAGE APPLICATIONS IN INDUSTRY **9**

Introduction – electrostatic applications- electrostatic precipitation, separation, painting / coating, spraying, imaging, printing, Transport of materials – manufacturing of sand paper – Smoke particle detector – Electrostatic spinning, pumping, propulsion – Ozone generation – Biomedical applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Analyze overvoltage phenomena in power systems including lightning and switching surges.
CO2: Evaluate dielectric breakdown mechanisms in gases, liquids, and solids.
CO3: Generate and measure high voltages/currents using standard test circuits.
CO4: Test power apparatus according to international high-voltage standards.
CO5: Implement high-voltage technologies in biomedical and industrial applications

TEXT BOOKS

1. M.S.Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Sixth Edition, 2020.
2. E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals',Newness Second Edition, Elsevier , New Delhi, 2005.
3. C.L. Wadhwa, 'High voltage Engineering', New Age International Publishers, Fourth Edition, 2020.

REFERENCE BOOKS

1. L.L.Alston, High Voltage Technology, Oxford University Press, First Indian Edition 2006.
2. Mazen Abdel – Salam, Hussein Anis, Ahdab A-Morshedy, Roshday Radwan, High Voltage Engineering – Theory &Practice, Second Edition, Taylor & Francis Gourp, 2019.
3. Subir Ray." An Introduction to High Voltage Engineering "PHI Learning Private Limited, New Delhi, Second Edition-2011.
4. C.L. Wadhwa, 'High voltage Engineering', New Age International Publishers, Fourth Edition, 2020.
5. E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals', Newness Second Edition, Elsevier , New Delhi, 2005.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	3	3	3	2	2	-	1	2	2	2	3
CO2	3	2	2	3	3	1	2	3	1	1	1	2	2	2
CO3	3	2	2	3	3	1	2	2	2	1	1	1	1	3
CO4	3	2	2	3	3	2	3	3	3	2	3	2	2	2
CO5	3	2	2	3	3	3	3	3	2	2	3	.3	3	2
AVG	3	2	2	3	3	2	2.4	2.6	1.6	1.4	2	2	2	2.4

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

24EEPE08 DISTRIBUTED GENERATION AND MICRO GRID **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To explain the concept of distributed generation, explore its various topologies, and evaluate the effects of its integration with the grid.
- To study concept of Microgrid and its configuration.
- To understand various modes of operation and control of micro grid.

UNIT I INTRODUCTION TO DISTRIBUTED GENERATION **9**

Need for Distributed generation, renewable sources in distributed generation, current scenario in Distributed Generation, Planning of DGs – Siting and sizing of DGs – optimal placement of DG sources in distribution systems.

UNIT II GRID INTEGRATION OF DISTRIBUTED GENERATION 9

Different types of interfaces - Inverter based DGs and rotating machine based interfaces - Aggregation of multiple DG units. Energy storage elements: Batteries, ultra capacitors, flywheels.

UNIT III TECHNICAL IMPACTS OF DISTRIBUTED GENERATION 9

Transmission systems, Distribution systems, De-regulation – Impact of DGs upon protective relaying – Impact of DGs upon transient and dynamic stability of existing distribution systems.

UNIT IV ECONOMIC AND CONTROL ASPECTS OF DISTRIBUTED GENERATION 9

Market facts, issues and challenges - Limitations of DGs. Voltage control techniques, Reactive power control, Harmonics, Power quality issues. Reliability of DG based systems – Steady-state and Dynamic analysis.

UNIT V INTRODUCTION TO MICRO-GRIDS 9

Types of micro-grids – autonomous and non-autonomous grids – Sizing of micro-grids modeling & analysis- Micro-grids with multiple DGs – Micro- grids with power electronic interfacing units. Transients in micro-grids - Protection of micro-grids – Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Plan distributed generation systems with optimal siting and sizing strategies.
CO2: Integrate DG units with grid interfaces using inverters and energy storage.
CO3: Assess technical impacts of DG on power system protection and stability.
CO4: Evaluate economic and control aspects of DG including power quality management.
CO5: Design microgrid systems with multiple DGs and protection schemes.

TEXT BOOKS

1. S. N. Singh, Electric Power Generation, Transmission, and Distribution: Distributed Generation and Microgrid, PHI Learning Pvt. Ltd., 2011.
2. R. C. Bansal, Distributed Generation and Microgrids, CRC Press India, 2017.
3. S. Chowdhury, P. Crossley, and S. P. Chowdhury, Microgrids and Active Distribution Networks, IET India, 2009.

REFERENCE BOOKS

1. Nick Jenkins, Janaka Ekanayake , Goran Strbac , “Distributed Generation”, Institution of Engineering and Technology, London, UK,2010.
2. S. Chowdhury, S.P. Chowdhury and P. Crossley, “Microgrids and Active Distribution Networks”, The Institution of Engineering and Technology, London, United Kingdom, 2009.

3. Math H. Bollen , Fainan Hassan, "Integration of Distributed Generation in the Power System", John Wiley &Sons, New Jersey, 2011.
4. Magdi S. Mahmoud, Fouad M. AL-Sunni, "Control and Optimization of Distributed Generation Systems", Springer International Publishing, Switzerland, 2015.
5. Nadarajah Mithulananthan, Duong Quoc Hung, Kwang Y. Lee, "Intelligent Network Integration of Distributed Renewable Generation", Springer International Publishing, Switzerland, 2017.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	3	3	3	2	2	-	1	2	2	2	3
CO2	3	2	2	3	3	1	2	3	1	1	1	2	2	2
CO3	3	2	2	3	3	1	2	2	2	1	1	1	1	3
CO4	3	2	2	3	3	2	3	3	3	2	3	2	2	2
CO5	3	2	2	3	3	3	3	3	2	2	3	.3	3	2
AVG	3	2	2	3	3	2	2.4	2.6	1.6	1.4	2	2	2	2.4

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

24EEPE09 CONVERTERS FOR RENEWABLE ENERGY SYSTEMS

L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand the various renewable energy sources.
- To explain the different architectures of power converters associated with renewable energy systems.
- To study the control strategies for renewable energy converters.

UNIT I INTRODUCTION TO RENEWABLE ENERGY SYSTEMS 9

Types of Renewable Energy-A general overview of solar, wind, small hydro, biomass, and other renewable energy technologies. Power Electronic Converters in Renewable Energy-The role of converters in converting variable DC power from renewables to usable AC power.

UNIT II BASIC POWER ELECTRONICS CONCEPTS 9

Semiconductor Devices: Understanding power electronic devices like transistors (IGBTs), diodes, and MOSFETs. DC-DC Converters: Topologies like buck, boost, and buck-boost converters and their applications.AC-DC Converters: Rectifiers, AC voltage controllers, and their use in converting AC to DC power.

UNIT III CONVERTER TOPOLOGIES FOR RENEWABLE ENERGY 9

Solar PV Systems: Converters for interfacing PV panels with the grid, including MPPT techniques. Wind Energy Systems: Converters for variable speed wind turbines, grid-

connected wind farms, and control strategies. Small Hydropower Systems: Converters for interfacing small hydro generators with the grid.

UNIT IV POWER QUALITY AND GRID INTEGRATION 9

Harmonic Reduction: Techniques for minimizing harmonics generated by converters in renewable systems. Power Factor Correction: Methods for improving power factor in renewable energy systems. Grid Synchronization: Techniques for synchronizing converters with the grid for reliable operation.

UNIT V CONTROL STRATEGIES FOR RENEWABLE ENERGY CONVERTERS 9

PWM Control: Understanding pulse width modulation and its applications in converter control.PID Control: Implementing proportional-integral-derivative control for converter performance. Advanced Control Techniques: Exploring advanced control algorithms for optimal converter operation.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Classify renewable energy sources and their power conversion requirements.
CO2: Design DC-DC and AC-DC converter topologies for renewable energy interfaces.
CO3: Implement MPPT and grid-synchronization techniques for renewable energy systems
CO4: Analyze power quality issues and mitigation strategies for grid integration.
CO5: Develop the control strategies for renewable energy converters using PWD, PID and advanced algorithms.

TEXT BOOKS

1. S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford University Press, 2009, 7th impression.
2. Rashid .M. H "Power electronics Hand book", Academic press,2nd Edition, 2006 4th Edition, 2017.
3. Rai. G.D, "Non-conventional energy sources", Khanna publishers, 6th Edition, 2017.

REFERENCE BOOKS

1. H.Khan "Non-conventional Energy sources ",Tata McGraw-hill Publishing Company, New Delhi, 2017, 3rd Edition.
2. Chetan Singh Solanki, "Solar Photovoltaic's: Fundamentals, Technologies and Applications, 3rd Edition, PHI learning.
3. John Twideu and Tony Weir, "Renewable Energy Resources" BSP Publications, 2006.
4. B.H.Khan, "Non-conventional Energy sources", , McGraw-hill, 2nd Edition, 2009.
5. Fang Lin Luo Hong Ye, "Renewable Energy systems", Taylor & Francis Group, 2013.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	3	3	3	2	2	-	1	2	2	2	3
CO2	3	2	2	3	3	1	2	3	1	1	1	2	2	2
CO3	3	2	2	3	3	1	2	2	2	1	1	1	1	3
CO4	3	2	2	3	3	2	3	3	3	2	3	2	2	2
CO5	3	2	2	3	3	3	3	3	2	2	3	.3	3	2
AVG	3	2	2	3	3	2	2.4	2.6	1.6	1.4	2	2	2	2.4

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

24EEPE10 POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS **L T P C 3 0 0 3**

COURSE OBJECTIVES

- To understand the electrical machines to be used for wind energy conversion systems.
- To learn the principles of power converters used in solar PV and wind system.
- To study the principle of power converters used in hydro power system.

UNIT I INTRODUCTION TO POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS **9**

Need of power electronics for power generation from renewable energies. Role of Power electronics in renewable energy resources: Ocean energy, Biomass energy, Hydrogen energy, - Solar Photovoltaic (PV), Fuel cells.

UNIT II ELECTRICAL MACHINES FOR WIND ENERGY CONVERSION SYSTEMS (WECS) **9**

Construction, Principle of operation and analysis: Squirrel Cage Induction Generator (SCIG), Doubly Fed Induction Generator (DFIG) - Permanent Magnet Synchronous Generator (PMSG).

UNIT III POWER CONVERTERS FOR SOLAR PV SYSTEMS **9**

Power Converters: Line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing. Simulation of line commutated converters, buck/boost converters.

UNIT IV POWER CONVERTERS FOR WIND SYSTEMS **9**

Power Converters: Three-phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid-Interactive Inverters - Matrix converter.

UNIT V POWER CONVERTERS FOR OTHER RENEWABLE ENERGY SYSTEMS **9**

Hydro Power-Inverters (for micro hydropower), Hydrokinetic Converters: Full Converter Solutions (for pumped storage)

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Analyze the role of power electronics in diverse renewable energy systems including solar, wind, and ocean energy.

CO2: Evaluate electrical generators like SCIG, DFIG, PMSG for wind energy conversion systems.

CO3: Design power converters suitable for solar PV systems.

CO4: Implement wind energy conversion systems with appropriate converters.

CO5: Develop hydro power inverters and hydrokinetic converter solutions for microgrid integration.

TEXT BOOKS

1. S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford University Press, 2009, 7th impression.
2. Rashid .M. H "Power electronics Hand book", Academic press,2nd Edition, 2006 4th Edition, 2017
3. Rai. G.D, "Non-conventional energy sources", Khanna publishers, 6th Edition, 2017.

REFERENCE BOOKS

1. H.Khan "Non-conventional Energy sources ",Tata McGraw-hill Publishing Company, New Delhi, 2017, 3rd Edition.
2. Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, Technologies and Applications, 3rd Edition, PHI learning Pvt Ltd.
3. John Twideu and Tony Weir, "Renewable Energy Resources" BSP Publications, 2006.
4. B.H.Khan, " Non-conventional Energy sources", , McGraw-hill, 2nd Edition, 2009.
5. Fang Lin Luo Hong Ye, "Renewable Energy systems", Taylor & Francis Group,2013.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	-	2	-	-	-	-	-	-	2	-	2	3	3
CO2	3	-	2	-	-	-	-	-	-	2	-	2	3	3
CO3	3	-	2	-	-	-	-	-	-	2	-	2	3	3
CO4	3	-	3	-	-	-	-	-	-	2	-	2	3	3
CO5	3	3	2	3	3	-	-	3	-	2	-	3	3	3
AVG	**3**	**3**	**2.25**	3	3	-	-	3	-	**2**	-	**2.2**	3	3

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

24EEPE11 SOLAR ENERGY CONVERSION SYSTEM **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To impart the knowledge on the basics of solar energy and solar thermal collectors.
- To design different types of Solar PV system and to analyze maximum power point tracking algorithms
- To learn about various types of solar furnaces.

UNIT I FUNDAMENTALS OF SOLAR ENERGY **9**

Solar Cell and its function, Solar Technologies, Solar Cell Parameters, Efficiency of Solar Cell, Solar PV Module, Rating of Solar PV Module, PV Module Parameters, Efficiency of PV Module, Measuring Module Parameters. Solar Photovoltaic Module Array Connection of PV Module in Series and Parallel, Estimation and Measurement of PV Module Power, Selection of PV Module.

UNIT II SOLAR THERMAL POWER GENERATION **9**

Solar Parabolic trough - Design considerations, tracking and control systems - Thermal design of receivers - Solar parabolic dish - Design considerations, Sterling engine, Brayton cycle, tracking and control systems - Performance study, site selection and land requirement for the above technologies - Techno-economic analysis of solar thermal power plants.

UNIT III SOLAR PV SYSTEM DESIGN AND INTEGRATION **9**

Solar Radiation Energy Measurements, Estimating Energy requirement, Types of Solar PV System, Design methodology for SPV system, Design of Off Grid Solar Power Plant, Case studies of 3KWp Off grid Solar PV Power Plant, Design and Development of Solar Street Light and Solar Lantern, Off Grid Solar power Plant.

UNIT IV MAXIMUM POWER POINT TRACKING **9**

Maximum Power Point Tracking techniques - Algorithm and Flow chart- Perturb and Observe (P&O) / Hill Climbing: Incremental Conductance(IncCond); Constant Voltage/Current-Fractional Short Circuit Current (Isc) and Open Circuit Voltage (Voc)- Fuzzy Logic-Artificial Neural Networks (ANNs)- Meta heuristic Algorithms.

UNIT V SOLAR FURNACES **9**

Introduction – Types of solar furnaces – Components of solar furnaces – Sun tracking Concentrator –Single concentrator furnace –Heliostat – Single heliostat solar furnace - Multiple heliostats solar furnace.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Evaluate solar PV module parameters and array configurations for optimal performance.
CO2: Design solar thermal power systems using parabolic troughs and dish technologies.
CO3: Develop off-grid solar PV systems including street lighting applications.
CO4: Implement maximum power point tracking algorithms for solar energy harvesting
CO5: Analyze solar furnace components and tracking systems for high-temperature applications.

TEXT BOOKS

1. Stefan C. W. Krauter," Solar Electric Power Generation - Photovoltaic Energy Systems: Modeling of optical and thermal performance, electrical yield, energy balance, effect on reduction of greenhouse gas emissions", Springer, 2006.
2. JA Duffie and WA Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons, 2006.
3. Sukhatme.S.P., "Solar Energy: Principles of Thermal Collection and Storage", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009

REFERENCE BOOKS

1. A. Goetzberger, V. U. Hoffmann, Volker Uwe, "Photovoltaic Solar Energy Generation", Springer, 2005.
2. Jenny Nelson, "The Physics of Solar Cells", Imperial College Press, 2003.
3. Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI Learning Pvt. Ltd, 2005.
4. T. Markvart, "Solar Electricity", John Wiley & Sons, 2000.
5. R. A. Messenger and Amir Abtahi, "Photovoltaic Systems Engineering", CRC Press, 2017.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	-	-	-	-	-	-	-	1	2	2	2	3	-
CO2	3	-	-	-	-	-	-	-	1	3	2	2	3	-
CO3	3	-	-	-	-	-	3	-	1	2	2	2	3	-
CO4	3	-	-	-	-	-	3	-	1	2	2	2	3	-
CO5	3	-	-	-	-	-	3	-	1	2	2	2	3	2
AVG	**3**	-	-	-	-	-	**3**	-	**1**	**2.3**	**2**	**2**	**3**	**2**

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

24EEPE12 WIND ENERGY CONVERSION SYSTEM **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To learn the concept, design and control principles of Wind turbine
- To understand the concepts of fixed speed and variable speed wind energy conversion systems
- To model the grid integrated systems

UNIT I FUNDAMENTALS OF WIND ENERGY GENERATION SYSTEM **9**

Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory- Power coefficient-Sabinin's theory-Aerodynamics of Wind turbine-wind resources worldwide and in India, wind energy forecast.

UNIT II WINDTURBINES **9**

Types and characteristics of wind turbine-HAWT-VAWT-Power developed-Thrust-Efficiency-Rotor selection-Rotor design considerations- Tip speed ratio-No. Of Blades-Blade profile-Power Regulation-yaw control -Pitch angle control- stall control-Schemes for maximum power extraction.

UNIT III FIXED SPEED SYSTEMS **9**

Generating Systems- Constant speed constant frequency systems –Choice of Generators Deciding factors-Synchronous Generator-Squirrel Cage Induction Generator- Model of Wind Speed- Model wind turbine rotor – Drive Train model- Generator model for Steady state and Transient stability analysis.

UNIT IV VARIABLE SPEED SYSTEMS **9**

Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator- DFIG- PMSG –Variable speed generators modeling – Variable speed variable frequency schemes.

UNIT V GRID CONNECTED SYSTEMS **9**

Wind interconnection requirements, low-voltage ride through (LVRT), ramp rate limitations, and supply of ancillary services for frequency and voltage control, current practices and industry trends wind interconnection impact on steady-state and dynamic performance of the power system including modeling issue.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Analyze wind energy fundamentals including momentum theory and power coefficient calculations.

CO2: Design wind turbine systems considering aerodynamics, blade profiles, and power regulation.

CO3: Model fixed-speed wind energy systems using generator and drive train representations.

CO4: Evaluate variable-speed systems with DFIG and PMSG machines.

CO5: Assess grid integration challenges including LVRT and frequency control requirements.

TEXT BOOKS

1. L.L.Freris “Wind Energy conversion Systems”, Prentice Hall,1990
2. S.N.Bhadra, D.Kastha, S.Banerjee, ”Wind Electrical Systems”, Oxford University Press,2010.
3. E.W.Golding “The generation of Electricity by wind power”, Redwood burn Ltd., Trowbridge,1976.

REFERENCE BOOKS

1. VVN Kishore, "Renewable Energy Engineering and Technology – A Knowledge Compendium", TERI Press, 2008.
2. S.N. Bhadra "Wind Electrical Systems, Oxford, 7th Impression, 2005.
3. Brendan Fox, "Wind Power Integration – Connection and System Operational Aspects", IET, 2nd Edition. 2014.
4. Dan M. Ionel, Frede Blaabjerg, "Renewable Energy Devices and Systems with Simulations in MATLAB and ANSYS", CRC press, 1st Edition. 2017
5. Fang Lin Luo Hong Ye, " Renewable Energy systems", Taylor & Francis Group,2013

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	1	1	3	2	3	1	-	-	-	-	-	-	3	-
CO2	3	1	3	2	3	1	-	-	-	-	-	-	3	3
CO3	3	1	3	2	3	1	-	-	-	-	-	-	3	3
CO4	3	1	3	2	3	1	-	-	-	-	-	-	3	3
CO5	3	1	3	2	3	1	-	-	-	-	-	-	3	3
AVG	**2.6**	**1**	**3**	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**

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

24EEPE13 DESIGN AND MODELING OF RENEWABLE ENERGY SYSTEMS **L T P C 3 0 0 3**

COURSE OBJECTIVES

- To understand the research and development of renewable energy sources
- To design and develop grid connected and three phase photovoltaic systems
- To learn about the generator selection for small wind energy systems

UNIT I RENEWABLE ENERGY SYSTEMS: TECHNOLOGY OVERVIEW AND PERSPECTIVES **9**

Introduction-State of the Art- Examples of Recent Research and Development Challenges and Future Trends

UNIT II SOLAR PV SYSTEM DESIGN AND INTEGRATION **9**

Solar Radiation Energy Measurements, Estimating Energy requirement, Types of Solar PV System, Design methodology for SPV system, Design of Off Grid Solar Power Plant, Case studies of 3KWp Off grid Solar PV Power Plant, Design and Development of Solar Street Light and Solar Lantern, Off Grid Solar power Plant.

UNIT III SINGLE-PHASE GRID-CONNECTED PHOTOVOLTAIC SYSTEMS **9**

Introduction- Demands for Grid-Connected PV Systems-Power Converter Technology for

Single- Phase PV Systems, Transformer less AC-Module Inverters (Module-Integrated PV Converters, Transformer less Single-Stage String Inverters, DC-Module Converters in Transformer less Double-Stage PV Systems

UNIT IV THREE-PHASE PHOTOVOLTAIC SYSTEMS: STRUCTURES, TOPOLOGIES **9**

Introduction-PV Inverter Structures, Three-Phase PV Inverter Topologies- -Control Building Blocks for PV Inverters, Modulation Strategies for Three-Phase PV Inverters, Implementation of the Modulation Strategies., Grid Synchronization, Implementation of the PLLs for Grid Synchronization, Current Control, Implementation of the Current Controllers

UNIT V SMALL WIND ENERGY SYSTEMS **9**

Introduction-Generator Selection for Small-Scale Wind Energy Systems- Turbine Selection for Wind Energy- Self-Excited Induction Generators for Small Wind Energy Applications- Permanent Magnet Synchronous Generators for Small Wind Power Applications- Grid-Tied Small Wind Turbine Systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Assess grid integration challenges including LVRT and frequency control requirements.

CO2: Design off-grid solar PV systems including street lighting applications.

CO3: Implement single-phase grid-connected PV systems with transformer less inverters.

CO4: Develop three-phase PV inverter systems with grid synchronization controls.

CO5: Select appropriate generators and turbines for small wind energy systems.

TEXT BOOKS

1. Ahmad Azar, Nashwa Kamal, "Renewable Energy Systems", Academic Press, First Edition, 2021.
2. VVN Kishore, “Renewable Energy Engineering and Technology – A Knowledge Compendium”, TERI Press, 2008.
3. Nabil Derbel, Quanmin Zhu Modeling, "Identification and Control Methods in Renewable Energy Systems" , Springer, First Edition, 2019.

REFERENCE BOOKS

1. Bin Wu, “ Power Conversion and Control of Wind Energy Systems”, 2011, Wiley- IEEE, 1st Edition.
2. S.N. Bhadra ,”Wind Electrical Systems”, 2005, Oxford, 7th Impression Wind Power Integration – Connection and System Operational Aspects, Brendan Fox, 2014, IET, 2nd Edition.
3. Dan M. Ionel, Frede Blaabjerg, “Renewable Energy Devices and Systems with Simulations in MATLAB and ANSYS”, CRC press, 1st Edition. 2017.

4. Fang Lin Luo Hong Ye, " Renewable Energy systems", Taylor & Francis Group, 2013.
5. D.S.Chauhan, S.K.Srivastava,'Non – Conventional Energy resources, New Age Publishers, 2006.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	-	3	2	-	-	-	-	-	-	-	-	3	-
CO2	3	2	3	3	-	-	-	-	-	-	-	-	3	3
CO3	3	2	3	3	2	-	-	-	-	-	-	-	3	3
CO4	3	2	3	3	-	-	-	-	-	-	-	-	3	3
CO5	3	2	3	3	2	-	-	-	-	-	-	-	3	3
AVG	**3**	**2**	**3**	**2.8**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**

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

24EEPE14 HYBRID ENERGY TECHNOLOGY **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To learn the working principles and integration of different renewable energy sources.
- To understand the power electronic interfaces and control strategies used in hybrid systems.
- To analyze energy storage systems and battery management techniques used in hybrid technologies.

UNIT I HYDRID ENERGY SYSTEMS **9**

Need for Hybrid Energy Systems – Solar-Wind-Fuel Cell-Diesel, Wind Biomass-Diesel, Micro-Hydel-PV, Ocean and geyser energy - Classification of Hybrid Energy systems – Importance of Hybrid Energy systems – Advantages and Disadvantages - Environmental aspects of renewable energy - Impacts of renewable energy generation on the environment - Present Indian and international energy scenario of conventional and RE sources.

UNIT II ENERGY STORAGE AND CONTROL SYSTEMS **9**

Energy storage systems: Batteries, flywheels, compressed air, supercapacitors, and pumped hydro- Battery management systems and charge controllers-Control strategies for hybrid systems-Load forecasting and demand-side management.

UNIT III POWER CONVERTERS AND ANALYSIS OF HYBRID SOLAR PV SYSTEMS **9**

Power converters for Solar PV systems: Line-commutated converters (inversion-mode), boost and buck-boost converter-Selection of inverters, battery sizing, and array sizing- Analysis of Solar PV systems: Block diagrams and types (stand-alone PV systems**)**

UNIT IV ANALYSIS OF POWER CONVERTERS FOR HYBRID ENERGY SYSTEMS **9**

Introduction to Power Converters – Stand-alone Converters -AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters - Bi-Directional Converters - Grid-Interactive Inverters - Matrix converter –Merits and Limitations.

UNIT V CASE STUDIES FOR HYBRID RENEWABLE ENERGY SYSTEMS **9**

Hybrid Systems- Range and type of Hybrid systems – Performance Analysis – Cost Analysis - Case studies of Diesel-PV, Wind-PV-Fuel-cell, Micro-hydel-PV, Biomass-Diesel-Fuel-cell systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Evaluate hybrid energy system configurations and their environmental impacts.

CO2: Design energy storage solutions using batteries, super capacitors, and pumped hydro systems.

CO3: Analyze solar PV systems with appropriate power converters.

CO4: Implement power converters for stand-alone and grid-interactive hybrid systems.

CO5: Interpret real-time case studies of hybrid systems.

TEXT BOOKS

1. Md. Rabiul Islam et al., Emerging Power Converters for Renewable Energy and Electric Vehicles, CRC Press, First Edition, 2021.
2. G.D. Rai, Solar Energy Utilization, Khanna Publishers, 3rd Edition, 1987.
3. B.H. Khan, Non-Conventional Energy Sources, Tata McGraw-Hill Publishing Company, New Delhi, 2017, 3rd Edition.

REFERENCE BOOKS

1. S.N. Bhadra, D. Kastha, & S. Banerjee, Wind Electrical Systems, Oxford University Press, 2005.Rashid M.H., Power Electronics Handbook, Academic Press, 4th Edition, 2018.
2. G.D. Rai, Non-Conventional Energy Sources, Khanna Publishers, 6th Edition,2017.
3. Gray L. Johnson, Wind Energy System, Prentice Hall of India, 2nd Edition, 2006. Wind Power Integration - Connection and System Operational Aspects, Brendan Fox, 2014, IET, 2nd Edition.
4. Twidell & Wier, 'Renewable Energy Resources' CRC Press (Taylor & Francis).
5. Ernst Joshua, Wind Energy Technology, PHI, India, 2018, 3rd Edition.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	-	-	-	-	2	1	-	2	-	-	3	3
CO2	3	3	-	-	3	-	2	1	-	2	-	-	3	-
CO3	3	-	-	-	-	-	2	1	-	2	-	-	3	-
CO4	3	-	-	-	-	-	2	1	-	2	-	-	3	-
CO5	3	-	-	-	-	-	2	1	-	2	-	-	3	-
AVG	3	3	-	-	3	-	2	1	-	2	-	-	3	3

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

24EEPE15 ENERGY MANAGEMENT AND AUDITING **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To provide general awareness on the importance of energy and its conservation,
- To understand its impact on society, various energy sources, energy conversion processes, energy management, energy audit and energy conservation measures.
- To explain the basic concepts of economic analysis, material and energy balance.

UNIT I GENERAL ASPECTS OF ENERGY MANAGEMENT AND ENERGY AUDIT **9**

Commercial and Non-commercial energy - final energy consumption - energy needs of growing economy - energy pricing - energy conservation and its importance - Re-structuring of the energy supply sector - Energy Conservation Act 2001, Energy Conservation (Amendment) Act, 2010, and its features – electricity tariff - Thermal Basics - need and types of energy audit - Energy management/audit approach understanding energy.

UNIT II MATERIAL AND ENERGY BALANCE **9**

Methods for preparing process flow - material and energy balance diagrams - Energy policy purpose - location of energy management - roles and responsibilities of energy manager – employees training and planning- Financial Management: financial analysis techniques, simple payback period, return on investment, net present value, internal rate of return.

UNIT III ENERGY EFFICIENCY IN THERMAL UTILITIES **9**

Introduction to fuels - properties of fuel oil, coal and gas - principles of combustion - combustion of oil, coal and gas - Boilers: Types, combustion in boilers, performances evaluation, analysis of losses – energy conservation opportunities - FBC boilers - Steam System: Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, condensate and flash steam recovery system, identifying opportunities for energy savings.

UNIT IV ENERGY EFFICIENCY IN COMPRESSED AIR SYSTEM **9**

Compressed Air System: Types of air compressors - efficient compressor operation - Compressed air system components - leakage test - savings opportunities - Refrigeration

System: Vapour compression refrigeration cycle – refrigerants - coefficient of performance - factors affecting Refrigeration and Air conditioning system - savings opportunities - Vapour absorption refrigeration system: working principle - types and comparison with vapour compression system - saving potential - Cooling Tower: Types and performance evaluation, efficient system operation - flow control strategies and energy saving – Diesel Generating system: Factors affecting selection - energy performance assessment of diesel conservation avenues - Case Study.

UNIT V ENERGY EFFICIENCY IN ELECTRICAL UTILITIES 9

Electrical load management and maximum demand control - power factor improvement and its benefit - selection and location of capacitors - performance assessment of PF capacitors - automatic power factor controllers - transformer losses - Electric motors: Types - losses in induction motors - motor efficiency - factors affecting motor performance - rewinding and motor replacement issues - energy saving opportunities with energy efficient motors - soft starters with energy saver - variable speed drives – Fans and blowers: Types - efficient system operation - flow control strategies.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Analyze energy consumption patterns and regulatory frameworks under the Energy Conservation Act.

CO2: Develop material/energy balance diagrams and evaluate financial metrics for energy projects.

CO3: Analyze thermal utility efficiency in boilers, steam systems, and combustion processes.

CO4: Optimize compressed air, refrigeration, and cooling tower systems for energy savings.

CO5: Implement electrical load management strategies using power factor correction and efficient motor drives

TEXT BOOKS

1. Mehmet Kanoglu, Yunus A Cengel, "Energy Efficiency and Management for Engineers",McGraw-Hill Education, First Edition, 2020.
2. “Energy Efficiency in Electrical Utilities”, Third Edition, Bureau of Energy Efficiency (BEE), India,2010.
3. Al Thumann, William J.Younger, Terry Niehus, “Handbook of Energy Audits”, 8th Edition,The Fairmont Press, Inc., 2010.

REFERENCE BOOKS

1. Moncef Krati, ‘Energy Audit of Building Systems: An Engineering Approach’, Third Edition, CRC Press, Dec.2020.
2. Sonal Desai, ‘Handbook of Energy Audit’, McGraw Hill Education (India) Private Limited, 2015.

3. Michael P.Deru, Jim Kelsey, 'Procedures for Commercial Building Energy Audits', American Society of Heating, Refrigerating and Air conditioning Engineers, 2011.
4. Thomas D.Eastop, 'Energy Efficiency: For Engineers and Technologists', Longman Scientific & Technical, 1990, 1st Edition.
5. Daniel Martinez, Ben W. Ebenhack, Travis Wagner, "Energy Efficiency Concepts and Calculations", First Edition, Elsevier Science, 2019.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	1	1	1	1	1	1	-	-	-	-	3
CO2	3	2	2	1	1	1	1	1	1	-	-	-	-	3
CO3	3	2	2	1	1	1	1	1	1	-	-	-	-	3
CO4	3	2	2	1	1	1	1	1	1	-	-	-	-	3
CO5	3	2	2	1	1	1	1	1	1	-	-	-	-	3
AVG	3	2	2	1	1	1	1	1	1	-	-	-	-	3

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

24EEPE16 DESIGN OF ELECTRICAL APPARATUS

L T P C
3 0 0 3

COURSE OBJECTIVES

- To know the major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings.
- To analyze the thermal considerations, heat flow, temperature rise, rating of machines.
- To understand the design of transformers and induction motors .

UNIT I DESIGN OF FIELD SYSTEM AND ARMATURE 9

Major considerations in Electrical Machine Design – Materials for Electrical apparatus – Design of Magnetic circuits – Magnetising current – Flux leakage – Leakage in Armature. Design of lap winding and wave winding.

UNIT II DESIGN OF TRANSFORMERS 9

Construction - KVA output for single and three phase transformers – Overall dimensions – design of yoke, core and winding for core and shell type transformers – Estimation of No load current – Temperature rise in Transformers – Design of Tank and cooling tubes of Transformers. Computer program: Complete Design of single phase core transformer

UNIT III DESIGN OF DC MACHINES 9

Construction - Output Equations – Main Dimensions – Choice of specific loadings – Selection of number of poles – Design of Armature – Design of commutator and brushes – design of field Computer program: Design of Armature main dimensions

UNIT IV DESIGN OF INDUCTION MOTORS **9**

Construction - Output equation of Induction motor – Main dimensions – choice of specific loadings – Design of squirrel cage rotor and wound rotor –Magnetic leakage calculations – Operating characteristics: Magnetizing current- Short circuit current–Circle diagram Computer program: Design of slip-ring rotor

UNIT V DESIGN OF SYNCHRONOUS MACHINES **9**

Output equations – choice of specific loadings – Design of salient pole machines – Short circuit ratio – Armature design – Estimation of air gap length – Design of rotor –Design of damper winding – Determination of full load field MMF – Design of field winding – Design of turbo alternators -Computer program: Design of Stator main dimensions-Brushless DC Machines

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1: Develop magnetic circuits and armature windings considering flux leakage and material properties.

CO2: Design core-type and shell-type transformers including cooling system components.

CO3: Compute DC machine parameters including armature, commutator and field winding dimensions.

CO4: Formulate induction motor designs with squirrel cage and wound rotor configurations.

CO5: Construct synchronous machine designs for both salient pole and turbo alternator applications.

TEXT BOOKS

1. Sawhney, A.K., ‘A Course in Electrical Machine Design’, Dhanpat Rai& Sons, New Delhi, Fifth Edition, 1984.
2. M V Deshpande ‘Design and Testing of Electrical Machines’ PHI learning Pvt Ltd, 2011.
3. Sen S.K., ‘Principled of Electrical Machines Designs with Computer Programmes’, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2009.

REFERENCE BOOKS

1. A.Shanmugasundaram, G.Gangadharan, R.Palani ‘Electrical Machine Design Data Book’, New Age International Pvt. Ltd., Reprint 2007.
2. Balbir Singh, ‘Electrical Machine Design’, Vikas Publishing House Private Limited,1981.
3. V Rajini, V.S Nagarajan, ‘Electrical Machine Design’, Pearson, 2017.
4. K.M.Vishnumurthy ‘Computer aided design of electrical machines’ B S Publications, 2008.
5. K. L. Narang, “A Text Book of Electrical Engineering Drawings”, Satya Prakashan, 1969.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	1	1	3	2	3	1	-	-	-	-	-	-	3	-
CO2	3	1	3	2	3	1	-	-	-	-	-	-	3	3
CO3	3	1	3	2	3	1	-	-	-	-	-	-	3	3
CO4	3	1	3	2	3	1	-	-	-	-	-	-	3	3
CO5	3	1	3	2	3	1	-	-	-	-	-	-	3	3
AVG	**2.6**	**1**	**3**	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**

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

24EEPE17 SOFT COMPUTING TECHNIQUES IN ELECTRICAL ENGINEERING **L P T C 3 0 0 3**

COURSE OBJECTIVES

- To motivate students to design intelligent systems and control.
- To study the learning strategies of Artificial Neural networks and their training algorithms.
- To discuss neural networks, architectures, algorithms and applications,

UNIT I INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS **9**

Introduction, Biological Neuron, Artificial Neuron, Basic concepts of Neural Networks, Basic Models of ANN Connections, McCulloch-Pitts Model, Characteristics of ANN, Applications of ANN.

UNIT II NEURAL NETWORK ARCHITECTURE AND ALGORITHM **9**

Back propagation neural net: architecture algorithm- derivation of learning rules number of hidden layers--associative and other neural networks- hetro and auto associative memory neural net- Bidirectional associative memory- Kohonenself organizing maps and applications- adaptive resonance theory: basic architecture and operation-architecture, algorithm-applications.Case study: DC motor speed control with ANN.

UNIT III INTRODUCTION TO GENETIC ALGORITHMS **9**

Introduction to Genetic Algorithm - Chromosome Encoding Schemes, Population initialization and selection methods, Evaluation function, Genetic operators, Cross over, Mutation, Fitness Function, Maximizing function.

UNIT IV INTRODUCTION TO FUZZY LOGIC **9**

Introduction to Fuzzy Sets- Uncertainty and Information- Operations on Fuzzy Sets-Characteristics of Fuzzy Sets-Classical Sets and Their Properties-α-Cuts and Their Role in Fuzzy Sets-Fuzzy Relations-Demorgan's Law in Fuzzy Logic-Various Shapes of Fuzzy Membership Functions.Case study: Fuzzy controllers Air conditioning system**.**

UNIT V FUZZY LOGIC SYSTEM COMPONENTS **9**

Fuzzification-Membership value assignment, development of rule base and decision-making system, Defuzzification to crisp sets, Defuzzification methods, Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Model biological neurons using artificial neural network architectures.

CO2: Design back propagation networks and self-organizing maps for engineering applications.

CO3: Implement genetic algorithms with appropriate selection and mutation operators.

CO4: Formulate fuzzy logic systems using membership functions.

CO5: Develop fuzzy controllers through fuzzification-defuzzification processes.

TEXT BOOKS

1. Neural Networks: A Comprehensive Foundation – Siman Haykin, IEEE, Press,MacMillan, N.Y. 1994.
2. S. Rajasekaran, G. A. Vijayalakshmi, Neural Networks, Fuzzy logic and Genetic algorithms, PHI publication.
3. Neural Networks and Fuzzy Logic System by Bart Kosko, PHI Publications.

REFERENCE BOOKS

1. Chaturvedi, Devendra K, Soft Computing Techniques and its Applications in Electrical Engineering, Hardcover ISBN:- 978-3-540-77480-8, Springer.
2. Kevin Warwick, Arthur Ekwue, Rag Agarwal, Artificial intelligence techniques in power systems. IEE Power Engineering Series-22.
3. J.Klin and T.A.Folger, ―Fuzzy sets‖ University and information- Prentice Hall - 1996.
4. J.M.Zurada, ―Introduction to artificial neural systems‖-Jaico Publication house,Delhi , 1994.
5. Fuzzy Sets and Fuzzy logic: Theory and Applications - George J. Klir and Bo. Yuan, Prentice- Hall of India Private Limited.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	2	1	-	-	-	-	-	-	-	1	3
CO2	3	3	2	2	2	-	-	-	-	-	-	-	1	3
CO3	3	3	3	3	3	-	-	-	-	-	-	1	1	3
CO4	2	3	3	3	2	-	-	-	-	-	-	2	1	2
CO5	2	3	3	2	3	-	-	-	-	-	-	-	1	2
AVG	3	3	3	2	1	-	-	-	-	-	-	-	1	3

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

24EEPE18 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN ELECTRICAL ENGINEERING **L T P C 3 0 0 3**

COURSE OBJECTIVES

- Understand the importance, principles, and search methods of AI.
- Provide knowledge on predicate logic and Prolog.
- Introduce machine learning fundamentals

UNIT I INTELLIGENT AGENT AND UNINFORMED SEARCH **9**

Introduction - Foundations of AI - History of AI - The state of the art - Risks and Benefits of AI - Intelligent Agents - Nature of Environment - Structure of Agent - Problem Solving Agents - Formulating Problems - Uninformed Search - Breadth First Search - Dijkstra's algorithm or uniform-cost search - Depth First Search - Depth Limited Search

UNIT II PROBLEM SOLVING WITH SEARCH TECHNIQUES **9**

Informed Search - Greedy Best First - A* algorithm - Adversarial Game and Search - Game theory - Optimal decisions in game - Min Max Search algorithm - Alpha-beta pruning - Constraint Satisfaction Problems (CSP) - Examples - Map Coloring - Job Scheduling - Backtracking Search for CSP

UNIT III MACHINE LEARNING **9**

Machine Learning: Definitions – Classification - Regression - approaches of machine learning models - Types of learning - Probability - Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation, Concept of over fitting, under fitting, Bias and Variance - Regression: Linear Regression - Logistic Regression

UNIT IV SUPERVISED LEARNING **9**

Neural Network: Introduction, Perceptron Networks – Adaline - Back propagation networks - Decision Tree: Entropy – Information gain - Gini Impurity - classification algorithm - Rule based Classification - Naïve Bayesian classification - Support Vector Machines (SVM)

UNIT V UNSUPERVISED LEARNING **9**

Unsupervised Learning – Principle Component Analysis - Neural Network: Fixed Weight Competitive Nets - Kohonen Self-Organizing Feature Maps – Clustering: Definition - Types of Clustering – Hierarchical clustering algorithms – k-means algorithm - Applications of AI techniques -Load flow Studies – Economic load dispatch – Single Area and Two area systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Formulate AI problems using search techniques like BFS, DFS, and A* algorithm.
CO2: Implement adversarial search strategies including minimax and alpha-beta pruning.
CO3: Differentiate machine learning approaches including supervised and unsupervised learning.

CO4: Develop neural networks and decision tree models for classification tasks.
CO5: Apply clustering algorithms like k-means and PCA for unsupervised learning.

TEXT BOOKS

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Fourth Edition, 2021.
2. S.N.Sivanandam and S.N.Deepa, Principles of soft computing-Wiley India.3rd, Edition, 2007.
3. Introduction to Machine Learning ,The Wikipedia Guide.

REFERENCE BOOKS

1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
2. Bratko, "Prolog: Programming for Artificial Intelligence‖, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
3. C. Muller & Sarah, Ethem Alpaydin, Introduction to machine learning. MIT press, 2020.
4. Elaine Rich, Kevin Knight, Shivasankar B. Nair, Artificial Intelligence, The McGraw Hill publications, Third Edition, 2009.
5. George F. Luger. Tom M. Mitchell, Machine Learning, McGraw-Hill Science, ISBN: 0070428077.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	3	-	-	-	-	1	3	3	3	1	2
CO2	1	1	1	3	1	-	-	-	1	2	1	1	2	3
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CO4	3	1	3	1	-	-	-	-	2	1	2	2	2	2
CO5	2	1	1	2	2	-	-	-	3	1	2	2	2	1
AVG	2	1	2	2	1	-	-	-	2	2	2	2	2	2

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

24EEPE19 ELECTRICAL DRIVES **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understand steady state operation and transient dynamics of a motor load system.
- To study and analyze the operation of the converter / chopper fed dc drive, both qualitatively and quantitatively.
- To study and understand the operation and performance of AC Induction motor drives.

UNIT I DRIVE CHARACTERISTICS **9**

Electric drive and its classification – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, starting & stopping – typical load torque characteristics – Selection of motor.

UNIT II CONVERTER / CHOPPER FED DC MOTOR DRIVE **9**

Steady state analysis of the single and three phase converter fed separately excited DC motor drive – continuous and discontinuous conduction – Time ratio and current limit control – four quadrant operation of converter / chopper fed drive.

UNIT III INDUCTION MOTOR DRIVES **9**

Stator voltage control – energy efficient drive – V/F control – constant air gap flux – field weakening mode – voltage / current fed inverter – closed loop control.

UNIT IV SYNCHRONOUS MOTOR DRIVES **9**

V/F control and self-control of synchronous motor: Margin angle control and power factor control –permanent magnet synchronous motor.

UNIT V DESIGN OF CONTROLLERS FOR DRIVES **9**

Transfer function for DC motor / load and converter – closed loop control with current and speed feedback – armature voltage control and field weakening mode – design of controllers; current controller and speed controller-converter selection and characteristics.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Analyze electric drive systems including multi-quadrant dynamics and motor selection criteria.

CO2: Evaluate converter-fed DC motor drives in continuous/discontinuous conduction modes.

CO3: Implement induction motor drive techniques including V/F control and field weakening.

CO4: Design synchronous motor drive systems with margin angle and power factor control.

CO5: Develop the controllers for DC drives with current and speed feedback.

TEXT BOOKS

1. Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House,2nd Edition January 2010.
2. Bimal K.Bose. Modern Power Electronics and AC Drives, Pearson Education,2002, 1st Edition.
3. M.H. Rashid, Power Electronics Circuits, Devices and Applications, PHI.

REFERENCES BOOKS

1. S.K.Pillai, A First course on Electrical Drives, Wiley Eastern Limited, 3rd Edition 2012.
2. Murphy J.M.D and Turnbull, Thyristor Control of AC Motor, Pergamon Press,Oxford 1988, 1st Edition.
3. Gopal K.Dubey, Power semiconductor controlled Drives, Prentice Hall Inc., NewJersey,1989, 1st Edition.
4. R.Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Prentice hall of India, 2001,1st Edition.
5. B.K. Bose, Modern Power Electronics And AC Drives, PHI.

Mapping of COs with POs & PSOs

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

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

24EEPE20 ANALYSIS OF ELECTRICAL MACHINES **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To model & simulate all types of DC machines.
- To develop reference frame equations for various elements like R, L and C.
- To model an induction (three phase and 'n' phase) and synchronous machine.

UNIT I MODELING OF BRUSHED-DC ELECTRIC MACHINERY **9**

Fundamentals of Operation – Introduction – Governing equations and modeling of Brushed DC Motor – Shunt, Series and Compound – State model derivation – Construction of Model of a DC Machine using state equations- Shunt, Series and Compound-Time domain block diagram of DC Machine.

UNIT II REFERENCE FRAME THEORY **9**

Historical background –Necessary for transformation and types- – transformation of variables from stationary to arbitrary reference frame - variables observed from several frames of reference. Principles of 'dq' transformation-Application of dq transformation to stationary elements (Three phase R, C, RL Circuits)-Problems

UNIT III INDUCTION MACHINES **9**

Three phase induction machine - equivalent circuit– free acceleration characteristics – voltage and torque equations in machine variables and arbitrary reference frame variables – Simulation under no- load and load conditions- Machine variable form and arbitrary reference variable form.

UNIT IV SYNCHRONOUS MACHINES **9**

Three phase synchronous machine - voltage and torque equations in machine variables and application of transformation for synchronous machines (Park's equations)-voltage and torque equations.

UNIT V MULTIPHASE (MORE THAN THREE-PHASE) MACHINES CONCEPTS **9**

Preliminary Remarks - Necessity - Evolution -Advantages - Working Principle - Multiphase Induction Machine, Multiphase Synchronous Machine -Modeling of 'n' phase machine. Applications of Multiphase Machines.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Model brushed DC machines using state equations and time-domain block diagrams.

CO2: Apply reference frame theory to transform variables across different coordinate systems).

CO3: Simulate induction machine dynamics using arbitrary reference frame variables

CO4: Formulate synchronous machine equations using Park's transformation.

CO5: Analyze multiphase machine systems and their modeling approaches.

TEXT BOOKS

1. Chee Mun Ong, Dynamic Simulation of Electric Machinery using MATLAB, Prentice Hall, 1997,1st Edition.
2. Atif Iqbal, Shaikh Moinoddin, Bhim Reddy Prathap Reddy, Electrical Machine.
3. Fundamentals with Numerical Simulation using MATLAB/SIMULINK, Wiley,2021,1st Edition.

REFERENCES BOOKS

1. Stephen D. Umans, "Fitzgerald & Kingsley's Electric Machinery", Tata McGraw Hill, 7th Edition,2020.
2. Bogdan M. Wilamowski, J. David Irwin, "The Industrial Electronics Handbook", Second Edition, CRC Press, 2011, 1st Edition.
3. Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven D. Pekarek, "Analysis of Electric Machinery and Drive Systems", 3rd Edition, Wiley-IEEE Press, 2013.
4. R. Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Pearson Education, 1st Imprint, 2015, 1st Edition.
5. R.Ramanujam, Modeling and Analysis of Electrical Machines, I.K. International Publishing House Pvt. Ltd, 2018.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	2	2	2	-	-	-	-	-	-	1	3	2
CO2	3	3	1	1	1	-	-	-	-	-	-	1	3	3
CO3	2	2	1	1	3	-	-	-	-	-	-	1	3	3
CO4	2	2	2	1	2	-	-	-	-	-	-	1	3	3
CO5	2	2	1	1	3	-	-	-	-	-	-	1	3	3
AVG	2.2	3	1.4	1.2	2.2	-	-	-	-	-	-	1	3	2.8

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

24EEPE21 SPECIAL ELECTRICAL MACHINES **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understand the working of special machines like stepper motor, switched reluctance motor, BLDC motor & PMSM.
- To derive torque equation and study the characteristics of special machines.
- To design the controller for special machines.

UNIT I PERMANENT MAGNET BRUSHLESS DC MOTORS **9**

Fundamentals of Permanent Magnets - Types- Principle of operation- Magnetic circuit analysis- EMF and Torque equations- Characteristics and control.

UNIT II PERMANENT MAGNET SYNCHROUNOUS MOTORS **9**

Principle of operation – EMF and torque equations - Phasor diagram - Power controllers– performance characteristics – Digital controllers – Constructional features, operating principle and characteristics of synchronous reluctance motor.

UNIT III SWITCHED RELUCTANCE MOTORS **9**

Constructional features –Principle of operation- Torque prediction –performance Characteristics-Power controllers – Control of SRM drive- Sensor less operation of SRM – Applications.

UNIT IV STEPPER MOTORS **9**

Constructional features –Principle of operation –Types – Different modes of excitation - Torque equation – Characteristics – Drive circuits – Closed loop control – Applications.

UNIT V STUDY OF OTHER SPECIAL ELECTRICAL MACHINES **9**

Principle of operation and characteristics of Hysteresis motor – Universal motor – Linear induction motor – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Analyze permanent magnet brushless DC motors including their magnetic circuits and control characteristics.

CO2: Evaluate permanent magnet synchronous motors through phasor diagrams and digital control methods.

CO3: Design switched reluctance motor drives including sensorless operation techniques.

CO4: Implement stepper motor systems with different excitation modes and closed-loop control.

CO5: Compare operational principles of hysteresis motors, universal motors, and linear induction machines.

TEXT BOOKS

1. K.Venkataratnam, 'Special Electrical Machines', Universities Press (India) Private Limited, 2008.
2. T. Kenjo, 'Stepping Motors and Their Microprocessor Controls', Clarendon Press London, 1984
3. E.G. Janardanan, 'Special electrical machines', PHI learning Private Limited, Delhi, 2014.

REFERENCES BOOKS

1. T.J.E. Miller, 'Brushless magnet and Reluctance motor drives', Clarendon press,London, 1989.
2. T.Kenjo, ' Stepping motors and their microprocessor controls', Oxford University press, New Delhi, 2000.
3. R. Krishnan - Switched Reluctance Motor Drives Modeling, Simulation, Analysis, Design, and Applications -CRC Press 2017.
4. Bilgin, Berker Emadi, Ali Jiang, James Weisheng - Switched reluctance motor drives: fundamentals to applications CRC 2019.
5. Ramu Krishnan, "Permanent Magnet Synchronous and Brushless DC Motor Drives" CRC Press 2009.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	3	2	2	3	-	-	-	-	-	-	1	3	3
CO2	2	3	3	2	3	-	-	-	-	-	-	1	3	3
CO3	2	3	3	2	3	-	-	-	-	-	-	1	3	3
CO4	1	1	1	2	2	-	-	-	-	-	-	1	3	2
CO5	1	2	2	3	1	-	-	-	-	-	-	1	2	2
AVG	1.6	2.4	2.2	2.2	3	-	-	-	-	-	-	1	2.6	2.6

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

24EEPE22 UTILIZATION AND CONSERVATION OF ELECTRICAL ENERGY **L T P C 3 0 0 3**

COURSE OBJECTIVES

- To know various electric drives and traction motors with applications
- To introduce the energy saving concept by different ways of illumination.
- To understand the different methods of electric heating and electric welding.

UNIT I ELECTRIC DRIVES AND TRACTION **9**

Fundamentals of electric drive - choice of an electric motor - application of motors for particular services traction generator set, traction motors, power transformers - characteristic features of traction motor - systems of railway electrification - electric braking - train movement and energy consumption - traction motor control - track equipment and collection gear.

UNIT II ILLUMINATION **9**

Introduction - definition and meaning of terms used in illumination engineering - classification of light sources - incandescent lamps, sodium vapour lamps, mercury vapour lamps, fluorescent lamps – design of illumination systems - indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting – UPS- energy saving lamps, LED – working principle of air conditioning system.

UNIT III HEATING AND WELDING **9**

Introduction - advantages of electric heating – modes of heat transfer - methods of electric heating - resistance heating - arc furnaces - induction heating - dielectric heating - electric welding – types - resistance welding - arc welding - power supply for arc welding - radiation welding.

UNIT IV ENERGY CONSERVATION AND ITS IMPORTANCE **9**

Energy conservation act 2001 and its Features – Review of Industrial Energy Conservation – Energy conservation in electrical Industries – Simulation study of energy conservation using Power factor controller. (Three phase circuit simulation with and without capacitor)

UNIT V DOMESTIC UTILIZATION OF ELECTRICAL ENERGY **9**

House wiring – working principle of air conditioning system, Induction based appliances, Online an OFF line UPS, Batteries – Power quality aspects – nonlinear and domestic loads – Earthing system for Domestic, Industrial and Substation.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Select appropriate electric motors for traction systems and analyze their control methods

CO2: Design illumination systems using various light sources and energy-efficient technologies.

CO3: Compare electric heating and welding methods for industrial applications.
CO4: Evaluate solar energy collectors and calculate their performance metrics.
CO5: Analyze wind energy conversion systems and their aerodynamic performance.

TEXT BOOKS

1. N.V. Suryanarayana, "Utilization of Electric Power", Wiley Eastern Limited, 1993.
2. B. Gupta, "Utilization Electric power and Electric Traction", S.K.Kataria and sons, 2000.
3. G.D. Rai, "Non-Conventional Energy sources", Khanna publications Ltd., New Delhi 1997.

REFERENCES BOOKS

1. D.P.Kothari, K.C.Singal, Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", PHI Learing Private Limited, 2013.
2. R.K.Rajput, Utilisation of Electric Power, Laxmi publications private Limited.,2007
3. H.Partab, Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Co., New Delhi-2004.
4. C.L.Wadhwa, "Generation, Distribution and Utilisation of Electrical Energy", New age international Pvt.Ltd.,2003.
5. B.H. Khan, Non-Conventional Energy Sources, Tata McGraw-Hill Publishing Company, New Delhi, 2017, 3rd Edition.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	-	-	1	1	-	1	-	-	1	2	2
CO2	3	2	1	-	-	1	1	-	1	-	-	1	2	2
CO3	3	2	1	-	-	1	1	-	1	-	-	1	2	2
CO4	3	2	1	-	-	1	1	-	1	-	-	1	2	2
CO5	3	2	1	-	-	1	1	-	1	-	-	1	2	2
AVG	3	2	1	-	-	1	1	-	1	-	-	1	2	2

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

24EEPE23 EMBEDDED PROCESSORS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- Understand and analyze the architecture and memory organization of ARM processors.
- Develop proficiency in programming ARM microcontrollers using general and Thumb instruction sets, along with fundamental DSP programming techniques.
- Gain hands-on experience in interfacing peripherals such as I/O ports, EEPROM, timers, UART, ADC/DAC.

UNIT I ARM ARCHITECTURE **9**

Architecture – Memory Organization – addressing modes -Registers – Pipeline - Interrupts – Coprocessors – Interrupt Structure.

UNIT II ARM MICROCONTROLLER PROGRAMMING **9**

ARM general Instruction set – Thumb instruction set –Introduction to DSP on ARM- basic programming.

UNIT III PERIPHERALS OF ARM **9**

ARM: I/O Memory – EEPROM – I/O Ports – SRAM –Timer –UART – Serial Communication with PC – ADC/DAC Interfacing-stepper motor interfacing.

UNIT IV ARM COMMUNICATION **9**

ARM With CAN, I2C, and SPI protocols.

UNIT V INTRODUCTION TO SINGLE BOARD EMBEDDED PROCESSOR **9**

Raspberry Pi Architecture - Booting Up RPi- Operating System and Linux Commands - Working with RPi using Python and Sensing Data using Python-programming - GPIO and interfacing peripherals With Raspberry Pi.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain ARM architecture features including memory organization and pipeline structure.

CO2: Develop ARM programs using both general and Thumb instruction sets.

CO3: Interface peripherals like timers, UART, and ADC/DAC with ARM microcontrollers.

CO4: Implement communication protocols including CAN, I2C, and SPI using ARM.

CO5: Design embedded applications using Raspberry Pi with Python programming

TEXT BOOKS

1. Steve Furber, 'ARM system on chip architecture', Addisonn Wesley, 2nd Edition,2015.
2. Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield's ARM System.
3. Developer's Guide Designing and Optimizing System Software', Elsevier 2004, 1st Edition.

REFERENCE BOOKS

1. William Hohl, 'ARM Assembly Language' Fundamentals and Techniques, CRC Press, 2nd Edition 2014.
2. Rajkamal," Microcontrollers Architecture, Programming, Interfacing, & System Design, Pearson, 2nd Edition,2012.

3. ARM Architecture Reference Manual, LPC214x User Manual, www.nuvoton.com/websites on Advanced ARM Cortex Processors.
4. ARM System Developer's Guide: Designing and Optimizing System Software 1st Edition, Morgan Kaufmann Publishers, 2011.
5. Lyla B. Das, "Architecture, Programming and Interfacing of Low-power Processors ARM 7, Cortex-M", Cengage, 1st Edition, 2017.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	2	2	3	1	-	-	1	-	1	1	3	2
CO2	3	3	1	1	2	1	-	-	1	-	1	2	3	2
CO3	2	2	1	1	1	1	-	-	1	-	1	1	3	3
CO4	3	1	2	1	2	1	-	-	1	-	1	1	3	2
CO5	1	2	1	1	3	1	-	-	1	-	1	1	3	3
AVG	2.2	2.2	1.4	1.2	2.2	1	-	-	1	-	1	1.2	3	2.4

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

24EEPE24 DIGITAL SIGNAL PROCESSING **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To describe signals mathematically and understand how to perform mathematical operations on signals.
- To provide knowledge of Digital filter.
- To discuss word length issues, multi rate signal processing and application.

UNIT I INTRODUCTION **9**

Classification of systems: Continuous, discrete, linear, causal, stability, 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**.**

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 – Discrete Time Fourier transform , magnitude and phase representation.

UNIT III DISCRETE FOURIER TRANSFORM & COMPUTATION **9**

Discrete Fourier Transform- properties, magnitude and phase representation - Computation of DFT using FFT algorithm – DIT &DIF using radix 2 FFT – 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. Analog filter Design, butterworth

and Chebyshev approximations; IIR Filters, digital design using impulse invariant and bilinear transformation Warping, pre warping.

UNITV DIGITAL SIGNAL PROCESSORS **9**

Introduction – Architecture – Features – Addressing Formats – Functional modes - Introduction to Commercial DS Processors.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Understand the importance of Fourier transform, digital filters and DS processors.
CO2: Acquire knowledge on Signals and systems and their mathematical representation.
CO3: Analyze the discrete time systems.
CO4: Design and compute the transformation techniques.
CO5: Acquire knowledge on programmability digital signal processor and quantization effects.

TEXT BOOKS

1. Oppenheim A V and Sehafer R W, "Discrete Time Signal Processing", Prentice Hall (1989).
2. Proakis J G and Manolakis D G, "Digital Signal Processing", Pearson Education India.
3. Loney Ludeman ,Fundamentals of Digital Signal Processing –, John Wiley, 2009.

REFERENCES

1. Oppenheim A V, Willsky A S and Young I T, "Signal & Systems", Prentice Hall, (1983).
2. Ifeachor and Jervis, "Digital Signal Processing", Pearson Education India.
3. DeFatta D J, Lucas J G and Hodgkiss W S, "Digital Signal Processing", J Wiley and Sons,Singapore, 1988
4. Sanjit K Mitra "Digital Signal Processing" TMH.
5. Taan S. EIAli, Discrete Systems and Digital Signal Processing, CRC press, 2009.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	2	3	-	-	-	1	-	1	2	3	3
CO2	2	2	3	2	2	-	-	-	1	-	1	2	2	3
CO3	2	3	1	2	1	-	-	-	1	-	1	1	1	1
CO4	3	2	1	1	2	-	-	-	1	-	1	1	1	2
CO5	2	1	2	3	3	-	-	-	1	-	1	1	2	2
AVG	2.4	2.2	1.8	2	2.2	-	-	-	1	-	1	1.3	1.8	2.2

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

24EEPE25 ELECTRIC VEHICLE ARCHITECTURE **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To understand the structure and specifications of Electric Vehicles (EVs) and Hybrid Electric Vehicles (HEVs), including Plug-in Hybrid Electric Vehicles (PHEVs).
- To study the components involved in EV conversion and their functionality.
- To model and simulate various types of DC motors used in electric and hybrid vehicles .

UNIT I VEHICLE ARCHITECTURE AND SIZING **9**

Electric Vehicle History and Evolution of Electric Vehicles, Series, Parallel and Series parallel Architecture, Micro and Mild architectures, Mountain Bike - Motorcycle- Electric Cars and Heavy Duty EVs. -Details and Specifications.

UNIT II VEHICLE MECHANICS **9**

Vehicle mechanics- Roadway fundamentals, Laws of motion, Vehicle Kinetics, Dynamics of vehicle motion, propulsion power, velocity and acceleration, Tire –Road mechanics, Propulsion System Design.

UNIT III POWER COMPONENTS AND BRAKES **9**

Power train Component sizing- Gears, Clutches, Differential, Transmission and Vehicle Brakes. EV power train sizing, HEV Power train sizing, Example.

UNIT IV HYBRID VEHICLE CONTROL STRATEGY **9**

Vehicle supervisory control, Mode selection strategy, Modal Control strategies.

UNIT V PLUG-IN HYBRID ELECTRIC VEHICLE **9**

Introduction-History-Comparison with electrical and hybrid electrical vehicle-Construction and workingof PHEV-Block diagram and components-Charging mechanisms-Advantages of PHEVs.

TOTAL : 45 PERIODS

LIST OF EXPERIMENTS

1. Verification of Variables and Expressions Formats, Vectors and Matrices with example using Matlab.
2. Verification of Arrays with examples using Matlab.
3. Verification of Vectors with examples using Matlab
4. Verification of Matrices, Built-in functions, Trigonometric functions with example with Matlab
5. Verification of Data types and Plotting using Matlab.
6. Simulation of drive cycles.
7. Simulation model of PHEV
8. Simulation of Vector control of PMSM.

TOTAL : 30 PERIODS

COURSE OUTCOMES

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

CO1: Analyze EV architectures and their evolution across vehicle types from bikes to heavy-duty EVs.

CO2: Apply vehicle mechanics principles to calculate propulsion power and acceleration requirements.

CO3: Design power train components including gears, differentials and brakes for EVs/HEVs.

CO4: Develop hybrid vehicle control strategies for optimal mode selection.

CO5: Compare PHEV systems with conventional EVs/HEVs including charging mechanisms.

TEXT BOOKS

1. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press, First edition 2017.
2. MehrdadEhsani, Yimin Gao, Sebastian E. Gay, Ali Emadi, 'Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design', CRC Press, 2004.
3. Build Your Own Electric Vehicle, SethLeitman , Bob Brant, McGraw Hill, Third Edition 2013.

REFERENCE BOOKS

1. The Electric Vehicle Conversion Handbook: How to Convert Cars, Trucks, Motorcycles, and Bicycles -- Includes EV Components, Kits, and Project Vehicles Mark Warner, HP Books,2011.
2. Heavy-duty Electric Vehicles from Concept to Reality, Shashank Arora, Alireza Tashakori Abkenar, Shantha Gamini Jayasinghe, Kari Tammi, Elsevier Science, 2021.
3. Electric Vehicles Modern Technologies and Trends, Nil Patel, Akash Kumar Bhoi, Sanjeevi kumar Padmanaban, Jens Bo Holm-Nielsen Springer, 2020.
4. Hybrid Electric Vehicles: A Review of Existing Configurations and Thermodynamic Cycles,Rogelio León , Christian Montaleza , José Luis Maldonado Marcos Tostado- Véliz and Francisco Jurado, Thermo, 2021, 1, 134–150. https://doi.org/10.3390/thermo1020010.
5. Emerging Power Converters for Renewable Energy and Electric Vehicles Modeling, Designand Control, Md. RabiulIslam,Md. Rakibuzzaman Shah, Mohd. Hasan Ali, CRC Press,2021,1st Edition.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	2	-	-	-	-	1	-	-	-	2	3	-
CO2	3	-	2	-	-	-	-	1	-	-	-	2	3	3
CO3	3	-	2	-	-	-	-	1	-	-	-	2	3	-
CO4	3	-	2	-	-	-	-	1	-	-	-	2	3	-
CO5	3	-	3	3	3	-	-	1	-	-	-	2	3	3
AVG	3	-	2.2	3	3	-	-	1	-	-	-	2	3	3

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

24EEPE26 DESIGN OF MOTOR AND POWER CONVERTERS FOR ELECTRIC VEHICLES **L T P C 3 0 2 4**

COURSE OBJECTIVES

- To understand Electric and Hybrid Electric Vehicle Systems.
- To analyze Drive Cycles and Power Management.
- To gain knowledge in the basics of simulation for control systems, applying these principles to model and analyze electrical systems relevant to EV applications.

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UNIT I ELECTRIC VEHICLE DYNAMICS **9**

Standard drive cycles-Dynamics of Electric Vehicles-Tractive Force-Maximum speed, torque, power, energy requirements of EVs.

UNIT II MOTORS FOR ELECTRIC VEHICLES **9**

Speed And Torque control of above and below rated speed-Speed control of EV in the constant power region of electric motors. DC Motors, Induction Motor, Permanent Magnet Synchronous Motors (PMSM), Brushless DC Motors, Switched Reluctance Motors (SRMs). Synchronous Reluctance Machines-Choice of electric machines for EVs.

UNIT III BASICS OF SIMULATION IN CONTROL SYSTEMS **9**

Transfer Function-How to build transfer function, identify Poles, zeros, draw time response plots, bode plot (Bode Plots for Multiplication Factors, Constant, Single and Double Integration Functions, Single and Double Differentiation Functions, Single Pole and Single Zero Functions, RHP Pole and RHP Zero Functions), state space modelling-transfer function from state space Model.

UNIT IV MODELING OF DC-DC CONVERTERS **9**

Overview of PWM Converter Modeling -Power Stage Modeling - PWM Block Modelling– Voltage Feedback Circuit and Small-Signal Model of PWM Converter - Averaging Power Stage Dynamics -Average Models for buck/boost Converter - Small-Signal Model of Converter Power Stage -Frequency Response of Converter

UNIT V POWER STAGE TRANSFER FUNCTIONS OF DC – DC CONVERTERS 9

Power Stage Transfer Functions of buck-boost Converter in CCM Operation, Input-to-Output Transfer Function, Duty Ratio-to-Output Transfer Function, Load Current-to-Output Transfer Function.

TOTAL: 45 PERIODS

LAB EXPERIMENTS

1. Simulation experiments of basic control systems
2. Simulation of buck, boost and buck boost converter-open loop (With power circuit and Transfer function).
3. Design of transfer function from state space Model.
4. Simulation of frequency response of Converter.
5. Simulation of PWM converter.
6. Open loop and close loop speed control of EV induction motor drive(V/F)
7. In both clockwise and anti-clockwise direction
8. Simulation of grid side converter operation and analyze the active power flow and reactive power compensation

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Calculate tractive force and energy requirements for electric vehicles using standard drive cycles.

CO2: Compare electric motor types and their speed-torque characteristics for EV applications)

CO3: Develop transfer function models and analyze system responses using Bode plots.

CO4: Construct small-signal models for DC-DC converters in power electronic systems.

CO5: Derive power stage transfer functions for buck-boost converters in continuous conduction mode.

TEXT BOOKS

1. Power Electronic Converters, TeuvoSuntio, Tuomas Messo, JoonasPuukko, First Edition 2017.
2. Fundamentals of Power Electronics with MATLAB, Randall Shaffer, 2nd Edition, 2013, Lakshmi publications.
3. Feedback Control problems using MATLAB and the Control system tool box, Dean Frederick and Joe Cho, 2000, 1st Edition, Cengage learning.

REFERENCE BOOKS

1. Handbook of Automotive Power Electronics and Motor Drives, Ali Emadi, Taylor & Francis,2005,1st Edition.
2. Electrical Machine Fundamentals with Numerical Simulation using MATLAB/SIMULINK., Atif Iqbal, Shaikh Moinoddin, Bhimireddy Prathap Reddy, Wiley,2021, 1st Edition.

3. Emerging Power Converters for Renewable Energy and Electric Vehicles Modeling, Design and Control, Md. Rabiul Islam, Md. Rakibuzzaman Shah, Mohd. Hasan Ali, CRC Press,2021,1st Edition.
4. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals, Second Edition" CRC Press, Taylor & Francis Group, Third Edition 2021.
5. Dynamic Simulation of Electric Machinery using MATLAB, Chee Mun Ong, Prentice Hall,1997,1st Edition.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	-	-	-	-	1	-	3	-	3	-	1
CO2	3	3	3	3	3	-	-	1	-	3	-	3	3	3
CO3	3	3	3	3	3	-	-	1	-	3	-	3	3	3
CO4	3	3	3	3	3	-	-	1	-	3	-	3	3	3
CO5	3	3	3	3	3	-	-	1	-	3	-	3	3	3
AVG	**3**	**3**	**3**	3	3	-	-	1	-	3	-	3	3	2.6

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

24EEPE27 ELECTRIC VEHICLE DESIGN, MECHANICS AND CONTROL L T P C
3 0 2 4

COURSE OBJECTIVES

- To learn the basics of electric vehicles (EVs), including vehicle mechanics and the overall EV architecture.
- To explore the concepts of energy storage systems, including different types of b batteries, their charging methods and the derivation of models for batteries.
- To gain knowledge of control preliminaries specific to DC-DC converters and their application in electric vehicle systems.

UNIT I INTERNAL COMBUSTION ENGINES 9

IC Engines, BMEP and BSFC, Vehicle Fuel Economy, Emission Control Systems, Treatment of Diesel Exhaust Emissions.

UNIT II ELECTRIC VEHICLES AND VEHICLE MECHANICS 9

Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings- Comparisons of EV with internal combustion Engine vehicles- Fundamentals of vehicle mechanics.

UNIT III BATTERY MODELING, TYPES AND CHARGING 9

Batteries in Electric and Hybrid Vehicles - Battery Basics -Battery Parameters. Types- Lead Acid Battery - Nickel-Cadmium Battery - Nickel-Metal-Hydride (NiMH) Battery - Li-Ion Battery - Li-Polymer Battery, Zinc-Air Battery, Sodium-Sulphur Battery, Sodium-Metal-Chloride.

UNIT IV CONTROL PRELIMINARIES **9**

Control Design Preliminaries - Introduction - Transfer Functions – Bode plot analysis for First order and second order systems - Stability - Transient Performance- Power transfer function for boost converter - Gain margin and Phase margin study-open loop mode.

UNIT V CONTROL OF AC MACHINES **9**

Introduction- Reference frame theory, basics-modeling of induction and synchronous machine in various frames-Vector control- Direct torque control.

TOTAL: 45 PERIODS

LAB EXPERIMENTS

1. Develop a model that could estimate SOC and SOH of Li-Ion Battery.
2. Modelling and thermal analysis of Li-Ion Battery.
2. Simulation of boost converter and calculating gain and phase margin from the
3. transfer function.
4. Simulation of vector control of induction motor.
5. Simulation of Bode plot analysis for First order and second order system
6. Modeling of induction machine.
7. Modeling of synchronous machine
8. Simulation of Power transfer function for boost converter.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Analyze internal combustion engines and compare their performance metrics with electric vehicles.

CO2: Evaluate different battery technologies for electric and hybrid vehicle applications.

CO3: Design control systems for power converters using Bode plot analysis.

CO4: Model AC machines in different reference frames for vector control.

CO5: Implement advanced control techniques like direct torque control for electric drives.

TEXT BOOKS

1. Electric and Hybrid Vehicles, Design Fundamentals, Third Edition, Iqbal Husain, CRC Press,2021.
2. Power Electronic Converters: Dynamics and Control in Conventional and Renewable Energy Applications, Teuvo Suntio, Tuomas Messo, Joonas Puukko, 1st Edition, Wiley - VCH
3. Ali Emadi, Mehrdad Ehsani, John M.Miller, “Vehicular Electric Power Systems”, Special Indian Edition, Marcel dekker, Inc 2003, 1st Edition.

REFERENCE BOOKS

1. C.C. Chan and K.T. Chau, 'Modern Electric Vehicle Technology', Oxford University Press, 2001, 1st Edition.
2. Electrical Machine Fundamentals with Numerical Simulation using MATLAB/ SIMULINK, Atif Iqbal, Shaikh Moinoddin, Bhimireddy Prathap Reddy, Wiley, 2021, 1st Edition.
3. Emerging Power Converters for Renewable Energy and Electric Vehicles Modeling, Design and Control, Md. Rabiul Islam, Md. Rakibuzzaman Shah, Mohd. Hasan Ali, CRC Press,2021,1st Edition.
4. Nil Patel, Akash Kumar Bhoi, Sanjeevi kumar Padmanaban, Jens Bo Holm-Nielsen, Electric Vehicles Modern Technologies and Trends. Springer Publisher 1st Edition, 2021.
5. Electric and Hybrid Electric Vehicles, James D Haldeman, pearson, 2022, 1st Edition.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	-	-	-	-	-	-	1	2	2	2	3	-
CO2	3	-	-	-	-	-	-	-	1	3	2	2	3	-
CO3	3	-	-	-	-	-	3	-	1	2	2	2	3	-
CO4	3	-	-	-	-	-	3	-	1	2	2	2	3	-
CO5	3	-	-	-	-	-	3	-	1	2	2	2	3	2
AVG	3	3	3	3	3	-	3	-	1	2.3	2	2	3	2.5

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

24EEPE28 DESIGN OF ELECTRIC VEHICLE CHARGING SYSTEM **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To know the charging station and standards.
- To learn the concepts of power converters in charging.
- To find the charging scheme in renewable based EV charging.

UNIT I CHARGING STATIONS AND STANDARDS **9**

Introduction-Charging technologies- Conductive charging, EV charging infrastructure, International standards and regulations - Inductive charging, need for inductive charging of EV, Modes and operating principle, Static and dynamic charging, Bidirectional power flow, International standards and regulations

UNIT II POWER ELECTRONICS FOR EV CHARGING **9**

Layouts of EV Battery Charging Systems-AC charging-DC charging systems- Power Electronic Converters for EV Battery Charging- AC–DC converter with boost PFC circuit, with bridge and without bridge circuit - Bidirectional DC–DC Converters- Non-isolated DC–DC bidirectional converter topologies- Half-bridge bidirectional converter.

UNIT III EV CHARGING USING RENEWABLE AND STORAGE SYSTEMS 9

Introduction- - EV charger topologies, EV charging/discharging strategies - Integration of EV charging-home solar PV system, Operation modes of EVC-HSP system, Control strategy of EVCHSP system - fast-charging infrastructure with solar PV and energy storage.

UNIT IV WIRELESS POWER TRANSFER 9

Introduction - Inductive, Magnetic Resonance, Capacitive types. Wireless Chargers for Electric Vehicles - Types of Electric Vehicles - Battery Technology in EVs -Charging Modes in EVs – Benefitsof WPT. - WPT Operation Modes - Standards for EV Wireless Chargers, SAE J2954, IEC 61980. ISO19363.

UNIT V POWER FACTOR CORRECTION IN CHARGING SYSTEM 9

Need for power factor correction- Boost Converter for Power Factor Correction, Sizing the Boost Inductor, Average Currents in the Rectifier and calculation of power losses.

TOTAL: 45 PERIODS

LAB COMPONENT: 30 PERIODS

1. Simulation and analysis for bi-directional charging V2G .
2. Simulation and analysis for bi-directional charging G2V.
3. Design and demonstrate solar PV based EV charging station.
4. Simulate and infer wireless power charging station for EV charging.
5. Simulation of boost converter-based power factor correction.
6. Simulation of Control strategy of EVCHSP system
7. Simulation of sizing of Boost inductor.
8. Simulation of Converter topologies.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Compare conductive and inductive charging technologies, including international standards.

CO2: Design power electronic converters for AC/DC EV charging systems.

CO3: Develop EV charging solutions integrated with solar PV and energy storage systems.

CO4: Analyze wireless charging standards (SAE J2954, IEC 61980) for EV applications.

CO5: Implement power factor correction techniques in EV charging system.

TEXT BOOKS

1. Handbook of Automotive Power Electronics and Motor Drives, Ali Emadi, Taylor & Francis,2005.
2. Wie Liu, “Hybrid Electric Vehicle System Modeling and Control”, Second Edition, John Wiley &Sons, 2017.
3. Electric Vehicle Systems Architecture and Standardization Needs, Reports of the PPP European Green Vehicles Initiative, Beate Müller, Gereon Meyer, Springer 2015, 1st Edition.

REFERENCE BOOKS

1. Mobile Electric Vehicles Online Charging and Discharging, Miao Wang Ran Zhang Xuemin(Sherman) Shen, Springer 2016, 1st Edition.
2. Alicia Triviño-Cabrera, José M. González-González, José A. Aguado, Wireless Power Transferor Electric Vehicles: Foundations and Design Approach, Springer Publisher 1st Edition.2020.
3. Nil Patel, Akash Kumar Bhoi, Sanjeevi kumar Padmanaban, Jens Bo Holm-Nielsen, Electric Vehicles Modern Technologies and Trends. Springer Publisher 1st Edition, 2021.
4. Cable Based and Wireless Charging Systems for Electric Vehicles, Technology and control, management and grid integration, Rajiv Singh, Sanjeevikumar Padmanaban, Sanjeet Dwivedi, Marta Molinas and Frede Blaabjerg, IET 2021, 1st Edition.
5. Electric and Hybrid Electric Vehicles, James D Halderman, Pearson, 2022, 1st Edition.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	3	-	-	2	2	-	3	-	3	3	-
CO2	3	3	3	3	-	-	2	2	-	3	-	3	3	3
CO3	3	-	-	-	-	-			-		-		3	3
CO4	3	3	3	3	-	-	2	2	-	2	-	1	3	3
CO5	3	-	-	-	-	-	-	-	-		-	-	3	3
AVG	**3**	**3**	**3**	**3**	**-**	**-**	**3**	**3**	**-**	**2.66**	**-**	**2.33**	**3**	**3**

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

24EEPE29 TESTING OF ELECTRIC VEHICLES **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To know various standardization procedures.
- To learn the testing procedures for EV & HEV components.
- To know the functional safety and EMC

UNIT I EV STANDARDIZATION **9**

Introduction - Current status of standardization of electric vehicles, electric Vehicles and Standardization - Standardization Bodies Active in the Field – Standardization activities in countries like Japan. The International Electro Technical Commission - Standardization of Vehicle Components.

UNIT II TESTING OF ELECTRIC MOTORS AND CONTROLLERS FOR ELECTRIC AND HYBRID ELECTRIC VEHICLES **9**

Test Procedure Using M-G Set, electric motor, controller, application of Test Procedure,

Analysis of Test Items for the Type Test - Motor Test and Controller Test (Controller Only). - Test Procedure Using Eddy Current Type Engine Dynamometer, Test Strategy, Test Procedure, Discussion on Test Procedure. Test Procedure Using AC Dynamometer.

UNIT III FUNDAMENTALS OF FUNCTIONAL SAFETY AND EMC 9

Functional safety life cycle - Fault tree analysis - Hazard and risk assessment – software development - Process models - Development assessments - Configuration management – Reliability- Reliability block diagrams and redundancy - Functional safety and EMC - Functional safety and quality - Standards - Functional safety of autonomous vehicles.

UNIT IV EMC IN ELECTRIC VEHICLES 9

Introduction - EMC Problems of EVs, EMC Problems of Motor Drive, EMC Problems of DC-DC Converter System, EMC Problems of Wireless Charging System, EMC Problem of Vehicle Controller, EMC Problems of Battery Management System, Vehicle EMC Requirements.

UNIT V EMI IN MOTOR DRIVE AND DC-DC CONVERTER SYSTEM 9

Overview -EMI Mechanism of Motor Drive System, Conducted Emission Test of Motor Drive System, IGBT EMI Source, EMI Coupling Path, EMI Modelling of Motor Drive System. EMI in DC-DC Converter, EMI Source, The Conducted Emission High-Frequency, Equivalent Circuit of DC-DC Converter System, EMI Coupling Path.

TOTAL: 45 PERIODS

LAB EXPERIMENTS

1. Design and simulate motor controller for hybrid electric vehicle applications.
2. Simulation of EMC analysis for Wireless power transfer EV charging.
3. Design and simulation of EMI filter.
4. Analyze EMC for wireless power transfer EV charging.
5. Design EMI filter for EV applications.
6. Simulate EMI filter for EV applications
7. Simulate motor controller for electric vehicle applications.
8. Perform EMC analysis for wireless power transfer charging systems.

TOTAL: 30PERIODS

COURSE OUTCOMES

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

CO1: Describe the status and other details of standardization of EVs.
CO2: Illustrate the testing protocols for EVs and HEV components.
CO3: Analyze the safety cycle and need for functions safety for EVs.
CO4: Analyze the problems related with EMC for EV components.
CO5: Evaluate the EMI in motor drive and DC-DC converter system.

TEXT BOOK

1. Handbook of Automotive Power Electronics and Motor Drives, Ali Emadi, Taylor & Francis,2005, 1st Edition.
2. Electromagnetic Compatibility of Electric Vehicle, Li Zhai, Springer 2021, 1st Edition.
3. Electric Vehicle Systems Architecture and Standardization Needs, Reports of the PPP European Green Vehicles Initiative, Beate Müller, Gereon Meyer, Springer 2015, 1st Edition.

REFERENCES

1. EMC and Functional Safety of Automotive Electronics, Kai Borgeest, IET 2018, 1st Edition.
2. EMI/EMC Computational Modeling Handbook, Druce Archam beault, colin branch, Omar M.Ramachi ,Springer 2012, 2nd Edition.
3. Automotive EMC, Mark Steffika, Springer 2013, 1st Edition.
4. Emerging Power Converters for Renewable Energy and Electric Vehicles Modeling, Design and Control, Md. Rabiul Islam, Md. Rakibuzzaman Shah, Mohd. Hasan Ali, CRC Press,2021,1st Edition.
5. Nil Patel, Akash Kumar Bhoi, Sanjeevi kumar Padmanaban, Jens Bo Holm-Nielsen, Electric Vehicles Modern Technologies and Trends. Springer Publisher 1st Edition, 2021

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Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	1	-	-	-	2	-	-	-	-	-	3	-
CO2	3	1	1	-	-	-	1	-	-	-	-	-	3	-
CO3	3	1	1	-	-	-	2	-	-	-	-	-	3	-
CO4	3	1	1	-	-	-	1	-	-	-	-	-	3	-
CO5	3	1	1	-	-	-	2	-	-	-	-	-	3	3
AVG	**3**	**1**	**1**	**-**	**-**	**-**	**1.8**	**-**	**-**	**-**	**-**	**-**	**3**	**3**

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

24EEPE30 SMPS AND UPS **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To understand Modern power electronic converters and its applications in electric power utility.
- To learn Resonant converters and UPS.
- To learn controller design.

UNIT I POWER CONDITIONERS AND UPS **9**

Introduction – Power line disturbances – Power conditioners – UPS: Offline and On-line – Need for filters – Filter for PWM VSI – Front-end battery charger – boost charger.

UNIT II ANALYSIS OF NON-ISOLATED DC-DC CONVERTERS **9**

Basic topologies: Buck, Boost and Buck-Boost - Principles of operation – Continuous conduction mode– Concepts of volt-sec balance and charge balance – Analysis and design based on steady state relationships – Introduction to discontinuous conduction mode.

UNIT III ANALYSIS OF ISOLATED DC-DC CONVERTERS **9**

Introduction - classification- forward- flyback- pushpull – half bridge – full bridge topologies- C'uk converter as cascade combination of boost followed by buck - design of SMPS – Introduction to design of magnetic components for SMPS using relevant software.

UNIT IV CONVERTER MODELLING **9**

AC equivalent circuit analysis – State space averaging – Circuit averaging – Transfer function model for buck, boost and buck-boost converters.

UNIT V CONTROLLER DESIGN **9**

Review of P, PI, and PID control concepts – gain margin and phase margin – Bode plot based analysis – Design of controller for buck converter and boost converter.

TOTAL: 45 PERIODS

LAB EXPERIMENTS

1. Simulation of Basic topologies.
2. Simulation of bidirectional non-isolated DC DC converter.
3. Simulation of bidirectional isolated DC DC converter.
4. Simulation of basic topologies using state space model.
5. Simulation study of controller design for buck converter
6. Simulation study of controller design for boost topologies
7. Simulation study of controller design for buck boost and cuk converter.
8. Simulation of battery charger for EV application.

COURSE OUTCOMES

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

CO1: Analyze power line disturbances and design UPS systems with appropriate filters.

CO2: Design non-isolated DC-DC converters (Buck, Boost, Buck-Boost) for specified requirements.

CO3: Develop isolated DC-DC converter topologies and SMPS designs with proper magnetic components.

CO4: Model converter dynamics using state-space averaging and transfer function approaches.

CO5: Implement controller designs for DC-DC converters using frequency response techniques.

TEXT BOOKS

1. Robert W. Erickson & Dragon Maksimovic, " Fundamentals of Power Electronics", Third Edition, 2020
2. Ned Mohan," Power Electronics: A First Course", John wiley, 2013.
3. Marian K. Kazimierczuk and Agasthya Ayachit,"Laboratory Manual for Pulse-Width Modulated DC–DC Power Converters", Wiley 2016.

REFERENCES

1. Power Electronics handbook, Industrial Electronics series, S.K.Varenina, CRC press, 2002.
2. Power Electronic Converters, Teuvo Suntio, Tuomas Messo, Joonas Puukko, First Edition 2017.
3. Automotive EMC, Mark Steffika, Springer 2013, 1st Edition.
4. Iqbal Hussain,"Electric and Hybrid Vehicles: Design Fundamentals, Third Edition", CRC Press, Taylor & Francis Group,2021,1st Edition.
5. Electric and Hybrid Electric Vehicles, James D Halderman, Pearson, 2022, 1st Edition.

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COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	1	-	-	-	2	-	-	-	-	-	3	-
CO2	3	1	1	-	-	-	1	-	-	-	-	-	3	-
CO3	3	1	1	-	-	-	2	-	-	-	-	-	3	-
CO4	3	1	1	-	-	-	1	-	-	-	-	-	3	-
CO5	3	1	1	-	-	-	2	-	-	-	-	-	3	3
AVG	3	1	1	-	-	-	1.8	2	-	3	-	2	3	3

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

24EEPE31 INTELLIGENT CONTROL OF ELECTRIC VEHICLES **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To design and drive the mathematical model of a BLDC motor and its characteristics.
- To learn the different control schemes for BLDC motor.
- To study the basics of fuzzy logic.

UNIT I MATHEMATICAL MODEL AND CHARACTERISTICS ANALYSIS OF THE BLDC MOTOR **9**

Structure and Drive Modes - Basic Structure, General Design Method, Drive Modes. Mathematica lModel, Differential Equations, Transfer Functions, State-Space Equations. Characteristics Analysis,Starting Characteristics, Steady-State Operation, Dynamic Characteristics, Load Matching Commutation Transients

UNIT II SPEED CONTROL FOR ELECTRIC DRIVES **9**

Introduction -PID Control Principle, Anti windup Controller, Intelligent Controller. Vector Control. Control applied to BLDC motor.

UNIT III FUZZY LOGIC **9**

Membership functions: features, fuzzification, methods of membership value assignments Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle - fuzzy measures - measures of fuzziness -fuzzy integrals - fuzzy rule base and approximate reasoning: truth values and tables, overview of fuzzy expert system-fuzzy decision making.

UNIT IV FPGA AND VHDL BASICS **9**

Introduction – FPGA Architecture-Advantages-Review of FPGA family processors-Spartan 3, Spartan 6 and Spartan 7. VHDL Basics- Fundamentals-Instruction set-data type-conditional statements- programs like arithmetic, sorting, PWM generation, Speed detection.

UNIT V REAL TIME IMPLEMENTATION **9**

Inverter design, identifying rotor position via hall effect sensors, open loop and fuzzy logic control of BLDC motor using FPGA**.**

TOTAL: 45 PERIODS

LAB EXPERIMENTS

1. Design a speed controller for induction motors in EV for dynamic performance.
2. Design a speed controller for induction motors in EV for steady state performance.
3. Simulate a speed controller for induction motors in EV for dynamic performance.
4. Simulate a speed controller for induction motors in EV for steady state performance.
5. Simulate a fuzzy logic controller for an energy storage system in EV.
6. Implement a fuzzy logic controller for an energy storage system in EV.
7. Control a BLDC motor using a fuzzy logic approach in real time.
8. Implement fuzzy logic control of a BLDC motor using FPGA.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Model BLDC motor dynamics using differential equations and state-space representations.

CO2: Design speed control systems for BLDC motors using PID and vector control techniques.

CO3: Implement fuzzy logic controllers with appropriate membership functions and defuzzification methods.

CO4: Describe the basics of VHDL & FPGA applied to control of EVs.

CO5: Develop real-time BLDC motor control systems with fuzzy logic algorithms.

TEXT BOOKS

1. Wei Liu, Hybrid Electric Vehicle System Modeling and Control, Wiley 2017, 2nd Edition.
2. Robert Shorten, Sonja Stüdli, Fabian Wirth Electric, Plug-in Hybrid Vehicle Networks Optimization and Control, Emanuele Crisostomi, CRC Press, 1st Edition. 2018.
3. Ali Emadi, Advanced Electric Drive Vehicles, , CRC Press 2017, 1st Edition.

REFERENCE BOOKS

1. JG Hayes G. Abas Goodarzi, Electric Power train Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, Wiley.
2. Electric and Hybrid Electric Vehicles, James D Halderman, Pearson, 2022, 1st Edition.
3. VHDL Primer, A (3rd Edition), JayaramBhasker, Prentice Hall, 1st Edition 2015.
4. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals, Third Edition" CRC Press, Taylor & Francis Group, 2021, 1st Edition.
5. Chang-liang, Permanent Magnet Brushless DC Motor Drives and Controls, XiaWiley 2012,1st Edition.

Mapping of COs with POs & PSOs

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CO1	3	3	2	2	-	-	-	3	-	2	-	3	3	-
CO2	3	3	2	2	-	-	-	3	-	2	-	3	3	3
CO3	3	3	3	3	-	-	-	-	-	2	-	3	2	3
CO4	3	3	3	3	-	-	-	-	-	2	-	3	3	3
CO5	3	3	3	3	3	-	-	3	-	2	-	3	3	3
AVG	3	3	2.6	2.6	3	-	-	3	-	2	-	3	2.8	2.4

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

24EEPE32 MULTILEVEL POWER CONVERTERS **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To learn multilevel topology (Symmetry & Asymmetry) with common DC bus link.
- To study the working of cascaded H Bridge, Diode Clamped and Flying Capacitor MLI.
- To study the working of MLI with reduced switch count and MLI with resistive and reactive load

UNIT I MULTILEVEL TOPOLOGIES **9**

Introduction – Generalized Topology with a Common DC bus – Converters derived from the generalized topology – symmetric topology without a common DC link – Asymmetric topology.

UNIT II CASCADED H-BRIDGE MULTILEVEL INVERTERS 9

Introduction -H-Bridge Inverter, Bipolar Pulse Width Modulation, Unipolar Pulse Width Modulation.Multilevel Inverter Topologies, CHB Inverter with Equal DC Voltage, H-Bridges with Unequal DC Voltages – PWM, Carrier-Based PWM Schemes, Phase-Shifted Multicarrier Modulation, Level-Shifted Multicarrier Modulation, Comparison Between Phase- and Level-Shifted PWM Schemesstaircase Modulation.

UNIT III DIODE CLAMPED MULTILEVEL CONVERTER (DCMC) 9

Introduction – Converter structure and Functional Description – Modulation scheme for diode clamped Multilevel converters– Voltage balance Control –Boundary of voltage balancing in DCMC converters – Performance results.

UNIT IV FLYING CAPACITOR MULTILEVEL CONVERTER (FCMC) 9

Introduction – Flying Capacitor topology – Modulation scheme for the FCMC – Dynamic voltage balance of FCMC.

UNIT V CASCADED ASYMMETRIC MULTILEVEL INVERTER 9

Multilevel inverter (MLI) with reduced switch count-structures, working principles - pulse generation methods for the inverter with carrier signals and without carrier signals.

TOTAL: 45 PERIODS

LAB EXPERIMENTS

1. Simulation of Fixed PWM for an inverter.
2. Simulation of, Sinusoidal PWM for an inverter.
3. Simulation of H bridge inverter with R load.
4. Simulation of H bridge inverter with RL load.
5. Simulation of H bridge inverter with RLE load.
6. Simulation of three level diode clamped MLI with R load.
7. Simulation of three level capacitor clamped MLI with R load.
8. Simulation of MLI with reduced switch configuration.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Explain the working principles of multilevel topologies (symmetric/asymmetric) and their advantages over conventional inverters.

CO2: Design a Cascaded H-Bridge (CHB) inverter using PWM techniques (phase-shifted, level-shifted) for reduced harmonic distortion.

CO3: Analyze voltage balancing challenges in Diode-Clamped Multilevel Converters (DCMC) and propose solutions.

CO4: Implement a Flying Capacitor Multilevel Converter (FCMC) with dynamic voltage balancing control.

CO5: Develop a reduced-switch asymmetric MLI topology and validate its output harmonics **.**

TEXT BOOKS

1. Rashid M.H," Power Electronics Circuits, Devices and Applications", Prentice Hall India, Third Edition, New Delhi, 2014 Pearson 4th edition.
2. Sergio Alberto Gonzalez, Santiago Andres Verne, Maria Ines Valla," Multilevel Converters for Industrial Applications", CRC Press, 2017,1st Edition.
3. Bin Wu, Mehdi Narimani, High Power Converters and AC drives by IEEE press 2017, 2nd Edition.

REFERENCE BOOKS

1. Thomas A. Lipo, Pulse Width Modulation for Power Converters: Principles and practice, D.Grahame Holmes, John Wiley & Sons, 2003, 1st Edition.
2. Fang Lin Luo, Hong Ye,Advanced DC/AC Inverters: Applications in Renewable Energy, CRC Press, 2013, 2017, 1st Edition.
3. Hani Vahedi, Mohamed Trabelsi, Single-DC-Source Multilevel Inverters, Springer,
4. Ersan Kabalcı, Multilevel Inverters Introduction and Emergent Topologies, Academic Press Inc,2021, 1st Edition.
5. Iftekhar Maswood, Dehghani Tafti, Advanced Multilevel Converters and Applications in Grid Integration, Wiley, 2018, 1st Edition.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	3	2	2	1	-	-	-	-	-	1	3	3
CO2	2	2	3	3	3	1	-	-	-	-	-	1	3	3
CO3	2	2	2	3	2	2	-	-	-	-	-	1	2	3
CO4	1	2	3	3	3	1	-	-	-	-	-	1	3	3
CO5	2	2	2	2	2	1	-	-	-	-	-	1	3	3
AVG	1.8	2	2.6	2.6	2.3	1.2	-	-	-	-	-	1	3	3

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

24MC3101 LEGAL SYSTEM OF INDIA **L T P C**

3 0 0 0

COURSE OBJECTIVES

- To introduce the basic concepts necessity of law among engineers.
- To introduce Indian legal system.
- To familiarize taxations and basic laws.

UNIT I INTRODUCTION TO INDIAN LEGAL SYSTEM **9**

Constitution of India, Sources of Law and Judicial system.

UNIT II CONTRACTS AND ITS ELEMENTS **9**

Employment contracts, Contract Interpretation, Service Contract, Contract of Indemnity, Law of Agency. Employment agreement.

UNIT III LEGAL DOCUMENTATION **9**

Drafting of legal documents including Non-Disclosure Agreements (NDA), Request for Proposal (RFP), collaboration agreements, joint venture agreements, tendering and subcontracting

UNIT IV CYBER AND LABOUR LAWS **9**

E-Commerce and E-Governance. Provident Fund, ESIC, Gratuity, Bonus, Perquisites, Contract labour Health, Safety and welfare of construction workers.

UNIT V TAXATION **9**

Income Tax, Service Tax, VAT, Excise Duty, GST. Alternate Dispute Resolution (ADR) in Domestic and International dealings, Code of Conduct and Ethics for engineering professionals

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Explore the Indian Legal System.
CO2: Explain the basics of different laws.
CO3: Acquire practical insight of legal system and its application in engineering profession.
CO4: Analyze the cyber and labour law.
CO5: Use the tax system.

TEXT BOOKS

1. Karnika Seth, Computer Internet and New Technology Laws, Lexisnexis, First Edition 2013.
2. Prafulla C Pant, The Arbitration and Conciliation Act, 1996, Butterworths India, New Delhi.
3. Joseph Minattur, Indian Legal System, Indian Law Institute, New Delhi.

REFERENCE BOOKS

1. J. Beatson, Anson's Law of Contract, Oxford University Press.
2. V. S. Datey , Indirect Taxes: Law and Practice, Taxmann Publications (P) Ltd.
3. Dr. Vinod K. Singhania and Dr. Monica Singhania , Student's Guide To Income Tax, Taxmann Publications (P) Ltd.
4. S.C. Srivastava, Industrial Relations and Labour Laws, Vikas Publishing House Pvt. Ltd.
5. Singh, M. P., & Kumar, N, The Indian legal system: An enquiry. Oxford University Press, 2019.

24MC3102 IPR AND PATENT DRAFTING **L T P C**
3 0 0 0

COURSE OBJECTIVES

- To introduce the basic concepts intellectual property.
- To familiarize the importance of patent copyrights and trademarks.
- To train the students for drafting of patent.

UNIT I BASICS OF IPR **9**

Introduction – Invention and Creativity – Intellectual Property (IP) – Importance – Protection of IPR – Basic types of property (Movable Property, Immovable Property and Intellectual Property).

UNIT II PATENT, COPYRIGHTS AND TRADEMARKS **9**

IP – Patents – Copyrights and related rights – Trade Marks and rights arising from Trademark registration – Definitions – Industrial Designs and Integrated circuits – Protection of Geographical Indications at national and International levels – Application Procedures.

UNIT III INTERNATIONAL PATENT FILING **9**

International convention relating to Intellectual Property – Establishment of WIPO – Mission and Activities – History – General Agreement.

UNIT IV DRAFT OF PATENT **9**

Pre-drafting requirement, Types of specifications, Drafting of Provisional specifications, Drafting of complete specifications, Drafting of claims, Filing procedure for Ordinary application, Convention application, PCT International Phase application, PCT National Phase application, Patent of addition, Divisional application, Publication of paten, First Examination Report, Time limit for different phase of prosecution, Pre Grant opposition, Post Grant opposition.

UNIT V INFRINGEMENT OF PATENTS AND CASE STUDIES 9

Infringement & remedies, Literal Infringement, Case Studies on – Patents, Copyright and related rights – Trade Marks – Industrial design and Integrated circuits – Geographic indications – Protection against unfair competition.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Explain the basics of IPR.
CO2: Explore the importance of Patenting.
CO3: Discuss the method of international patent filing.
CO4: Draft of patent application.
CO5: Explain the importance of patent infringement.

TEXT BOOKS

1. Kompal Bansal, Parikshit Bansal, Fundamentals of Intellectual Property for Engineers, BS Publications 2013.
2. Pmbuddha Ganguli, Inrelletul property right - Unleasbing the knowledge economy, Tata Mccraw HiU Publishing Company Ltd.
3. Deborah Bouchoux, Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets Delmar Cengage Learning; 5th Edition.

REFERENCE BOOKS

1. N.K Acharya, Intellectual property rights, Asia Law House, 9th Edition.
2. Jeffrey G. Sheldon, How to Write a Patent Application, Third Edition, Practising Law Institute, 2016.
3. WIPO Intellectual Prcpeny Handbook. Policy, Law and Use, 2nd Edition.
4. Dr. R. Ashok Raj, Dr. K. Panneer Selvam, and V. Sivaganesan "Introduction to Intellectual Property Rights and Patent Drafting, JBR TRY SEA Publishers, 2024.
5. The American Society of International law, Electronic resource guide, ERC publication.

24MC3103 LITERARY FORMS AND TECHNIQUES **L T P C**
3 0 0 0

COURSE OBJECTIVES

- To make the students aware about the finer sensibilities of human existence through an art form.
- The students will learn to appreciate different forms of literature as suitable modes of expressing human experience.
- To gain knowledge in modern tools for visualization.

UNIT I INTRODUCTION TO ELEMENTS OF LITERATURE **9**

Relevance of literature, Enhances Reading, thinking, discussing and writing skills. Develops finer sensibility for better human relationship. Increases understanding of the problem of humanity without bias. Providing space to reconcile and get a cathartic effect.

UNIT II ELEMENTS OF FICTION **9**

Fiction, fact and literary truth. Fictional modes and patterns. Plot character and perspective.

UNIT III ELEMENTS OF POETRY **9**

Emotions and imaginations. Figurative language. Simile, metaphor, conceit, symbol, pun and irony). Personification and animation. Rhetoric and trend.

UNIT IV ELEMENTS OF DRAMA **9**

Drama as representational art. Content mode and elements. Theatrical performance. Drama as narration, mediation and persuasion. Features of tragedy, comedy and satire.

UNIT V MODERN TOOLS FOR VISUALIZATION **9**

Plot Diagram Infographic, Theme Video Tone & Mood, Visual Set, Setting Diorama or 3D Model Soundtrack for a Story, Symbolism Poster, Book Trailer.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Explain the relevance of literature in human life.

CO2: Explore the relevance various aspects in developing finer sensibilities.

CO3: Explore the essence of poetry.

CO4: Enumerate the essence of drama.

CO5: Use the modern tools for visualization.

TEXT BOOKS

1. W.H. Hudson, An Introduction to the Study of English Literature, Atlantic, 2007.
2. Mario Klarer, Routledge, An Introduction to Literary Studies, 2013.
3. The Experience of Poetry, Graham Mode, Open college of Arts with Open Unv Press, 1991.

REFERENCE BOOKS

1. Wolfstuff, The Elements of Fiction: A Survey, Ulf Wolf (ed), 2014
2. The Elements of Drama, J.L.Styan, Literary Licensing, 2011.
3. WIPO Intellectual Prcpeny Handbook. Policy, Law and Us.
4. Kelly j. Mays "The Norton Introduction to Literature, W.W. Norton & Company.Fifteenth Edition, 2025
5. Eleclronic resource guide ERc published online by the American Society of International law.

24MC3104 DISASTER RISK REDUCTION AND MANAGEMENT **L T P C**

3 0 0 0

COURSE OBJECTIVES

- To impart knowledge on concepts related to disaster management.
- To acquaint with the skills for planning and organizing disaster response.
- To impart knowledge on concepts related to disaster, disaster risk reduction.

UNIT I HAZRADS, VULNERABILITY AND DISASTER RISKS **9**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies,-Inter relations between Disasters and Sustainable development Goals.

UNIT II DISASTER RISK REDUCTION (DRR) 9

Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.

UNIT III DISASTER MANAGEMENT 9

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers).

UNIT IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT 9

Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster Management.

UNIT V DISASTER MANAGEMENT: CASE STUDIES 9

Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work-Mock drill.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Use the concepts of Disaster, Vulnerability and Disaster Risk reduction.

CO2: Explore on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction.

CO3: Develop disaster response skills by adopting relevant tools and technology.

CO4: Enhance awareness of institutional processes for Disaster response in the country.

CO5: Develop rudimentary ability to respond to their surroundings with potential.

TEXT BOOKS

1. Taimpo, Disaster Management and Preparedness, CRC Publications, 2016.
2. Singh R, Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications, 2017.
3. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012.

REFERENCE BOOKS

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010.
2. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
3. Government of India, National Disaster Management Policy, 2009.
4. Shaw R., Community based Disaster risk reduction, Oxford University Press, 2016.
5. Madu, C. N., Kuei, C.-H., Madu, I. E., Ozumba, B. C., Nnadi, V. E., Odinkonigbo, U. L., & Ezeasor, I. C. (Eds.), Handbook of disaster risk reduction & management: Climate change and natural disasters. World Scientific Publishing Co, 2017.

24MC3105 FILM APPRECIATION

L	T	P	C
3	0	0	0

COURSE OBJECTIVES

- To gain knowledge on concepts film.
- To acquaint the skills on film language.
- To know the developments in films.

Theme - A: The Component of Films

A-1: The material and equipment
A-2: The story, screenplay and script
A-3: The actors, crew members, and the director
A-4: The process of film making… structure of a film

Theme - B: Evolution of Film Language

B-1: Film language, form, movement etc.
B-2: Early cinema… silent film (Particularly French)
B-3: The emergence of feature films: Birth of a Nation
B-4: Talkies

Theme - C: Film Theories and Criticism/Appreciation

C-1: Realist theory; Auteurists
C-2: Psychoanalytic, Ideological, Feminists
C-3: How to read films?
C-4: Film Criticism / Appreciation

Theme – D: Development of Films

D-1: Representative Soviet films

D-2: Representative Japanese films
D-3: Representative Italian films
D-4: Representative Hollywood film and the studio system

Theme - E: Indian Films

E-1: The early era
E-2: The important films made by the directors
E-3: The regional films
E-4: The documentaries in India

READING:

A Reader containing important articles on films will be prepared and given to the students. The students must read them and present in the class and have discussion on these.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Explain the components of film.
CO2: Utilize the development of film languages.
CO3: Explain the film theories.
CO4: Discuss the latest developments in film.
CO5: List the latest developments in Indian film.

TEXT BOOKS

1. Jim Piper, The Film Appreciation Book: The Film Course You Always Wanted to Take, Allworth Pr, 2014.
2. Monaco, How to read a film, Oxford University Press, 2000.
3. Bordwell, D., & Thompson, K., Film art: An introduction, 12th Edition, McGraw-Hill Education., 2020.

REFERENCE BOOKS

1. Nichols, B., Engaging cinema: An introduction to film studies. W. W. Norton & Company, 2017.
2. Cook, D. A., A history of narrative film (4th ed.). W. W. Norton & Company, 2004.
3. Giannetti, L., Understanding movies (14th ed.). Pearson, 2020.
4. Boggs, J. M., & Petrie, D. W., The art of watching films (9th ed.). McGraw-Hill Education, 2017.
5. Hayward, S. (2013). Cinema studies: The key concepts (4th ed.). Routledge.

24MC3106 WOMEN AND GENDER STUDIES **L T P C**
3 0 0 0

COURSE OBJECTIVES

- To gain knowledge in feminism and its theory's.
- To know the woman's global, national and locals movements.
- To understand the gender and representations.

UNIT I CONCEPTS **9**

Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour.

UNIT II FEMINIST THEORY **9**

Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.

UNIT III WOMEN'S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL **9**

Rise of Feminism in Europe and America. Women's Movement in India.

UNIT IV GENDER AND LANGUAGE **9**

Linguistic Forms and Gender. Gender and narratives.

UNIT V GENDER AND REPRESENTATION **9**

Advertising and popular visual media. Gender and Representation in Alternative Media. Gender and social media.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Distinguish between key concepts related to sex, gender, patriarchy and gender Rules.

CO2: Analyze various feminist theories, including liberal,Marxixt,Socialist, radical and Postmodernist perspectives.

CO3: Examine the development of women's movements globally, nationally (india) and Locally.

CO4: Interpret the relationship between gender and language, including narrative forms and linguistic structures.

CO5: Evaluate the representation of gender in mainstream, alternative and social media Platforms.

TEXT BOOKS

1. Madhu Nagla, Women and Gender Studies: A Textbook, Rawat Publications; First Edition, 2025.
2. Mary S Evans, Kathy Davis and Judith Lorber, Handbook of Gender and Women's Studies, Sage Publications, 2006.
3. Gillis, M. J., & Jacobs, A. T. Introduction to women's and gender studies: An interdisciplinary approach (2nd ed.). Oxford University Press, 2019.

REFERENCE BOOKS

1. Launius, C., & Hassel, H., Threshold concepts in women's and gender studies (2nd ed.). Routledge, 2018.
2. Hunter College Women's and Gender Studies Collective. Women's realities, women's choices: An introduction to women's and gender studies. Oxford University Press, 2014.
3. Saraswati, L. A., Shaw, B., & Rellihan, H. (2017). Introduction to women's, gender, and sexuality studies. Oxford University Press
4. Clemens, C. L.Introduction to women's & gender studies. The Pennsylvania Alliance for Design of Open Textbooks (PA-ADOPT), 2023.
5. Judith Lorber, Gender Inequality : Feminist Theories and Politics, Oxford University Press, Third Edition,2010.

24MC5101 FOOD AND NUTRITION

L	T	P	C
3	0	0	0

COURSE OBJECTIVES

- Obtain knowledge of different food groups, their composition and role in diet.
- To gain knowledge of different plant and animal derived foods and their nutritive values and properties.
- To gain knowledge in different methods of processing and cooking.

UNIT I FOOD GROUPS **9**

Basic 4, 5&7 food groups. Functional food groups-energy yielding, body building and protective foods (only sources and not properties and functions). Food Pyramid, My Plate. Study of various cooking methods - Boiling, steaming, stewing, frying, baking, roasting, broiling, cooking under pressure. Cereals - composition of rice, wheat, effects of cooking on parboiled and raw rice, principles of starch cookery, gelatinization.

UNIT II PULSES AND GRAMS **9**

Varieties of pulses & grams, composition, nutritive value, cooking quality of pulses, germination and its effect. Vegetables - Classification, composition, nutritive value, selection and preparation for cooking, methods and principles involved in cooking. Fruits - Composition, nutritive value, changes during ripening, methods and effects of cooking, enzymatic browning.

UNIT III BEVERAGES **9**

Classification, nutritive value, Milk based beverages- methods of preparing tea and coffee, fruit based beverages and preparation of carbonated non – alcoholic beverages. Spices and Condiments - Uses and abuses. Fats and Oils - Types of oils, function of fats and oils, shortening effects of oil, smoking point of oil, factors affecting absorption of oil. Sugar cookery- Stages of sugar cookery, crystallization and factors affecting crystallization.

UNIT IV MILK **9**

Composition, nutritive value, kinds of milk, pasteurization and homogenization of milk, changes in milk during heat processing, preparation of cheese and milk powder Egg -

Structure, composition, classification, nutritive value, uses of egg in cookery, methods of cooking, foam formation and factors affecting foam formation.

UNIT V MEAT **9**

Structure, composition, nutritive value, selection of meat, post mortem changes in meat, aging, tenderness, methods of cooking meat and their effects. Poultry – types, composition, nutritive value, selection, methods of cooking. Fish - Structure, composition, nutritive value, selection of fish, methods of cooking and effects

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Explain the food groups.
CO2: Explore the properties of pulses and grams.
CO3: Explore the properties of beverages.
CO4: Explore the properties of milk.
CO5: Explore the properties of meats.

TEXT BOOKS

1. M. Swaminathan. Food science, Chemistry and Experimental foods, International Book House Publication.
2. Norman.N.Potter, Food Science, New York: Chapman & HalI, 1995.
3. Griswold R.M, Experimental study of Foods, John Wiely & Sons, INC, New York, 1962.

REFERENCE BOOKS

1. Helen Charley, Food Science, Macmillan, 1982.
2. A.G. Peckam, Foundation of Food Preparation, Collier Macmillan Ltd, 1969.
3. Modern Cookery for teaching and trade, volume I&II ,Thangam Philip. Orient Longmans Ltd.
4. Food Fundamentals by MacWiliams, John Willy and son‟s, New York.
5. Food Facts & Principles by Shakunthala manay & Shadakhraswamy.

24MC5102 DESIGN THINKING **L T P C**
3 0 0 0

COURSE OBJECTIVES

- To learn design thinking concepts and principles.
- To use design thinking methods in every stage of the problem.
- To learn the different phases of design thinking.

UNIT I INTRODUCTION **9**

Why Design? - Four Questions, Ten Tools - Principles of Design Thinking - The process of Design Thinking - How to plan a Design Thinking project.

UNIT II UNDERSTAND, OBSERVE AND DEFINE THE PROBLEM 9

Search field determination - Problem clarification - Understanding of the problem - Problem, analysis - Reformulation of the problem - Observation Phase - Empathetic design - Tips for observing - Methods for Empathetic Design - Point-of-View Phase - Characterization of the target group - Description of customer needs.

UNIT III IDEATION AND PROTOTYPING 9

Ideate Phase - The creative process and creative principles - Creativity techniques - Evaluation of ideas - Prototype Phase - Lean Startup Method for Prototype Development - Visualization and presentation techniques.

UNIT IV TESTING AND IMPLEMENTATION 9

Test Phase - Tips for interviews - Tips for surveys - Kano Model - Desirability Testing - How to conduct workshops - Requirements for the space - Material requirements - Agility for Design Thinking.

UNIT V FUTURE 9

Design Thinking meets the corporation – The New Social Contract – Design Activism – Designing tomorrow**.**

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Explain the principles of design thinking.
CO2: Define the problems.
CO3: Create prototype.
CO4: Test the product.
CO5: Implement the product in the market sale.

TEXT BOOKS

1. Christian Mueller-Roterberg, Handbook of Design Thinking - Tips & Tools for how to design thinking.
2. Jeanne Liedtka and Tim Ogilvie, Designing for Growth: a design thinking tool kit for managers.
3. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation.

REFERENCE BOOKS

1. Johnny Schneider, “Understanding Design Thinking, Lean and Agile”, O'Reilly Media, 2017.
2. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press, 2009.
3. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2011
4. http://ajjuliani.com/design-thinking-activities/
5. https://venturewell.org/class-exercices

24MC5103 HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA

L	T	P	C
3	0	0	0

COURSE OBJECTIVES

- To know the contributions of sciences.
- To gain knowledge astronomy, mathematics and Ayurveda.
- To gain knowledge on technological development of India.

UNIT I INTRODUCTION **9**

Logic and methodology of Indian sciences. An overview of Indian contributions to sciences. An overview of Indian contributions to technology.

UNIT II ASTRONOMY **9**

Development of astronomy in India. Pancanga: Indian calendrical computations. The distinct features of Indian planetary models. Computation of eclipses: Its simplicity, elegance and efficiency. Observational astronomy in India.

UNIT III MATHEMATICS **9**

An overview of the development of mathematics in India. Mathematics contained in Sulbasutras. Combinatorial aspects of the Chandassastra. Solutions to the first and second order indeterminate equations. Weaving mathematics into beautiful poetry: Bhaskaracarya. The evolution of sine function in India. The discovery of calculus by Kerala astronomers

UNIT IV AYURVEDA **9**

History of Ayurveda, Rational foundations of Ayurveda, Textual sources in Ayurveda, Ayurveda and allied disciplines, Approach to health and disease in Ayurveda – 2 lectures, Approach to diet and nutrition in Ayurveda. Modern medicine, Ayurveda and Yoga.

UNIT V TECHNOLOGICAL DEVELOPMENT IN INDIA **9**

Agriculture- Origin, development, and Ancient crops, Water management- Overview, Harappan water management, other case studies, Medieval Water structures, Pottery-technical aspects, Silpasastra: Architecture and Construction- An introduction to Silpasastra and Construction Technology.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Explain the Indian science.
CO2: Explore the essence of Indian astronomy.
CO3: Enumerate the development of Indian mathematics
CO4: Discuss the sources of Ayurveda.
CO5: Explain the technological development of India.

TEXT BOOKS

1. Soni, S., India's glorious scientific tradition: Exploration of ancient knowledge and modern insights. Prabhat Prakashan.2020.
2. Joseph, G. G, A passage to infinity: Medieval Indian mathematics from Kerala and its impact. SAGE Publications, 2009.
3. Mohan, K., Science and technology in colonial India. Routledge, 2023.

REFERENCE BOOKS

1. Sarma, K. V. A history of the Kerala school of Hindu astronomy. Vishveshvarananda Institute of Sanskrit and Indological Studies, 1972.
2. Seshadri, C. S. (Ed.). Studies in the history of Indian mathematics. Hindustan Book Agency, 2010.
3. Datta, B., & Singh, A. N. History of Hindu mathematics: A source book. Asia Publishing House, 1962.
4. Kashyapa, K., Kashyapa Samhita. Chaukhambha Orientalia, 2007.
5. https://onlinecourses.swayam2.ac.in/arp19_ap87/preview.

24MC5104 POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY

L	T	P	C
3	0	0	0

COURSE OBJECTIVES

- To know the human society and system.
- To understand the capitalism, fascism and communism.
- To gain knowledge in human welfare and essential elements in Indian civilization.

UNIT I HUMAN SOCIETY AND SYSYTEM **9**

Considerations for humane society, holistic thought, human being's desires, harmony in self, harmony in relationships, society, and nature, societal systems.

UNIT II CAPITALISM **9**

Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, Imperialism. Liberal democracy.

UNIT III FASCISM AND COMMUNISM **9**

Fascism and totalitarianism. World War I and II. Cold war. Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical Materialism, historical materialism, Russian and Chinese models.

UNIT IV HUMAN WELFARE **9**

Welfare state. Relation with human desires. Empowered human beings, satisfaction. Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one's lives, Relationship with nature.

UNIT V ESSENTIAL ELEMENTS OF INDIAN CIVILIZATION **9**

Essential elements of Indian civilization, Technology as driver of society, Role of education in shaping of society. Future directions.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Explore the human society and system.
CO2: Explain the principles of capitalism.
CO3: Discuss the fascism and communism.
CO4: Explore the importance of Human Welfare.
CO5: List the essential elements of Indian civilization.

TEXT BOOKS

1. Capra, F, The Turning Point: Science, Society, and the Rising Culture (Revised ed.). HarperOne,2023.
2. Marx, K., & Engels, F. The Communist Manifesto. Penguin Classics. 2022.
3. Paxton, R. O. The Anatomy of Fascism. Vintage, 2022.

REFERENCES BOOKS

1. Kumar, S.,The Song of the Earth. Green Books, 2022.
2. Stiglitz, J. E, Globalization and Its Discontents Revisited: Anti-Globalization in the Era of Trump. Penguin UK, 2017.
3. Lenin, V. I., The State and Revolution. Penguin Random House 2024.
4. Sen, A., Development as Freedom. Oxford University Press.2022.
5. Capra, F., & Luisi, P. L., The Systems View of Life: A Unifying Vision. Cambridge University Press, 2022.

24MC5105 STATE, NATION BUILDING AND POLITICS IN INDIA **L T P C**
3 0 0 0

COURSE OBJECTIVE

- To gain knowledge in need and role of state and politics.
- To gain knowledge in Indian national movements.
- To gain knowledge in national politics and constitution.

UNIT I INTRODUCTION **9**

Understanding the need and role of State and politics. Development of Nation-State, sovereignty, sovereignty in a globalized world.

UNIT II STATE POLITICS **9**

Organs of State – Executive, Legislature, Judiciary. Separation of powers, forms of government unitary-federal, Presidential-Parliamentary.

UNIT III INDIAN NATIONAL MOVEMENTS **9**

The idea of India. 1857 and the national awakening. 1885 Indian National Congress and development of national movement – its legacies.

UNIT IV CONSTITUTION OF INDIA **9**

Constitution making and the Constitution of India. Goals, objective and philosophy.

UNIT V NATIONAL POLITICS **9**

National integration and nation-building. Challenges of nation-building – State against democracy (Kothari) New social movements. The changing nature of Indian Political System, the future scenario.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Explore the needs of politics.
CO2: Explain the organs of state politics.
CO3: Explain the history of Indian national movements.
CO4: Discuss the constitution of India.
CO5: Discuss the roles of national politics.

TEXT BOOKS

1. Sunil Khilnani, The Idea of India. Penguin India Ltd., New Delhi.
2. Madhav Khosla, The Indian Constitution, Oxford University Press. New Delhi, 2012.
3. Chatterjee, P. (Ed.). State and politics in India. Oxford University Press, 1997.

REFERENCE BOOKS

1. Sumantra Bose, Transforming India: Challenges to the World's Largest Democracy, Picador India, 2013.
2. V. Atul Kohli, Democracy and Discontent: India's Growing Crisis of Governability, Cambridge University Press, Cambridge, U. K., 1991.
3. M. P. Singh and Rekha Saxena, Indian Politics: Contemporary Issues and Concerns, PHI, New Delhi, 2008, latest edition.
4. Rajni Kothari, Rethinking Democracy, Orient Longman, New Delhi, 2005.
5. Brij Kishore Sharma, Introduction to the Indian Constitution, PHI, New Delhi, latest edition.

24MC5106 INDUSTRIAL SAFETY **L T P C**

3 0 0 0

COURSE OBJECTIVES

- To Understand the Introduction and basic Terminologies safety.
- To enable the students to learn about the Important Statutory Regulations and standards.
- To enable students to Conduct and participate the various Safety activities in the Industry.

UNIT I SAFETY TERMINOLOGIES **9**

Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold Limit Value (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS

UNIT II STANDARDS AND REGULATIONS **9**

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006.

UNIT III SAFETY ACTIVITIES **9**

Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment.

UNIT IV WORKPLACE HEALTH AND SAFETY **9**

Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane SafetyToxic gas Release.

UNIT V HAZARD IDENTIFICATION TECHNIQUES **9**

Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Course outcomes on completion of this course the student will be able:

CO1: Explain the basic concept of safety.
CO2: Obtain knowledge of Statutory Regulations and standards.
CO3: Know about the safety Activities of the Working Place.
CO4: Analyze on the impact of Occupational Exposures and their Remedies
CO5: Obtain knowledge of Risk Assessment Techniques.

TEXT BOOKS

1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER
2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education
3. Asfahl, C. R., & Rieske, D. W., Industrial safety and health management (7^{th} ed.). Pearson 2018.

REFERENCE BOOKS

1. Frank Lees, 'Lees' Loss Prevention in Process Industries. Butterworth-Heinemann publications, UK, 4th Edition., 2012.
2. John Ridley & John Channing, Safety at Work: Routledge, 7th Edition., 2008.
3. Dan Petersen, Techniques of Safety Management: A System Approach, 2003
4. Alan Waring, Safety management system: Chapman & Hall, England 5. Society of Safety Engineers, USA, 1996
5. Ferris, R. W., & Murphy, D, Workplace safety: Establishing an effective violence prevention program. Butterworth-Heinemann.

24OCI101 ESTIMATION AND COSTING OF BUILDING **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To understand methods for estimating quantities in a range of construction projects, including buildings, roads, and infrastructure.
- To acquire knowledge in rate analysis and cost estimation for construction activities.
- To build proficiency in drafting construction specifications, technical reports, and tender documents.

UNIT I ESTIMATION OF QUANTITIES **9**

Philosophy – Purpose – Methods of estimation – Centre line method – Long and short wall method – Types of estimates – Approximate estimates – Detailed estimate – Estimation of quantities for buildings, bituminous and cement concrete roads, septic tank, soak pit.

UNIT II COSTING AND RATE ANALYSIS **9**

Standard Data – Observed Data – Schedule of rates – Market rates – Materials and Labour – Standard Data for Man Hours and Machineries for common civil works.

UNIT III CONSTRUCTION SPECIFICATIONS AND DOCUMENTATION **9**

Specifications – Detailed and general specifications – Constructions – Sources – Types of specifications – Principles for report preparation – report on estimate of residential building – Culvert – Roads.

UNIT IV TYPES OF CONTRACTS **9**

Contract – Types of contracts – BOT – Types - Formation of contract – Contract conditions – Contract for labour, material, design, construction.

UNIT V PROPERTY VALUATION **9**

Definitions – Various types of valuations – Valuation methods - Necessity –Year's purchase-sinking fund- Capitalised value – Depreciation – Escalation – Valuation of land – Buildings – Calculation of Standard rent.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS (Using MS Excel Software)

1. Deriving an approximate estimate for a multistoried building by approximate methods.
2. Detailed estimate for the following with the required material survey for the same.
3. Derive an estimate for Ground plus three storied RCC Framed structure with blockwork walls.
4. Prepare the detailed estimate for the bridge with minimum 2 spans.
5. Detailed estimate for the factory building.
6. Detailed estimate for the road work cross drainage work.
7. Derive an estimate for Ground plus three storied building with load-bearing walls.
8. Preparation of valuation report in standard Government form.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On Successful completion of this course, the student will able to

CO1: Estimate quantities for construction projects using standard methods and software.

CO2: Analyze rates and create cost estimates for different construction works.

CO3: Gain skills in preparing construction specifications, reports, and tenders.

CO4: Analyze different types of construction contracts, their formation, and how disputes are resolved.

CO5: Value the properties such as land, buildings, mortgages, and leases.

TEXT BOOKS

1. B.N Dutta 'Estimating and Costing in Civil Engineering', CBS Publishers & Distributors (P) Ltd, Twenty eighth revised edition, 2020.
2. B.S.Patil, 'Civil Engineering Contracts and Estimates', 7th edition, University Press, 2015.
3. D.N. Banerjee, 'Principles and Practices of Valuation', V Edition, Eastern Law House, 2015.

REFERENCE BOOKS

1. Hand Book of Consolidated Data – 8/2000, Vol.1, TNPWD.
2. Tamil Nadu Transparencies in Tenders Act, 1998 and rules 2000.
3. Arbitration and Conciliation Act, 1996.
4. Standard Bid Evaluation Form, Procurement of Good or Works, The World Bank, April 1996.
5. Standard Data Book for Analysis and Rates, IRC, New Delhi, 2019.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	3	3	2	3	2	3	3	3	2	3	3	-	2
CO2	2	3	3	2	3	2	3	3	3	2	3	3	-	2
CO3	2	3	3	2	3	2	3	3	3	2	3	3	-	2
CO4	2	3	3	2	3	2	3	3	3	2	3	3	-	2
CO5	2	3	3	2	3	2	3	3	3	2	3	3	-	2
AVG	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	-	2

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

24OCI102 QUALITY ASSESSMENT OF BUILDING MATERIALS **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To learn the importance of quality control and testing standards for building materials.
- To understand the methods for testing materials like cement, concrete, aggregates, bricks, and steel.
- To gain hands-on experience in testing the quality of building materials in the laboratory.

UNIT I INTRODUCTIONTO QUALITY ASSESSMENT AND TESTING STANDARDS **9**

Importance of quality control in construction - Properties of building materials - physical, chemical, and mechanical properties - Quality assurance vs. quality control - IS codes for material testing (cement, aggregates, steel, etc.) - Sampling techniques and procedures - Acceptance criteria and reporting.

UNIT II CEMENT AND CONCRETE **9**

Types and grades of cement - Testing of cement: fineness, consistency, setting time, strength - Concrete mix design (brief introduction) – Grades of Concrete - Workability and durability tests - Compressive, tensile, and flexural strength of concrete - Nondestructive testing (NDT) - rebound hammer, ultrasonic pulse velocity. Types and roles of admixtures - Quality assessment of chemical and mineral admixtures.

UNIT III AGGREGATES **9**

Types of aggregates - fine and coarse - Tests on aggregates - sieve analysis, specific gravity, water absorption, impact value, crushing value - Bulking of sand - Alkali-aggregate reaction - IS codes relevant to aggregate testing.

UNITI V BRICKS, BLOCKS, AND MASONRY UNITS **9**

Classification and properties of bricks and blocks - Water absorption, compressive strength, efflorescence of bricks - Testing of solid and hollow concrete blocks - Masonry mortar: types and tests - Quality standards for masonry units relevant to IS codes.

UNIT V STEEL, TIMBER, AND OTHER MATERIALS **9**

Types of steel used in construction – mild steel, HYSD, TMT - Tensile and bend tests for steel – Timber - defects, moisture content, and strength grading - Quality control for paints, plastics, and glass - Modern materials - Geosynthetics, Graphine infused materials, Fiber reinforced polymers, Phase change materials (PCMs), Recycled and sustainable materials, Geopolymer, Advanced composite materials and Nano materials.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Fineness and consistency test on cement.
2. Compressive strength test on cement mortar cubes and concrete cubes.
3. Workability test on fresh concrete using slump cone and compaction factor.
4. Compressive and flexural strength test on hardened concrete.
5. Sieve analysis and specific gravity test on aggregates.
6. Impact and crushing value test on coarse aggregates.
7. Water absorption and compressive strength test on bricks.
8. Non-Destructive test on concrete specimens.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On Successful completion of this course, the students will be able to

CO1: Demonstrate the use of quality control techniques to verify building material standards.

CO2: Evaluate the properties of cement, concrete, and admixtures using standard methods and non-destructive testing.

CO3: Perform test on different types of aggregates to evaluate their properties and compliance with relevant IS codes.

CO4: Analyze the quality of bricks and blocks to ensure they meet construction requirements.

CO5: Perform testing on steel, timber, and modern materials to determine their construction suitability.

TEXT BOOKS

1. Shetty, M.S., Concrete Technology (Theory and Practice), S. Chand and Company Ltd., 2008.
2. Gambhir, M.L., Concrete Technology, Tata McGraw Hill Education, 5th Edition, 2013.
3. Varghese, P.C., Quality Control and Testing of Construction Materials, PHI Learning Pvt. Ltd., 2007.

REFERENCE BOOKS

1. Duggal, S.K., Building Materials, New Age International Publishers, 4th Edition, 2008.
2. IS 456:2000 – Plain and Reinforced Concrete – Code of Practice, Bureau of Indian Standards, New Delhi.

3. IS 383:2016 – Specification for Coarse and Fine Aggregates for Concrete, Bureau of Indian Standards, New Delhi.
4. IS 516:2018 – Method of Tests for Strength of Concrete, Bureau of Indian Standards, New Delhi.
5. IS 3495 (Parts 1 to 4):1992 – Methods of Tests of Burnt Clay Building Bricks, Bureau of Indian Standards, New Delhi.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	3	3	2	3	2	3	3	3	2	3	3	-	2
CO2	2	3	3	2	3	2	3	3	3	2	3	3	-	2
CO3	2	3	3	2	3	2	3	3	3	2	3	3	-	2
CO4	2	3	3	2	3	2	3	3	3	2	3	3	-	2
CO5	2	3	3	2	3	2	3	3	3	2	3	3	-	2
AVG	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**-**	2

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

24OCI103 PROJECT MANAGEMENT

L T P C
3 0 2 4

COURSE OBJECTIVES

- To study and understand the formulation, scheduling and various safety concepts and its requirements applied to construction projects.
- To study the various management techniques for successful completion of construction projects.
- To study the effect of management for project organization, workers, material and equipment utilization, and cost estimation.

UNIT I GENERAL OVERVIEW AND PROJECT ORGANIZATION 9

Introduction - Interdisciplinary nature of modern construction projects – execution of project – evaluation of bits – resource management.

UNIT II ESTIMATION OF PROJECT COST & ECONOMICS 9

Estimating quantities – description of items – estimation of project cost – running account bills – decision making in construction projects – depreciation of construction equipment – case study.

UNIT III PLANNING AND SCHEDULING 9

Introduction – project scheduling – uncertainties in duration of activities using PERT – Project monitoring and control system – resource levelling and allocation – crashing of network.

UNIT IV SAFETY DURING CONSTRUCTION 9

Basic terminology in safety - types of injuries - safety pyramid - Accident patterns - Planning for safety budget, safety culture - Introduction to OSHA regulations - Site safety programs - Job hazardanalysis, accident investigation & accident indices-violation, penalty.

UNIT V SAFE OPERATING PROCEDURES **9**

Safety during alteration, demolition works — Earthwork, steel construction, temporary structures, masonry & concrete construction, cutting & welding - Construction equipment, materials handling- disposal & hand tools - Other hazards – fire, confined spaces, electrical safety - Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Introduction to various construction management software.
2. Planning and creating new project.
3. Scheduling and constraints using PRIMAVERA.
4. Project cost management using PRIMAVERA.
5. Construction project safety management using BIM.
6. Gantt Chart and Network Diagram Creation.
7. Critical Path Method (CPM) & PERT Analysis.
8. Risk Management Simulation.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Perform formulations of projects.
CO2: Analyze project costing.
CO3: Identify and estimate the activity in the construction.
CO4: Develop the knowledge on accidents and their causes.
CO5: Plan, assess, analyze and manage the construction project sites using CPM/PERT.

TEXT BOOKS

1. Chitkara, K.K. Construction Project Management: Planning, Scheduling and Control, Tata McGraw-Hill Publishing Company, New Delhi, 1998.
2. Choudhury S, Project Management, McGraw-Hill Publishing Company, New Delhi, 1988.
3. Chris Hendrickson and Tung Au, Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2000.

REFERENCE BOOKS

1. Barcus, S.W. and Wilkinson. J. W., Hand Book of Management Consulting Services, McGraw Hill,New York, 1986.
2. Joy P.K., Total Project Management - The Indian Context, New Delhi, Macmillan India Ltd., 1992.
3. Albert Lester, Project Management, Planning and Control, 7th Edition, Butterworth- Heinemann, USA, 2017.
4. Patrick X.W. Zou, Riza Yosia Sunindijo, Strategic Safety Management in Construction andEngineering John Wiley & Sons, Ltd 2015.
5. Frederick E. Gould, Construction Project Management, Wentworth Institute of Technology, Vary E. Joyce, Massachusetts Institute of Technology, 2000.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	3	3	2	3	2	3	3	3	2	3	3	-	2
CO2	2	3	3	2	3	2	3	3	3	2	3	3	-	2
CO3	2	3	3	2	3	2	3	3	3	2	3	3	-	2
CO4	2	3	3	2	3	2	3	3	3	2	3	3	-	2
CO5	2	3	3	2	3	2	3	3	3	2	3	3	-	2
AVG	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	-	2

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

24OCI104 BUILDING PLANNING USING VAASTU SASTRA **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To introduce the principles of Vaasthu Shastra and its role in modern building planning.
- To equip students with the knowledge of guidelines for residential and commercial spaces.
- To develop the skills to apply principles in planning spaces for maximum comfort, energy flow, and harmony.

UNIT I INTRODUCTION TO VAASTHU SHASTRA **9**

Introduction to traditional Indian building orientation concepts including Vaasthu Shastra: overview, historical context, and philosophical background. Introduction to the five elements (Pancha Bhootas), cardinal directions, and their relevance in spatial organization. Role of energy flow and psychological comfort in building planning.

UNIT II GUIDELINES FOR RESIDENTIAL BUILDINGS **9**

General Vaasthu planning guidelines for residential buildings with functional and spatial arrangements. Orientation and zoning for daylight, ventilation, and thermal comfort. Introduction to structural load considerations as per IS 875 – Part 1: Dead Loads and IS 875 – Part 2: Imposed Loads. Importance of safety, utility, and aesthetic harmony in layout design.

UNIT III PLANNING OF COMMERCIAL AND PUBLIC BUILDINGS **9**

Design principles for commercial and public buildings such as offices, retail spaces, educational institutions, and hospitals. Functional requirements, circulation, and service zoning. Application of planning standards and integration with IS 875 loading codes and IS 456: Plain and Reinforced Concrete – Code of Practice.

UNIT IV CLIMATIC DESIGN & ENVIRONMENTAL INTEGRATION **9**

Importance of site context, solar orientation, prevailing winds, and daylighting in building design. Incorporating passive design strategies for thermal comfort and sustainability. Overview of IS SP 41: Guidelines for Climatic Design and ECBC (Energy Conservation Building Code) basics.

UNIT V COMMON DEFECTS AND SOLUTIONS **9**

Common functional and structural design issues in residential and commercial buildings. Remedial measures as per structural codes and basic planning principles. Introduction to basic concepts of defect rectification through both engineering practices and traditional approaches. Real-life examples and mini-case studies.

TOTAL:45 PERIODS

LIST OF EXPERIMENTS

1. Vaasthu analysis of an existing residential floor plan.
2. Designing room layouts based on Vaasthu principles.
3. Vaasthu compliant commercial building layout planning.
4. Identifying and correcting Vaasthu defects in a building plan.
5. Vaasthu guidelines for entrance and exit planning.
6. Selecting a construction site based on Vaasthu considerations.
7. Kitchen layout design following Vaasthu principles.
8. Optimizing solar and wind orientation in building design using Vaasthu.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On Successful completion of this course, the student will able to

CO1: Explain the key principles of Vaasthu Shastra.

CO2: Apply guidelines in the design of residential and commercial buildings.

CO3: Plan spaces that promote balance, energy flow, and harmony.

CO4: Design buildings that respond to climate and environment using passive strategies and relevant IS codes.

CO5: Identify and rectify common defects in existing buildings.

TEXT BOOKS

1. Narayan, S. Vastu Shastra: For a better living. Rupa Publications, 2005.
2. Vasudevan, R. Vastu: Transcending time, tradition, and modernity. Orient BlackSwan, 2011.
3. Sastry, B. K. Vastu Shastra: The ancient Indian science of architecture. TBS Publishers, 2002.

REFERENCE BOOKS

1. Bhat, S. Vastu for modern living. New Age International,2009.
2. Chakraborty, P. The art of Vastu Shastra. Allied Publishers, 2010.
3. Nambiar, S. M. Vastu Shastra for home and office. Srishti Publishers, 2013.
4. Kumar, P. Vastu for health, wealth, and happiness. Orient Longman, 2016.
5. Sharma, A. Practical Vastu Shastra for the home. Sterling Publishers Pvt. Ltd, 2008.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	3	3	2	3	2	3	3	3	2	3	3	-	2
CO2	2	3	3	2	3	2	3	3	3	2	3	3	-	2
CO3	2	3	3	2	3	2	3	3	3	2	3	3	-	2
CO4	2	3	3	2	3	2	3	3	3	2	3	3	-	2
CO5	2	3	3	2	3	2	3	3	3	2	3	3	-	2
AVG	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	-	2

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

24OAI101 WEB TECHNOLOGY **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To understand different Internet Technologies.
- To learn java-specific web services architecture.
- To develop web applications using frameworks.

UNIT I WEB SITE BASICS, HTML5, CSS3, WEB2.0 **9**

Web Essentials**:** Clients, Servers and Communication – The Internet – World Wide Web – HTTP Request Message – HTTP Response Message – Web Clients – Web Servers – HTML5 – Tables – Lists – Image – HTML5 Control Elements – Drag and Drop – Audio – Video Controls – CSS3 – Inline, Embedded and External Style Sheets – Rule Cascading – Inheritance – Backgrounds – Border Images – Colors – Shadows – Text – Transformations – Transitions – Animations – Bootstrap Framework.

UNIT II CLIENT-SIDE PROGRAMMING **9**

Java Script: An introduction to JavaScript–JavaScript DOM Model-Exception Handling-Validation- Built-in objects-Event Handling- DHTML with JavaScript- JSON introduction – Syntax – Function Files.

UNIT III SERVER-SIDE PROGRAMMING **9**

Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions-Session Handling- Understanding Cookies- DATABASE CONNECTIVITY: JDBC.

UNIT IV PHP AND XML **9**

An introduction to PHP: PHP- Using PHP- Variables- Program control- Built -in functions-Form Validation. XML: Basic XML -Document Type Definition - XML Schema, XML Parsers and Validation, XSL.

UNIT V INTRODUCTION TO ANGULAR AND WEB APPLICATIONS FRAME WORKS **9**

Introduction to AngularJS, MVC Architecture, Understanding ng attributes, Expressions and data binding, Conditional Directives, Style Directives, Controllers, Filters, Forms, Routers, Modules, Services; Web Applications Frameworks and Tools – Firebase- Docker- Node JS- React- Django- UI & UX.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Create a webpage with the following using HTML
   a) To embed an image map in a webpage.
   b) To fix the hotspots.
   c) Show all the related information when the hotspots are clicked.
2. Create a webpage with all types of Cascading Style Sheets.
3. Client-side scripts for validating web form controls using DHTML.
4. Installation of Apache Tomcat web server.
5. Write programs in Java using Servlets:
   a) To invoke servlets from HTML forms.
   b) Session tracking.
6. Write programs in Java to create three-tier applications using JSP and Databases:
   a) For conducting online examination.
   b) For displaying student mark list. Assume that student information is available in a database which has been stored in a database server.
7. Programs using XML – Schema – XSLT/XSL.
8. Write a program to design a simple calculator using (a) JavaScript (b) PHP (c) Servlet and (d) JSP.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Construct a basic website using HTML and Cascading Style Sheets.

CO2: Build dynamic web page with validation using JavaScript objects and by applying different event handling mechanisms.

CO3: Develop server-side programs using Servlets and JSP.

CO4: Construct simple web pages in PHP and to represent data in XML format.

CO5: Develop interactive web applications.

TEXT BOOKS

1. Deitel and Deitel and Nieto, Internet and World Wide Web - How to Program, Prentice Hall,5th Edition, 2011.
2. Jeffrey C and Jackson, Web Technologies: A Computer Science Perspective, Pearson Education, 2011.
3. Angular 6 for Enterprise-Ready Web Applications, Doguhan Uluca, 1st Edition, Publishing.

REFERENCE BOOKS

1. Stephen Wynkoop and John Burke, Running a Perfect Website, QUE, 2nd Edition, 1999.
2. Chris Bates, Web Programming – Building Intranet Applications, 3rd Edition, Wiley publication, 2009.
3. Gopalan N. P. and Akilandeswari J., Web Technology, Prentice Hall of India, 2011.
4. Uttam K. Roy, Web Technologies, Oxford University Press, 2011.
5. Angular: Up and Running – Learning Angular, Step by Step, Shyam Seshadri, 1st Edition, O′Reilly.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	–	2	–	3	–	–	–	–	2	–	2	-	2
CO2	3	2	3	–	3	–	–	–	–	–	–	3	-	2
CO3	3	2	3	–	3	–	–	–	–	–	–	3	-	2
CO4	3	2	2	–	3	–	–	–	–	–	–	3	-	2
CO5	3	3	3	2	3	2	2	–	2	2	2	3	-	2
AVG	**3**	**2.3**	**2.6**	**2**	**3**	**2**	**2**	**-**	**2**	**2**	**2**	**2.8**	**-**	2

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

24OAI102 OBJECT ORIENTED PROGRAMMING **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To understand Object Oriented Programming concepts and basics of Java programming Language.
- To know the principles of packages, inheritance and interfaces.
- To develop a Java application with threads and generics classes.

UNIT I INTRODUCTION TO OOP AND JAVA **9**

Overview of OOP – Object oriented programming paradigms – Features of Object Oriented Programming – Java Buzzwords – Overview of Java – Data Types, Variables and Arrays – Operators – Control Statements –Programming Structures in Java – Defining classes in Java – Constructors-Methods -Access specifiers - Static members-Java Doc comments

UNIT II INHERITANCE PACKAGES AND INTERFACES **9**

Overloading Methods – Objects as Parameters – Returning Objects –Static, Nested and Inner Classes. Inheritance: Basics–Types of Inheritance –Super keyword –Method Overriding – Dynamic Method Dispatch –Abstract Classes –final with Inheritance. Packages and Interfaces: Packages – Packages and Member Access – Importing Packages – Interfaces.

UNIT III EXCEPTION HANDLING AND MULTI THREADING **9**

Exception Handling basics – Multiple catch Clauses – Nested try Statements – Java's Built-in

Exceptions–User defined Exception. Multithreaded Programming: Java Thread Model–Creating a Thread and Multiple Threads – Priorities – Synchronization – Inter Thread Communication- Suspending –Resuming, and Stopping Threads –Multithreading. Wrappers – Auto boxing.

UNIT IV I/O, GENERICS, STRING HANDLING 9

I/O Basics – Reading and Writing Console I/O – Reading and Writing Files. Generics: Generic Programming – Generic classes – Generic Methods – Bounded Types – Restrictions and Limitations. Strings: Basic String class, methods and String Buffer Class.

UNIT V JAVAFX EVENT HANDLING, CONTROLS AND COMPONENT 9

JAVAFX Events and Controls: Event Basics – Handling Key and Mouse Events. Controls:Checkbox, Toggle Button – Radio Buttons – List View – Combo Box – Choice Box – Text Controls – ScrollPane.Layouts–FlowPane–HBoxandVBox–BorderPane–StackPane–GridPane.Menus – Basics – Menu – Menu bars – Menu Item.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Develop stack and queue data structures using classes and objects.
2. Write a Java program to create an abstract class named Shape that contains two integers and an empty method named printArea(). Provide three classes named Rectangle, Triangle, and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method printArea() that prints the area of the given shape.
3. Solve the above problem using an interface.
4. Implement exception handling and creation of user-defined exceptions.
5. Write a Java program that implements a multi-threaded application that has three threads. First thread generates a random integer every 1 second and if the value is even, the second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of the cube of the number.
6. Write a program to perform file operations.
7. Develop applications to demonstrate the features of generics classes.
8. Implement single, multilevel, and hierarchical inheritance with method overriding.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Apply the concepts of classes and objects to solve simple problems.

CO2: Develop programs using inheritance, packages and interfaces.

CO3: Make use of exception handling mechanisms and multithreaded model to solve real- world problems.

CO4: Build Java applications with I/O packages, string classes, Collections and generics Concepts.

CO5: Integrate the concepts of event handling and JavaFX components and controls for developing GUI-based applications.

TEXT BOOKS

1. Herbert Schildt, "Java: The Complete Reference", 11th Edition, McGraw Hill Education, New Delhi, 2019.

2. Herbert Schildt, "IntroducingJavaFX8Programming",1st Edition, McGrawHill Education, New Delhi, 2015.
3. Design Patterns: Elements of Reusable Object-Oriented Software" by Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides (The Gang of Four).

REFERENCE BOOKS

1. Cay S. Horstmann, "Core Java Fundamentals", Volume 1, 11th Edition, Prentice Hall, 2018.
2. Head First Object-Oriented Analysis and Design" by Brett McLaughlin, Gary Pollice, and David West.
3. Object-Oriented Software Construction" by Bertrand Meyer.
4. Python 3 Object-Oriented Programming" by Dusty Phillips.
5. C++: "Object-Oriented Programming in C++" by Robert Lafore.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
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CO2	3	2	3	-	2	-	-	-	1	-	-	-	-	2
CO3	3	2	-	2	3	-	-	-	-	-	2	-	-	2
CO4	3	2	2	-	3	-	-	-	-	-	-	-	-	2
CO5	2	-	3	-	3	-	-	-	-	2	2	-	-	2
AVG	**2.8**	**2**	**2.5**	**2**	**2.4**	-	-	-	**1**	**2**	**2**	**2**	-	2

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

24OAI103 COMPUTATIONAL DATA ANALYTICS **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To understand the concepts of ADTs.
- To learn linear data structures – lists, stacks, and queues.
- To understand non-linear data structures – trees and graphs.

UNIT I LISTS **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 ADT – Radix Sort – Multi lists.

UNIT II STACKS AND QUEUES **9**

Stack ADT – Operations – Applications – Balancing Symbols – Evaluating arithmetic expressions- Infix to Postfix conversion–Function Calls–Queue ADT–Operations–Circular Queue–DeQueue – Applications of Queues.

UNIT III TREES **9**

Tree ADT–Tree Traversals –Binary Tree ADT–Expression trees–Binary Search Tree ADT–AVL Trees –Priority Queue (Heaps) – Binary Heap.

UNIT IV MULTI WAY SEARCH TREES AND GRAPHS **9**

B-Tree –B+Tree – Graph Definition – Representation of Graphs – Types of Graph - Breadth-first traversal –Depth-first traversal — Bi-connectivity – Euler circuits –Topological Sort – Dijkstra's algorithm – Minimum Spanning Tree –Prim's algorithm –Kruskal's algorithm

UNIT V SEARCHING, SORTING AND HASHING TECHNIQUES **9**

Searching –Linear Search –Binary Search. Sorting –Bubble sort –Selection sort –Insertion sort – Shell sort –. Merge Sort – Hashing –Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Array implementation of Stack, Queue and Circular Queue ADTs.
2. Implementation of Singly Linked List.
3. Linked list implementation of Stack and Linear Queue ADTs.
4. Implementation of Polynomial Manipulation using Linked list.
5. Implementation of Binary Search Trees.
6. Implementation of AVL Trees.
7. Implementation of Heaps using Priority Queues.
8. A Real-world case study using LSB (Least Significant Bit) steganography in data analytics.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Define linear and non-linear data structures.

CO2: Implement linear and non–linear data structure operations.

CO3: Use appropriate linear/non–linear data structure operations for solving a given problem.

CO4: Apply appropriate graph algorithms for graph applications.

CO5: Analyze the various searching and sorting algorithms.

TEXT BOOKS

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition,Pearson Education, 2005.
2. Kamthane, Introduction to Data Structures in C, 1st Edition, Pearson Education, 2007.

3. Data Science and Predictive Analytics: Biomedical and Health Applications using R (2nd Edition) by Ivo D. Dinov.

REFERENCE BOOKS

1. Langsam, Augenstein and Tanenbaum, Data Structures Using C and C++, 2nd Edition, Pearson Education, 2015.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, 4th Edition, McGraw Hill / MIT Press, 2022.
3. Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft, Data Structures and Algorithms, 1st Edition, Pearson, 2002.
4. Kruse, Data Structures and Program Design in C, 2nd Edition, Pearson Education, 2006.
5. Advanced Data Science and Analytics with Python by Jesús Rogel-Salazar.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	-	-	1	-	-	-	-	-	-	2	-	2
CO2	3	3	2	-	2	-	-	-	-	-	-	-	-	2
CO3	3	3	3	-	3	-	-	-	1	-	1	-	-	2
CO4	2	3	2	3	2	-	-	-	-	-	1	-	-	2
CO5	3	2	2	-	3	-	-	-	-	-	-	1	-	2
AVG	**2.8**	**2.6**	**2.3**	**3**	**2.2**	-	-	-	**1**	-	**1**	**1.5**	-	2

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

24OAI104 NETWORKING CONCEPTS **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To understand the concept of layering in networks.
- To know the functions of protocols of each layer of the TCP/IP protocol suite.
- To visualize the end-to-end flow of information.

UNIT I INTRODUCTION AND APPLICATION LAYER **10**

Data Communication – Networks – Network Types – Protocol Layering – TCP/IP Protocol Suite – OSI Model – Introduction to Sockets – Application Layer Protocols: HTTP, FTP, Email Protocols (SMTP, POP3, IMAP, MIME) – DNS – SNMP

UNIT II TRANSPORT LAYER **9**

Introduction – Transport Layer Protocols: UDP, TCP – Connection Management – Flow Control – Congestion Control – Congestion Avoidance (DECbit, RED) – SCTP – Quality of Service

UNIT III NETWORK LAYER **7**

Switching: Packet Switching – Internet Protocol – IPv4 – IP Addressing – Subnetting – IPv6 – ARP, RARP, ICMP, DHCP.

UNIT IV ROUTING **7**

Routing and Protocols: Unicast Routing – Distance Vector Routing – RIP – Link State Routing – OSPF – Path Vector Routing – BGP – Multicast Routing: DVMRP, PIM

UNIT V DATA LINK AND PHYSICAL LAYERS **12**

Data Link Layer – Framing – Flow Control – Error Control – Data Link Layer Protocols: HDLC, PPP – Media Access Control – Ethernet Basics – CSMA/CD – Virtual LAN – Wireless LAN (802.11) Physical Layer: Data and Signals – Performance – Transmission Media – Switching – Circuit Switching.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Learn to use commands like TCP dump, net stat, if config, ns lookup, and traceroute. Capture ping and trace route PDUs using a network protocol analyzer and examine.
2. Write a HTTP web client program to download a webpage using TCP sockets.
3. Applications using TCP sockets like a) Echo client and echo server b) Chat.
4. Simulation of DNS using UDP sockets
5. Use a tool like Wireshark to capture packets and examine the packets.
6. Write code simulating ARP/RARP protocols
7. Study of Network Simulator (NS) and simulation of congestion control algorithms using NS.
8. Study of TCP/UDP performance using a simulation tool

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Explain the basic layers and their functions in computer networks.

CO2: Explore the basics of how data flows from one node to another.

CO3: Analyze routing algorithms.

CO4: Describe protocols for various functions in the network.

CO5: Analyze the working of various application layer protocols.

TEXT BOOKS

1. James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach Featuring the Internet, Eighth Edition, Pearson Education, 2021.
2. Behrouz A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, Sixth Edition, TMH, 2022.
3. Andrew S. Tanenbaum & David J. Wetherall, Computer Networks.

REFERENCE BOOKS

1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.
2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013.
3. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
4. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, Computer Networks: An Open Source Approach, McGraw Hill, 2012.
5. William Stallings, Network Security Essentials: Applications and Standards.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	-	-	1	-	-	-	-	-	-	2	-	2
CO2	3	3	-	2	2	-	-	-	-	-	1	-	-	2
CO3	3	2	2	2	1	-	-	-	-	-	1	-	-	2
CO4	2	1	-	-	2	-	-	-	-	-	-	-	-	2
CO5	2	2	2	-	3	-	-	-	1	2	2	1	-	2
AVG	**2.6**	**2**	**2**	**2**	**1.8**	**-**	**-**	**-**	**1**	**2**	**1.3**	**1.5**	**-**	2

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

24OMI101 INTERNAL COMBUSTION ENGINES **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To impart the basic fundamental knowledge on IC engines and its working along with some of the recent trends in IC engine.
- To impart knowledge on cooling and lubrication.
- To study the modern engine technologies.

UNIT I INTRODUCTION IC ENGINES **9**

Introduction, Types of IC engines, Constructional details IC engine, working, principles – 2 & 4 stroke engines, Cycles – Air standard cycles, Fuel air cycles and actual cycles, Actual Indicator diagram for four stroke and two stroke engines, General fuel properties, ignition properties – octane and cetane rating, Materials for engine components.

UNIT II PETROL ENGINES **9**

Working and constructional details of petrol engines, Carburetor – constructional and working, types of carburetors, additional features in modern carburetor, A/F ratio calculation, Petrol Injection - introduction, Ignition – introduction and requirements, Battery and magneto coil ignition system, Electronic ignition system, Stages of combustion in petrol engines, Combustion chambers for petrol engine, formation of knock in petrol engine.

UNIT III DIESEL ENGINES **9**

Working and constructional details of diesel engines, fuel injection – requirements, types of

injection systems – inline, distributor pumps, unit injector, Mechanical and pneumatic governors. Fuel injector, Types of injection nozzles, Spray characteristics. Injection timing, Split and multiple injection, Stages of combustion in Diesel engines, direct and indirect combustion chambers for diesel engine, knocking in diesel engine, Introduction on supercharging and turbocharging.

UNIT IV COOLING AND LUBRICATION 9

Requirements, Types- Air cooling and liquid cooling systems, forced circulation cooling system, pressure and Evaporative cooling systems, properties of coolants for IC engine. Need of lubrication, Lubricants for IC engines - Properties of lubricants, Types of lubrication – Mist, Wet and dry sump lubrication systems.

UNIT V MODERN TECHNOLOGIES IN IC ENGINES 9

HCCI Engines – construction and working, CRDi injection system, GDI Technology, E - Turbocharger, Variable compression ratio engines, variable valve timing technology, Fuel cell, Hybrid Electric Technology.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Valve Timing Diagram of a Four-Stroke Engine.
2. Port Timing Diagram of a Two-Stroke Engine.
3. Actual Pressure-Volume (P–V) Diagrams of Internal Combustion Engines.
4. Performance Test on a Four-Stroke Diesel Engine.
5. Heat Balance Test on a Four-Stroke Diesel Engine.
6. Morse Test on a Multi-Cylinder Petrol Engine.
7. Retardation Test on a Diesel Engine.
8. Viscosity Measurement Using a Redwood Viscometer.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Analyze air standard cycles, engine components.
CO2: Explain SI engine fundamentals.
CO3: Express concept of CI engines.
CO4: Explain the purpose of cooling and lubrication.
CO5: Remember the recent trends in IC engines.

TEXT BOOKS

1. Ganesan.V., Internal Combustion Engines, Tata McGraw Hill Publishing Co., New York,1994.
2. Ramalingam. K. K., Internal Combustion Engines, Scitech publications, Chennai, 200352 Internal Combustion Engines.
3. John B.Heywood, “IC Engines fundamentals”, 2nd Edition, New York: McGraw-Hill, 2018.

REFERENCE BOOKS

1. Gupta H.N, "Fundamentals of Internal Combustion Engines", 2nd Edition Prentice Hall of India, 2013.
2. R.B. Mathur and R.P. Sharma, Internal Combustion Engines., Dhanpat Rai & Sons 2007.
3. Duffy Smith, Auto Fuel Systems, The Good Heart Willcox Company, Inc., 1987.
4. Rajput. R. K., "Internal Combustion Engines" Laxmi Publications, 2017.
5. Eric Chowenitz, Automobile Electronics, SAE Publications, 1995.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	-	2
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	2
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	2
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	2
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	2
AVG	3	2.8	2.8	-	-	-	-	-	-	-	-	-	-	2

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

24OMI102 TESTING OF ENGINEERING MATERIALS **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To gain and understanding of the response of various metals under the application of stress and temperature.
- To build necessary theoretical back ground of the role of lattice defects in governing both elastic and plastic properties of metals will be discussed.
- Obtain a working knowledge of various hardness testing machines BHN, VHN, RHN.

UNIT I INTRODUCTION **9**

Introduction, Importance of testing Hardness Test: Methods of hardness testing – Brinell, Vickers, Rockwell hardness tests. The Impact Test: Notched bar impact test and its significance, Charpy and Izod Tests, fracture toughness testing - COD and CTOD tests, significance of transition temperature curve.

UNIT II TENSILE TESTING **9**

Engineering stress-strain and True stress-strain curves. Tensile properties, conditions for necking. Stress-Strain diagrams for steel, Aluminum and cast iron.

UNIT III FATIGUE TESTING **9**

Introduction, Stress cycles, S-N Curve, Effect of mean stress, Mechanism of fatigue failure, Effect of stress concentration, size, surface condition and environments on fatigue.

UNIT IV CREEP AND STRESS RUPTURE **9**

Introduction, The creep curve, Stress-rupture test, Structural changes during creep, Mechanism of creep deformation, theories of creep. Fracture at elevated temperature.

UNIT V NON DESTRUCTIVE TESTING **9**

Principle, Operation, Advantages and Limitations of Liquid Penetrant, Magnetic Particle, Radiography and Ultrasonic tests.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Tension test on mild steel rod.
2. Torsion test on mild steel rod.
3. Hardness test on metal beam (Rockwell and Brinell Hardness Tests).
4. Compression test on helical spring.
5. Deflection test on carriage spring.
6. Impact Testing on mild steel rod.
7. Deflection of a cantilever wooden and steel beam.
8. Determine the deflection of a simply supported wooden and steel beam

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Classify mechanical testing of ferrous and non-ferrous metals and alloys.

CO2: Recognize the importance of crystal defects including dislocations in plastic deformation.

CO3: Solve the 2D vector variable problems using Finite Element technique.

CO4: Identify the testing methods for obtaining strength and hardness.

CO5: Examine the mechanisms of materials failure through fatigue and creep.

TEXT BOOKS

1. Mechanical Metallurgy – G. E. Dieter, Third edition, published by New York Mc GrawHill,1986.
2. J. Wulff,".Mechanical behavior", John Wiley & Sons Inc; Trans-ed edition.
3. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.

REFERENCE BOOKS

1. Mechanical Metallurgy – White & Lemay.
2. Testing of Metallic Materials - A.V.K. Suryanarayana
3. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9th Edition, American Society for Metals, 1978.
4. Brandon D.G., "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA, 1986.
5. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	-	2	-	-	-	-	-	-	-	-	-	2
CO2	3	3	-	2	-	-	-	-	-	-	-	-	-	2
CO3	3	3	-	2	-	-	-	-	-	-	-	-	-	2
CO4	3	3	-	2	-	-	-	-	-	-	-	-	-	2
CO5	3	3	-	2	-	-	-	-	-	-	-	-	-	2
AVG	3	3	-	2	-	-	-	-	-	-	-	-	-	2

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

24OMI103 INDUSTRIAL LAYOUT DESIGN AND SAFETY **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To introduce the industrial layout design principles, process and material flow analysis and product and equipment analysis.
- To impart knowledge layout design and algorithms.
- To study the safety planning and management.

UNIT I INTRODUCTION **9**

Industrial Facility Layout: Definition, Types of Layout Problems, Engineering Design Problem Approach – Product Analysis, Equipment Selection, Personnel Requirement Analysis, Space Requirement and Availability – Process and Material Flow Analysis, Data Requirement for Layout Decisions, Tools for Presenting Layout Designs.

UNIT II FACILITIES LAYOUT DESIGN & ALGORITHMS **9**

Traditional Approaches to Facility Layout, Systematic Layout Planning, Special Considerations in Office Layout, Engineering Design Problem Approach, Code Compliance, OSHA, ADA Regulations, and Other Considerations in Facility Design – Algorithms for the Layout Problem, Construction Algorithms, Improvement Algorithms, Hybrid Algorithms, Layout Software (CRAFT, BLOCPLAN, PFAST, Layout-iQ, VIP- PLANOPT, Factory CAD, Factory FLOW, Plant Simulation).

UNIT III FACILITIES LAYOUT PROBLEM MODELS & ALGORITHMS **9**

Models for the Layout Problem, Generic Modeling Tools, Models for the Single-Row Layout Problem, Models for the Multi row Layout Problem with Departments of Equal and Unequal Area – Material Handling, Principles, Types, Models for Material- Handling System Design – Storage and Warehousing, Warehouse Functions, Warehouse Design and Operation.

UNIT IV SAFETY PLANNING & MANAGEMENT **9**

Introduction: Elements of Safety Programming, Safety Management. Upgrading Safety Developmental Programs: Safety Procedures, Arrangements and Performance Measures, Education, Training and Development in Safety. Safety Performance: An Overview of an Accident, Occupational Health and Industrial Hygiene. Understanding the Risks: Prevention of Accidents Involving Hazardous Substances. Indian Factories Act 1948 for Health and Safety.

UNIT V APPROACHES IN SAFETY MANAGEMENT **9**

Safeguarding against Common Potential Hazards: Trips, Slips and Falls, Preventing Electrocution, Static Electricity, Hazardous Energy Control. Specific Hazard Control Measures: Forklift Hazard Control, Tractor Hazard Control. Safe Handling and Storage: Material Handling, Compressed Gas Cylinders, Corrosive Substances, Hydrocarbons, Waste Drums and Containers.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Simulation of Manufacturing Shop
2. Simulation of Batch Production System
3. Simulation of Multi Machine Assignment System
4. Simulation of Manufacturing and Material Handling Systems
5. Simulation of a Shop Floor
6. Simulation of Material Handling Systems
7. Write an algorithm for plant layout
8. Write an algorithm for storage and warehouse.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Explain the industrial facility layout design principles, process and material flow analysis and product and equipment analysis.

CO2: Discuss the facilities layout design algorithms and selecting appropriate software.

CO3: Describe the facilities layout problem modeling tools and algorithms for production, warehouse and material handling.

CO4: Explain the safety planning and management principles in industries.

CO5: Illustrate the various safety management approaches in industries.

TEXT BOOKS

1. Sunderesh S. Heragu, “Facilities Design”, 3rd Edition, CRC Press Taylor & Francis Group, 2008.
2. L. M. Deshmukh, “Industrial Safety Management: Hazard Identification and Risk Control”, Tata McGraw-Hill Publishing Co. Ltd., 2005.
3. Eric Teicholz, “Facility Design and Management Handbook”, Tata McGraw-Hill Publishing Co. Ltd., 2001.

REFERENCE BOOKS

1. James A. Tompkins, John A. White, Yavuz A. Bozer, and J. M. A. Tanchoco, “Facilities Planning”, 4th Edition, John Wiley & Sons, 2010.
2. Matthew P. Stevens and Fred E. Meyers, “Manufacturing Facilities Design and Material Handling”, 5th Edition, Purdue University Press, 2013.
3. Charles D.Reese, Occupational Health and Safety Management: A Practical Approach, CRC Press, 2003.

4. J Maiti, Pradip Kumar Ray, Industrial Safety Management: 21st Century Perspectives of Asia, Springer, 2017.
5. Industrial Hazard and Safety Handbook: (Revised impressionby Ralph W King and John Magid 24 September 2013.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	-	-	-	-	-	-	-	-	-	-	-	2
CO2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	2
CO4	3	3	3	2	-	-	-	-	-	-	-	-	-	2
CO5	3	3	3	2	-	-	-	-	-	-	-	-	-	2
AVG	2.6	2.4	2.67	2	-	-	-	-	-	-	-	-	-	2

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

24OMI104 PRODUCT DESIGN AND PROCESS DEVELOPMENT **L T P C**
3 0 2 4

COURSE OBJECTIVES

- Applying the principles of generic development process; and understanding the organization structure for new product design and development.
- Identifying opportunity and planning for new product design and development.
- Conducting customer need analysis; and setting product specification for new product design and development.

UNIT I INTRODUCTION **9**

Introduction – Characteristics of Successful Product Development – People involved in Product Design and Development - Duration and Cost of Product Development - The Challenges of Product Development - The Product Development Process - Concept Development: The Front- End Process - Adapting the Generic Product Development Process - Product Development Process Flows - Product Development Organizations.

UNIT II OPPORTUNITY DENTIFICATION & PRODUCT PLANNING **9**

Opportunity Identification: Definition - Types of Opportunities - Tournament Structure of Opportunity Identification - Effective Opportunity Tournaments – Opportunity densification Process - Product Planning: Four Types of Product Development Projects – The Process of Product Planning.

UNIT III IDENTIFYING CUSTOMER NEEDS & PRODUCT SPECIFICATIONS **9**

Identifying Customer Needs: The Importance of Latent Needs - The Process of Identifying Customer Needs. Product Specifications: Definition - Time of Specifications Establishment - Establishing Target Specifications - Setting the Final Specifications.

UNIT IV CONCEPT GENERATION & SELECTION **9**

Concept Generation: Activity of Concept Generation - Structured Approach - Five step method of Concept Generation. Concept Selection: Methodology - Concept Screening and Concepts Scoring.

UNIT V CONCEPT TESTING & PROTOTYPING **9**

Concept Testing: Seven Step activities of concept testing. Prototyping – Principles of Prototyping – Prototyping Technologies – Planning for Prototypes

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Identifying the customer needs for a selected product.
2. Plan for the Design Process.
3. Develop Engineering Specification.
4. Generate a concept for a product.
5. Develop a clay model for a new product.
6. Perform a design calculation.
7. Fabricate a prototype model of the new product as per the design.
8. Perform economic analysis for the new product.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Apply the principles of generic development process; and understand the organization structure for new p1roduct design and development.

CO2: Identify opportunity and plan for new product design and development.

CO3: Conduct customer need analysis; and set product specification for new product design and development.

CO4: Generate, select, and screen the concepts for new product design and development.

CO5: Test and prototype the concepts to design and develop new products.

TEXT BOOKS

1. Ulrich K.T., Eppinger S. D. and Anita Goyal, "Product Design and Development" McGraw-Hill Education; 7th edition, 2020.
2. Fabio Giudice, Guido La Rosa, Product Design for the environment-A life cycle approach, Taylor & Francis 2006
3. Saaksvuori Antti, ImmonenAnselmie, product Life Cycle Management Springer, Dreamtech, 3-540-25731-4.

REFERENCE BOOKS

1. Belz A., 36-Hour Course: "Product Development" McGraw-Hill, 2010.
2. Rosenthal S., "Effective Product Design and Development", Business One Orwin, Home Wood, 1992.
3. Stuart Pugh., "Total Design –Integrated Methods for Successful Product Engineering" Addison Wesley Publishing, 1991, ISBN 0-202-41639-5.

4. Chitale, A. K. and Gupta, R. C., Product Design and Manufacturing, PHI Learning, 2013.
5. Jamnia, A., Introduction to Product Design and Development for Engineers, CRC Press 2018.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	-	2
CO2	2	-	2	-	-	-	-	-	-	-	-	-	-	2
CO3	-	-	2	-	-	-	-	-	-	-	-	-	-	2
CO4	2	2	2	-	-	-	-	-	-	-	-	-	-	2
CO5	-	-	2	-	-	-	-	-	-	-	-	-	-	2
AVG	2.33	2	2	-	-	-	-	-	-	-	-	-	-	2

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

24OBI101 DIGITAL SIGNAL PROCESSING **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To introduce the concepts of discrete time random signal processing.
- To introduce about multirate signal processing and its applications.
- To understand the spectrum estimation techniques.

UNIT I MULTIRATE SIGNAL PROCESSING **9**

Review of Convolution, DFT and ZT, Multirate Signal Processing - Decimation, Interpolation, Sampling Rate Conversion by a rational factor – digital filter banks, sub band coding, Quadrature Mirror Filter.

UNIT II DISCRETE TIME RANDOM PROCESSES **9**

Stationary random processes, Autocorrelation, Rational Power Spectra, Filters for generating random Processes from white noise and inverse filter – AR, MA and ARMA processes – relationship between autocorrelation and the filter parameters.

UNIT III LINEAR PREDICTION AND FILTERING **9**

Linear Prediction – Forward and Backward - Wiener filters for filtering and prediction – FIR Wiener Filter – IIR Wiener Filter – Kalman Filter.

UNIT IV ADAPTIVE FILTERING **9**

IR adaptive filters – adaptive filters based on steepest descent method – LMS algorithm – Variants of LMS algorithm – adaptive echo cancellation – adaptive channel equalization – RLS Algorithm.

UNIT V SPECTRUM ESTIMATION **9**

Estimation of power spectra from finite duration observations of signals – Non parametric methods of spectrum estimation – the Bartlett and the Welch method – Parametric spectrum estimation – AR MA and ARMA.

TOTAL:45 PERIODS

LIST OF EXPERIMENTS

1. Study of autocorrelation and Cross Correlation of random signals.
2. Design and Implementation of Multirate Systems.
3. Design and Implementation of Wiener Filter.
4. Design and Implementation of FIR Linear Predictor.
5. Design of adaptive filters using LMS algorithm.
6. Spectrum Estimation using Bartlett and Welch Methods.
7. Design and Implementation of IIR .
8. Design of adaptive filters using RLS algorithm.

TOTAL:30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Comprehend multirate signal processing and demonstrate its applications.

CO2: Demonstrate an understanding of the power spectral density and apply to discrete random signals and systems.

CO3: Apply linear prediction and filtering techniques to discrete random signals for signal detection and estimation.

CO4: Analyze adaptive filtering problems and demonstrate its application.

CO5: Apply power spectrum estimation techniques to random signals.

TEXT BOOKS

1. John G. Proakis & Dimitris G.Manolakis, ―Digital Signal Processing – Principles, Algorithms & Applications, Fourth Edition, Pearson Education / Prentice Hall, 2007.
2. P. Vaidyanathan, "Multirate systems and filter banks", Prentice Hall Inc. 1993.
3. A. V. Oppenheim, R.W. Schafer and J.R. Buck, ―Discrete-Time Signal Processing", 8th Indian Reprint, Pearson, 2004.

REFERENCE BOOKS

1. Monson H. Hayes, "Statistical digital signal processing and modeling", John Wiley and Sons Inc. New York, Indian reprint 2008.
2. Haykin, Adaptive Filter Theory, 4th Edition, Pearson Education, New Delhi, 2006.
3. Sophoncles J. Orfanidis, "Optimum Signal Processing ", McGraw Hill, 2000.
4. Emmanuel C. Ifeachor& Barrie. W. Jervis, "Digital Signal Processing", Second Edition, Pearson Education / Prentice Hall, 2002.
5. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata Mc Graw Hill, 2007.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	-	-	-	-	-	-	-	-	-	-	-	2
CO2	2	3	-	-	-	-	-	-	-	-	-	-	-	2
CO3	2	3	-	-	-	-	-	-	-	-	-	-	-	2
CO4	2	3	-	-	-	-	-	-	-	-	-	-	-	2
CO5	2	3	-	-	-	-	-	-	-	-	-	-	-	2
AVG	2	3	-	-	-	-	-	-	-	-	-	-	-	2

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

24OBI102 IOT AND SENSORS TYPES **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To understand the fundamental concepts related to IoT and sensors types.
- To understand basics of an IOT System, IoT hardware and communication protocols, data storage, data analysis and use them for real time IoT enabled domains.
- To become familiar with sensor types and its functions.

UNIT I INTRODUCTION TO IOT AND IOT LEVELS **9**

Functional blocks of an IoT system (Sensors, Data Ingress, Data Aggregation Point Communication point back to the cloud, Analysis, Decision making, Actuation) Basic of Physical and logical design of IoT (IoT protocols, communication models) IoT enabled domains (Home automation, Smart cities, environment monitoring, renewable energy, agriculture, industry, healthcare, marketing and management) M2M, Difference between IoT, Embedded Systems and M2M, Industry 4.0 concepts.

UNIT II IOT SENSORS AND HARDWARE **9**

Passive and active sensors, differences, Different kinds of sensors (Temperature, humidity, pressure, obstacle, water flow, accelerometer, colour, gyro, load cell, finger print, motion, ultrasonic distance, magnetic vibration, eye blink, hear beat, PPG, glucose, body position, blood pressure), Multi-sensors, Pre-processing (sampling, filtering, ADC, size of data, local memory, compression), IoT front end hardware (Raspberry Pi, Arduino, Galileo, beagle bone equivalent platforms).

UNIT III INTRODUCTION TO IOT PROTOCOLS **9**

Infrastructure (6LowPAN, IPv4/IPv6, RPL), Identification (EPC, uCode, IPv6, URIs), Communication/ Transport (Wi-Fi, Bluetooth, ZigBee, LPWAN), Data Protocols (MQTT, CoAP, AMQP, Websocket, Node).

UNIT IV IOT CLOUD AND DATA ANALYTICS **9**

Collecting data from sensors,Data Ingress, Cloud storage, IoT cloud platforms (Amazon AWS, Microsoft Azure, Google APIs), Data analytics for IoT, Software and management tool for IoT, Dashboard design.

UNIT V IOT ARCHITECTURES WITH CASE STUDIES **9**

Business models for IoT, smart cities, agriculture, healthcare, industry. Case studies/Mini projects for the real time IoT applications.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Introduction to Arduino platform and programming .
2. Explore different communication methods with IoT devices (Zigbee, GSM, Bluetooth) .
3. Introduction to Raspberry PI platform and python programming.
4. Interfacing sensors with Raspberry PI .
5. Communicate between Arduino and Raspberry PI using any wireless medium.
6. Setup a cloud platform to log the data.
7. Log Data using Raspberry PI and upload to the cloud platform.
8. Design an IOT based system.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Enumerate basic premise of an IOT System.

CO2: Implement basic and to be familiar with the sensors available for IoT applications.

CO3: Learn the front-end hardware platforms and communication protocols for IoT.

CO4: Explain cloud storage, data analysis and management.

CO5: Design and develop the usage for real time IoT enabled domains.

TEXT BOOKS

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015.
2. Mayur Ramgir, Internet – of – Things, Architecture, Implementation and Security, First Edition, Pearson Education, 2020.
3. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, CISCO Press, 2017.

REFERENCE BOOKS

1. Raj kamal, Internet of Things, Architecture and Design Principles, McGraw-Hill, 2017.
2. Manoel Carlos Ramon, “Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for Linux Programmers”, Apress, 2014.H.Gerez, “Algorithms for VLSI Design Automation”, John Wiley, 1999.
3. Marco Schwartz, “Internet of Things with the Arduino Yun”, Packt Publishing, 2014.
4. Perry Lea, “Internet of things for architects”, Packt, 2018.
5. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	2
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	2
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	2
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	2
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	2
AVG	**3**	**3**	**3**	-	-	-	-	-	-	-	-	-	-	2

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

24OBI103 MEDICAL DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS L T P C
3 0 2 4

COURSE OBJECTIVES

- To understand the working of the devices for measurement of parameters related to ECG, EEG and EMG.
- To explain diagnostic and therapeutic devices related to respiratory parameters.
- To understand the various sensory measurements that hold clinical importance.

UNIT I CARDIAC EQUIPMENT 9

Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor- Holter Monitor, Phonocardiography, Cardiac Pacemaker-Internal and External Pacemaker, AC and DC Defibrillator- Internal and External.

UNIT II NEUROLOGICALEQUIPMENT 9

Clinical significance of EEG, Multi-channel EEG recording system, Evoked Potential– Visual, Auditory and Somatosensory, MEG (Magneto Encephalo Graph), EEG Bio Feedback Instrumentation.

UNIT III MUSCULAR AND BIOMECHANICAL EQUIPMENT 9

Clinical significance of EEG, Multi-channel EEG recording system, Evoked Potential– Visual, Auditory and Somatosensory, MEG (Magneto Encephalo Graph), EEG Bio Feedback Instrumentation.

UNIT IV RESPIRATORY MEASUREMENT AND ASSIST SYSTEM 9

Instrumentation for measuring the mechanics of breathing – Spiro meter, Lung Volume and vital capacity, measurements of residual volume, Pneumotacho meter, Whole body Plethysmo graph, Apnoea Monitor.

UNIT V SENSORY DIAGNOSTIC EQUIPMENT 9

Psycho physiological Measurements – polygraph, basal skin resistance (BSR), galvanic skin resistance (GSR), Sensory responses - Audiometer-Pure tone, Speech, Eye Tonometer, auto refractometer.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Measurement of visually and auditory evoked potential.
2. Galvanic skin resistance (GSR) measurement.
3. Measurement of output intensity from short wave and ultra sonic diathermy.
4. Electrical safety measurements.
5. Measurement of stimulation current wave forms used in medical stimulator.
6. Recording of Audiogram.
7. Study the working of Defibrillator and pacemakers.
8. Study of ECG, EEG and EMG electrodes.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Describe the working and recording setup of all basic cardiac equipment.
CO2: Utilise the working and recording of all basic neurological equipment's.
CO3: Discuss the recording of diagnostic and therapeutic equipment's related to EMG.
CO4: Explain about measurements of parameters related to respiratory system.
CO5: Describe the measurement techniques of sensory responses

TEXT BOOKS

1. John G.Webster," Medical Instrumentation Application and Design",4th edition, Wiley India Pvt Ltd, New Delhi, 2015.
2. Joseph J. Carrand John M. Brown," Introduction to Biomedical Equipment Technology", Pearson education, 2012.
3. Khandpur. R.S., "Handbook of Biomedical Instrumentation". Second Edition. Tata Mc- Graw Hill Pub. Co.,Ltd. 2003.

REFERENCE BOOKS

1. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", 3rd Edition, 2008.
2. Khandpur. R.S., "Handbook of Biomedical Instrumentation". Second Edition. Tata Mc Graw Hill Pub. Co., Ltd. 2003.
3. Antony Y. K. Chan, "Biomedical Device Technology, Principles and design", Charles Thomas Publisher Ltd, Illinois, USA, 2008.
4. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Pearson Education, New Delhi, 2007.
5. Shakti Chatterjee, Aubert Miller, "Bio medical Instrumentation Systems" 2010 1st edition, Delmar Cencage Learning, Clifton Park, New York.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1	-	1	-	-	-	-	-	-	1	-	2
CO2	3	2	1	-	1	-	-	-	-	-	-	1	-	2
CO3	3	2	1	-	1	-	-	-	-	-	-	1	-	2
CO4	3	2	1	-	1	-	-	-	-	-	-	1	-	2
CO5	3	2	1	-	1	-	-	-	-	-	-	1	-	2
AVG	**3**	**2**	**1**	-	**1**	-	-	-	-	-	-	**1**	-	2

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

24OBI104 BIOMEDICAL INSTRUMENT AND DESIGN **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To understand the origin of various biological signals and electrode configurations specific to bio-potential measurements.
- To understand the characteristics of Bio signals and the design of bio amplifiers.
- To explain the different techniques used for measurement of non-electrical bio-parameters.

UNIT I ELECTRODE CONFIGURATIONS **9**

Bio signals characteristics – Origin of bio potential and its propagation, Frequency and amplitude ranges, Electrode configurations: Electrode-electrolyte interface, electrode–skin interface impedance, Unipolar and bipolar configuration, classification of electrodes.

UNIT II BIO SIGNAL CHARACTERISTICS **9**

Bio signals characteristics – ECG-frequency and amplitude ranges, Einthoven's triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. EMG - Electrode configuration -unipolar and bipolar mode.

UNIT III BIO AMPLIFIERS **9**

Infrastructure (6LowPAN, IPv4/IPv6, RPL), Identification (EPC, uCode, IPv6, URIs), Communication/ Transport (Wi-Fi, Bluetooth, ZigBee, LPWAN), Data Protocols (MQTT, CoAP, AMQP, Websocket, Node).

UNIT IV MEASUREMENT OF BIO SIGNALS **9**

Temperature, respiration rate and pulse rate measurements. Blood Pressure - indirect methods and direct methods, Blood flow and cardiac output measurement- Indicator dilution and thermal dilution , Electromagnetic and ultrasound blood flow measurements.

UNIT V BIO CHEMICAL MEASUREMENTS **9**

Biochemical sensors - pH, pO2 and pCO2, Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Design of ECG Amplifiers.
2. Design of EMG amplifier.
3. Design of frontal EEG amplifier.
4. Design a Multiplexer and Demultiplexer for any two bio signals.
5. Measurement of body Temperature.
6. Measurement of pulse-rate using Photo transducer.
7. Measurement of pH and conductivity.
8. Measurement of blood pressure using sphygmomanometer.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Illustrate the origin of various biological signals and their characteristics.

CO2: Gain knowledge on characteristics of bio signals.

CO3: Gain knowledge on various amplifiers involved in monitoring and transmission of bio signals.

CO4: Explain the different measurement techniques for non-electrical bio-parameters.

CO5: Explain the biochemical measurement techniques as applicable for diagnosis and further treatment.

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 Mc Graw 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. Carrand John M.Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.
3. L. A. Geddas and L. E. Baker, "Principles of Applied Biomedical Instrumentation",2004.
4. John G. Webster, "Bioinstrumentation", John Willey and sons, New York, 2004.
5. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design", McGraw-Hill Publisher, 2003.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1	1	-	-	-	-	-	-	-	-	-	2
CO2	3	2	1	1	-	-	-	-	-	-	-	-	-	2
CO3	3	2	1	1	-	-	-	-	-	-	-	-	-	2
CO4	3	2	1	2	-	-	-	-	-	-	1	-	-	2
CO5	3	2	1	1	-	-	-	-	-	-	1	-	-	2
AVG	**3**	**2**	**1**	**1.2**	**-**	**-**	**-**	**-**	**-**	**-**	**0.4**	**-**	**-**	2

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

24OCT201 BUILDING PLANNING AND APPROVAL **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the principles of building planning, including utility, economy, aesthetics, and circulation.
- To learn the process of site selection, building orientation, and compliance with legal building regulations.
- To explore sustainable building concepts and smart technologies integrated into modern planning practices.

UNIT I FUNDAMENTALS OF BUILDING PLANNING **9**

Covers basic principles of building planning such as utility, economy, aesthetics, and circulation. Introduces types of buildings, their classification, and key components like walls, doors, windows, and stairs.

UNIT II SITE SELECTION AND ORIENTATION **9**

Explains factors affecting site selection including topography, soil, climate, and access. Emphasizes proper building orientation based on sun path, wind direction, and site features for energy efficiency and comfort.

UNIT III BUILDING RULES AND DEVELOPMENT CONTROL **9**

Introduces building byelaws and development regulations including FAR, setbacks, height limits, and open spaces. Discusses provisions of the National Building Code (NBC) and local municipal norms.

UNIT IV BUILDING APPROVAL PROCESS AND DOCUMENTATION **9**

Covers the step-by-step procedure for obtaining building permissions. Includes preparation of site plans, working drawings, and required documents. Introduces online approval systems and key authorities.

UNIT V SUSTAINABLE AND SMART BUILDING CONCEPTS **9**

Highlights eco-friendly planning and green building features. Discusses energy-efficient design, rainwater harvesting, and green certifications (GRIHA, IGBC, LEED). Introduces smart building technologies.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On Successful completion of this course, the student will able to

CO1: Use planning principles to design practical buildings.

CO2: Follow building rules and codes.

CO3: Choose the right site for building.

CO4: Prepare the required documents for approval.

CO5: Apply green and smart technologies in building designs.

TEXT BOOKS

1. Bindra, S. P., & Arora, S. P. Building construction: Planning techniques and methods. Dhanpat Rai Publishing Company, 2013.
2. Shah, M. G., Kale, C. M., & Patki, S. Y. Building drawing. Tata McGraw-Hill Education, 2010.
3. Bureau of Indian Standards. National building code of India (NBC). Bureau of Indian Standards, 2016.

REFERENCE BOOKS

1. Varghese, P. C. Building construction. PHI Learning Pvt. Ltd, Rai Publications.
2. Rangwala, S. C. Building construction. Charotar Publishing House, 2014.
3. Gopi, S. Building drawing and detailing. Pearson Education, 2010.
4. Ching, F. D. K. Architecture: Form, space, and order. Wiley,2015.
5. Birdie, G. S., & Birdie, J. S. Building design and drawing. Dhanpat Rai Publishing Company, 2004.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	-	3	2	-	2	3	3	-	3	3	3	-	2
CO2	2	-	3	2	-	2	3	3	-	3	3	3	-	2
CO3	2	-	3	2	-	2	3	3	-	3	3	3	-	2
CO4	2	-	3	2	-	2	3	3	-	3	3	3	-	2
CO5	2	-	3	2	-	2	3	3	-	3	3	3	-	2
AVG	**2**	**-**	**3**	**2**	**-**	**2**	**3**	**3**	**-**	**3**	**3**	**3**	**-**	2

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

24OCT202 ENERGY EFFICIENT BUILDING **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understand climate-responsive design principles and their impact on building performance.
- To learn passive strategies for heating, cooling, ventilation, and daylighting in buildings.
- To apply energy-efficient design techniques for different climatic zones using relevant tools and case studies.

UNIT I INTRODUCTION **9**

Climate adapted and climate rejecting buildings – Heat Transfer – Measuring Conduction – Thermal Storage – Measurement of Radiation – The Greenhouse Effect – Convection – Measuring latent and sensible heat – Psychrometry Chart – Thermal Comfort – Microclimate, Site Planning and Development – Temperature – Humidity – Wind – Optimum Site Locations – Sun Path Diagrams – Sun Protection – Types of Shading Devices – Design responses to energy conservation strategies.

UNIT II PASSIVE SOLAR HEATING AND COOLING **9**

General Principles of passive Solar Heating – Key Design Elements – Sunspace – Direct gain – Trombe Walls, Water Walls – Convective Air loops – Concepts – Case Studies – General Principles of Passive Cooling – Ventilation – Principles – Case studies – Courtyards – Roof Ponds– Cool Pools – Predicting ventilation in buildings – Window Ventilation Calculations – Room Organization Strategies for Cross and Stack Ventilation – Radiation – Evaporation and dehumidification – Wind Catchers – Mass Effect – Zoning – Load Control – Air Filtration and odor removal.

UNIT III DAYLIGHTING AND ELECTRICAL LIGHTING **9**

Materials, components and details – Insulation – Optical materials – Radiant Barriers – Glazing materials – Glazing Spectral Response – Day lighting – Sources and concepts – Building Design Strategies – Case Studies – Daylight apertures – Light Shelves – Codal requirements – Day lighting design – Electric Lighting – Light Distribution – Electric Lighting control for day lighted buildings – Switching controls – Coefficient of utilization – Electric Task Lighting – Electric Light Zones – Power Adjustment Factors.

UNIT IV HEAT CONTROL AND VENTILATION **9**

Hourly Solar radiation – Heat insulation – Terminology – Requirements – Heat transmission through building sections – Thermal performance of Building sections – Orientation of buildings – Building characteristics for various climates – Thermal Design of buildings – Influence of Design Parameters – Mechanical controls – Examples. Ventilation – Requirements – Minimum standards for ventilation – Ventilation Design – Energy Conservation in Ventilating systems – Design for Natural Ventilation – Calculation of probable indoor wind speed.

UNIT V DESIGN FOR CLIMATIC ZONES **9**

Energy efficiency – An Overview of Design Concepts and Architectural Interventions – Embodied Energy – Low Embodied Energy Materials – Passive Downdraft Evaporative Cooling – Design of Energy Efficient Buildings for Various Zones – Cold and cloudy – Cold and sunny – Composite – Hot and dry – Moderate – Warm and humid – Case studies of residences, office buildings and other buildings in each zones – Commonly used software packages in energy efficient building analysis and design - Energy Audit – Certification.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Analyze heat transfer, thermal comfort, and site-specific microclimate factors.

CO2: Apply passive heating and cooling strategies, including solar design elements and natural ventilation techniques.

CO3: Design effective daylighting systems using optical materials and integrate electrical lighting controls for energy efficiency.

CO4: Evaluate thermal performance and ventilation requirements for various building orientations and climate types.

CO5: Develop energy-efficient design solutions for diverse climatic zones using case studies, tools, and energy audit methods.

TEXT BOOKS

1. Jagadish, K.S., Venkatarama Reddy, B.V., Alternative Building Materials and Technologies, New Age International, 2005.
2. Majumdar, M (Ed), Energy - Efficient Buildings in India, Tata Energy Research Institute, Ministry of Non-Conventional Energy Sources, 2009.
3. Residential Energy: Cost Savings and Comfort for Existing Buildings by John Krigger and Chris Dorsi, Published by Saturn Resource Management, 2013.

REFERENCE BOOKS

1. Energy Conservation Building Code, cau of Energy Efficiency, New Delhi, 2018.
2. Handbook on Functional Requirements of Buildings Part 1 to 4 SP: 41 1995.
3. Brown, G.Z. and DeKay, M., Sun, Wind and Light - Architectural Design Strategies, John Wiley and Sons Inc,3rd Edition, 2014.
4. Marian Keeler and Prasad Vaidya, Fundamentals of Integrated Design for Sustainable Building, John Wiley & Sons, 2016.
5. Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	-	2	2	-	2	3	3	-	-	3	3	-	2
CO2	2	-	2	2	-	2	3	3	-	-	3	3	-	2
CO3	2	-	2	2	-	2	3	3	-	-	3	3	-	2
CO4	2	-	2	2	-	2	3	3	-	-	3	3	-	2
CO5	2	-	2	2	-	2	3	3	-	-	3	3	-	2
AVG	**2**	**-**	**2**	**2**	**-**	**2**	**3**	**3**	**-**	**-**	**3**	**3**	**-**	2

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

24OCT203 ENVIRONMENTAL IMPACT ASSESSMENT **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment.
- To develop the skill to prepare environmental management plan.
- To Gain working knowledge of environmental and human-health risk assessment methods and the strategies used to manage identified risks.

UNIT I INTRODUCTION **9**

Historical development of Environmental Impact Assessment (EIA), Environmental Clearance- EIA in project cycle, legal and regulatory aspects in India – types and limitations of EIA –EIA process screening – scoping - terms of reference in EIA- setting – analysis – mitigation. Cross sectoral issues –public hearing in EIA- EIA consultant accreditation.

UNIT II IMPACT INDENTIFICATION AND PREDICTION **10**

Matrices – networks – checklists – cost benefit analysis – analysis of alternatives – expert systems in EIA. prediction tools for EIA – mathematical modelling for impact prediction – assessment of impacts – air – water – soil – noise – biological — cumulative impact assessment

UNIT III SOCIO-ECONOMIC IMPACT ASSESSMENT **8**

Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. factors and methodologies- individual and family level impacts. communities in transition-rehabilitation.

UNIT IV EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN **9**

Environmental management plan - preparation, implementation and review – mitigation and rehabilitation plans – policy and guidelines for planning and monitoring programmes – post project audit – documentation of EIA findings – ethical and quality aspects of environmental impact assessment.

UNIT V CASE STUDIES **9**

Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Carry out scoping and screening of developmental projects for environmental and social assessments.

CO2: Explain different methodologies for environmental impact prediction and assessment.

CO3: Asses socio-economic investigation of the environment in a project.
CO4: Plan environmental impact assessments and environmental management plans.
CO5: Gain Knowledge to prepare environmental impact assessment reports for various projects.

TEXT BOOKS

1. Canter, L.W., "Environmental Impact Assessment", McGraw Hill, New York. 1996.
2. Lawrence, D.P., "Environmental Impact Assessment – Practical solutions to recurrent problems", Wiley-Inter science, New Jersey. 2003.
3. World Bank –Source book on EIA.

REFERENCE BOOKS

1. Cutter, S.L., "Environmental Risk and Hazards", Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
2. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff "Risk Assessment and Management Handbook", McGraw Hill Inc., New York, 1996.
3. K. V. Raghavan and A A. Khan, "Methodologies in Hazard Identification and Risk Assessment", Manual by CLRI, 1990.
4. Sam Mannan, Lees' Loss Prevention in the Process Industries, Hazard Identification, Assessment and Control, 4th Edition, Butterworth Heineman, 2012.
5. Westman, Walter E., "Ecology, Impact Assessment and Environment Planning" John Wiley and Sons, Canada, 1985.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	3	2	2	-	2	3	3	-	-	3	3	-	2
CO2	2	3	2	2	-	2	3	3	-	-	3	3	-	2
CO3	2	3	2	2	-	2	3	3	-	-	3	3	-	2
CO4	2	3	2	2	-	2	3	3	-	-	3	3	-	2
CO5	2	3	2	2	-	2	3	3	-	-	3	3	-	2
AVG	**2**	**3**	**2**	**2**	**-**	**2**	**3**	**3**	**-**	**-**	**3**	**3**	**-**	2

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

24OCT204 REHABILITATION OF STRUCTURES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To acquire the knowledge on maintenance aspects and causes of deterioration.
- To gain an understanding of concrete quality, durability characteristics and testing techniques.
- To impart knowledge on strengthening techniques and safe demolition procedures.

UNIT I MAINTENANCE AND REPAIR STRATIGES **9**

Maintenance, Repair and Rehabilitation - Facets of Maintenance - Importance of Maintenance - Various aspects of Inspection - Assessment procedure for evaluating a damaged structure - causes of deterioration.

UNIT II STRENGTH AND DURABILITY OF CONCRETE **9**

Quality assurance for concrete – Strength and Durability of concrete - Cracks, different types, causes-Effects due to climate, temperature, Sustained elevated Temperature, Corrosion.

UNIT III TESTING TECHNIQUES AND PROTECTION METHODS **9**

Non-destructive Testing Techniques, Epoxy injection, Shoring, Underpinning, Corrosion protection techniques – Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection.

UNIT IV STRENGTHENING AND REPAIR OF STRUCTURES **9**

Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, leakage and earthquake - Restoration of Heritage structures- Case studies.

UNIT V DEMOLITION **9**

Demolition Techniques, Demolition by Machines, Demolition by Explosives, Advanced Techniques using Robotic Machines, Demolition Sequence, Dismantling Techniques, Safety precaution in Demolition and Dismantling.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Discuss the importance of inspection and maintenance.
CO2: Study the Impacts of cracks, corrosion and climate on structures.
CO3: Explain about various testing techniques.
CO4: Classify the strengthening techniques and repair strategies.
CO5: Explore the safe demolition techniques.

TEXT BOOKS

1. Shetty,M.S. Jain A K., Concrete Technology - Theory and Practice, S.Chand and Company, Eighth Edition, 2019.
2. B.Vidivelli, Rehabilitation of Concrete Structures Standard Publishes Distribution.1st edition 2009.
3. Peter H.Emmons, “Concrete repair and maintenance illustrated”, Galgotia Publications Pvt. Ltd., 2001.

REFERENCE BOOKS

1. Hand book on Seismic Retrofit of Buildings, CPWD and Indian Buildings Congress, Narosa Publishers, 2008.
2. Hand Book on "Repair and Rehabilitation of RCC Buildings" – Director General works CPWD, Govt of India, New Delhi – 2002.
3. P.C.Varghese, Maintenance Repair and Rehabilitation & Minor works of building, Prentice Hall India Pvt Ltd, 2014.
4. Dodge Woodson, Concrete Structures, Protection, Repair and Rehabilitation, Butterworth-Heinemann, Elsevier, New Delhi 2012.
5. Ravishankar.K., and Krishnamoorthy.T.S, " Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures", Allied Publishers, 2004.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	3	3	2	-	2	3	3	-	-	3	3	-	2
CO2	2	3	3	2	-	2	3	3	-	-	3	3	-	2
CO3	2	3	3	2	-	2	3	3	-	-	3	3	-	2
CO4	2	3	3	2	-	2	3	3	-	-	3	3	-	2
CO5	2	3	3	2	-	2	3	3	-	-	3	3	-	2
AVG	**2**	**3**	**3**	**2**	**-**	**2**	**3**	**3**	**-**	**-**	**3**	**3**	**-**	2

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

24OCT205 DRINKING WATER SUPPLY AND TREATMENT **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To provide a basic understanding of water sources, quality, and supply system planning.
- To introduce the design and operation of water conveyance and treatment systems.
- To explain the components of water distribution systems and plumbing in buildings.

UNIT I SOURCES OF WATER **9**

Public water supply system – Planning, Objectives, Design period, Population forecasting; Water demand – Sources of water and their characteristics, Surface and Groundwater – Impounding Reservoir – Development and selection of source – Source Water quality – Characterization -Significance – Drinking Water quality standards.

UNIT II CONVEYANCE FROM THE SOURCE **9**

Water supply – intake structures – Functions; Pipes and conduits for water – Pipe materials - Hydraulics of flow in pipes – Transmission main design – Laying, jointing and testing of pipes -appurtenances – Types and capacity of pumps – Selection of pumps and pipe materials.

UNIT III WATER TREATMENT **9**

Objectives – Unit operations and processes – Principles, functions, and design of water treatment plant units, aerators of flash mixers, Coagulation and flocculation sand filters – Disinfection -Construction, Operation and Maintenance aspects.

UNIT IV ADVANCED WATER TREATMENT **9**

Water softening – Desalination- R.O. Plant – demineralization – Adsorption – Ion exchange Membrane Systems – Iron and Manganese removal – Defluoridation – Construction and Operation and Maintenance aspects.

UNIT V WATER DISTRIBUTION AND SUPPLY **9**

Requirements of water distribution – Components – Selection of pipe material – Service reservoirs - Functions – Network design – Economics – Computer applications – Appurtenances – Leak detection – Principles of design of water supply in buildings – House service connection - Fixtures and fittings, systems of plumbing and types of plumbing.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On Successful completion of this course, the students will be able to

CO1: Identify different sources of water and assess their suitability for supply.

CO2: Design of intake structures, pipes, and pumps used in water conveyance.

CO3: Explain the processes involved in water treatment and apply them in plant design.

CO4: Describe advanced treatment methods like softening, desalination, and removal of contaminants.

CO5: Design water distribution systems and understand plumbing arrangements in buildings.

TEXT BOOKS

1. Garg. S.K., "Water Supply Engineering", Khanna Publishers, Delhi, September 2008.
2. Punmia B.C, Arun K.Jain, Ashok K.Jain, “Water supply Engineering” Laxmi Publications (p) LTD, New Delhi, 2016.
3. Rangwala "Water Supply and Sanitary Engineering", Charotar Publishing house Pvt.Ltd, February 2022.

REFERENCE BOOKS

1. Fair. G.M., Geyer.J.C., “Water Supply and Wastewater Disposal”, John Wiley and Sons, 1954.
2. Babbit.H.E, and Donald.J.J, “Water Supply Engineering”, McGraw Hill book Co,1984.
3. Steel. E.W.et al., “Water Supply Engineering”, Mc Graw Hill International book Co, 1984.
4. Duggal. K.N., “Elememts of public Health Engineering”, S.Chand and Company Ltd, New Delhi, 1998.
5. Birdie.G.S., "Water Supply and Sanitary Engineering", Dhanpat Rai and sons, 2018.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	2	3	2	-	3	3	2	-	-	2	3	-	2
CO2	2	2	3	2	-	3	3	2	-	-	2	3	-	2
CO3	2	2	3	2	-	3	3	2	-	-	2	3	-	2
CO4	2	2	3	2	-	3	3	2	-	-	2	3	-	2
CO5	2	2	3	2	-	3	3	2	-	-	2	3	-	2
AVG	**2**	**2**	**3**	**2**	**-**	**3**	**3**	**2**	**-**	**-**	**2**	**3**	**-**	2

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

24OCT206 PROJECT SCHEDULING AND OPTIMIZATION USING CPM AND PERT TECHNIQUES **L T P C 3 0 0 3**

COURSE OBJECTIVES

- To understand fundamental project management concepts and principles.
- To learn principles and processes related to project scope management.
- To comprehend concepts and tools related to project scheduling and their applications in real-world projects.

UNIT I GENERAL OVERVIEW AND PROJECT ORGANIZATION **9**

Introduction to Projects, Types of Projects, Introduction to Construction Project Management, Project Lifecycle and its Phases, Key Activities Involved in Different Project Lifecycle Phases, Role of Various Stakeholders in Different Project Lifecycle Phases, Project Organization Structure and its Types.

UNIT II PROJECT SCOPE MANAGEMENT **9**

Gathering Project Requirements, Project Scope and Specifications, Project Scope Matrix, Project Contract Management, Work Breakdown Structure (WBS), WBS Types, Creating WBS, Scope Management Steps and Processes

UNIT II PROJECT PLANNING AND SCHEDULING **9**

Project Planning, Planning and Scheduling, Steps Involved in Project Planning, Networking and Non-Networking Techniques Scheduling Techniques, Gantt-Chart, Formulation and Applications of Critical Path Method (CPM), Program Evaluation & Review Technique (PERT) and Precedence Diagram Method (PDM), Introduction to Linear Scheduling Methods

UNIT IV PROJECT CONTROL **9**

Time-Cost Tradeoff, Earned Value Management (EVM), Crashing and Fast-tracking Projects, Resource Constrained Scheduling, Resource Levelling, Schedule Updation and Project Control.

UNIT V ADVANCED TOOLS IN PROJECT SCHEDULING **9**

Software Applications and Use of AI in Project Planning, Scheduling and Control, Data driven Decision Making

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explore the fundamental project management concepts and principles.

CO2: Comprehend the principles and processes related to project scope management.

CO3: Gain the ability to apply concepts and tools related to project scheduling in real world Projects.

CO4: Comprehend the use of advanced project scheduling tools.

CO5: Assess the use of advanced technology platforms in project scheduling and control.

TEXT BOOKS

1. Oberlender, G. D., & Oberlender, G. D. Project management for engineering and construction (Vol. 2). New York: McGraw-Hill,1993.
2. Sears, S. K., Sears, G. A., & Clough, R. H. Construction project management: A practical guide to field construction management. John Wiley & Sons,2010.
3. Callahan, M. T., Quackenbush, D. G., & Rowings, J. E. Construction project scheduling,1992.

REFERENCE BOOKS

1. Barcus, S.W. and Wilkinson.J.W., Hand Book of Management Consulting Services, McGraw Hill, New York, 1986.
2. Joy P.K., Total Project Management - The Indian Context, New Delhi, Macmillan India Ltd., 1992.
3. Albert Lester, Project Management, Planning and Control, 7th Edition, Butterworth-Heinemann, USA , 2017.
4. Guide, P. M. B. O. K. A guide to the project management body of knowledge,2008.
5. Mubarak, S. A. Construction project scheduling and control. John Wiley & Sons,2015.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	3	3	2	-	2	-	3	3	2	3	3	-	2
CO2	2	3	3	2	-	2	-	3	3	2	3	3	-	2
CO3	2	3	3	2	-	2	-	3	3	2	3	3	-	2
CO4	2	3	3	2	-	2	-	3	3	2	3	3	-	2
CO5	2	3	3	2	-	2	-	3	3	2	3	3	-	2
AVG	**2**	**3**	**3**	**2**	**-**	**2**	**-**	**3**	**3**	**2**	**3**	**3**	**-**	2

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

24OAT201 PRINCIPLES OF PROGRAMMING LANGUAGES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand and describe syntax and semantics of programming languages.
- To understand data, data types, and basic statements.
- To understand call-return architecture and ways of implementing them.

UNIT I SYNTAX AND SEMANTICS **9**

Evolution of programming languages – describing syntax – context-free grammars – attribute grammars – describing semantics – lexical analysis – parsing – recursive-descent – bottom up parsing.

UNIT II DATA, DATATYPES AND BASIC STATEMENTS **9**

Names–variables–binding–type checking–scope–scope rules–life time and garbage collection– primitive datatypes –strings–array types–associative arrays–record Types– union types–pointers and references–Arithmetic expressions–overloaded operators– type conversions– relational and boolean expressions– assignment statements– mixed mode assignments– control structures– selection– iterations– branching– guarded statements.

UNIT III SUBPROGRAMS AND IMPLEMENTATIONS **9**

Sub programs –design issues–local referencing–parameter passing–overloaded methods– generic methods – design issues for functions– semantics of call and return – implementing simple sub programs–stack and dynamic local variables–nested sub programs – blocks – dynamic scoping.

UNIT IV OBJECT-ORIENTATION, CONCURRENCY AND EVENT HANDLING **9**

Object - orientation– design issues for OOP languages– implementation of object- oriented constructs –concurrency– semaphores – monitors –message passing – threads – statement level concurrency – exception handling – event handling

UNIT V FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES **9**

Introduction to lambda calculus – fundamentals of functional programming languages – Programming with Scheme – Programming with ML – Introduction to logic and logic programming – Programming

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Describe syntax and semantics of programming languages.
CO2: Explain data, data types, and basic statements of programming languages.
CO3: Design and implement subprogram constructs.
CO4: Apply object-oriented, concurrency, and event handling programming constructs and develop programs in Scheme, ML, and Prolog.
CO5: Adopt new programming languages.

TEXT BOOKS

1. Robert W. Sebesta, “Concepts of Programming Languages”, Twelfth Edition (Global Edition), Pearson, 2022.
2. Michael L. Scott, “ProgrammingLanguagePragmatics”,FourthEdition, Elsevier, 2018.
3. Principles of Programming Languages" by Er. Anil Panghal & Ms. Sharda Panghal.

REFERENCE BOOKS

1. R. Kent Dybvig, “The Scheme programming language”, Fourth Edition, Prentice Hall,2011.
2. Jeffrey D. Ullman, “Elements of ML programming”, Second Edition, Pearson,1997.
3. W. F. Clocksin and C. S. Mellish, “Programming in Prolog: Using the ISO Standard”, Fifth Edition, Springer, 2003.
4. “Principles of Programming Languages" by Bruce J. MacLennan.
5. Essentials of Programming Languages" by Daniel P. Friedman, Mitchell Wand, and Christopher T. Haynes.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	-	-	2	-	-	-	-	-	-	-	-	2
CO2	3	2	1	-	2	-	-	-	-	-	-	-	-	2
CO3	3	3	3	-	2	-	-	-	-	-	1	-	-	2
CO4	3	2	2	-	3	-	-	-	1	1	1	-	-	2
CO5	2	2	-	-	2	-	-	-	-	-	-	3	-	2
AVG	**2.8**	**2.2**	**2**	**-**	**2.2**	**-**	**-**	**-**	**1**	**1**	**1**	**3**	**-**	2

1-Low, 2-Medium, 3-High, “-” – No correlation

24OAT202 INFORMATION SECURITY MANAGEMENT **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understand the basics of Information Security
- To know the legal, ethical and professional issues in Information Security
- To know the aspects of risk management

UNIT I INTRODUCTION **9**

History - What is Information Security? - Critical Characteristics of Information - NSTISSC Security Model - Components of an Information System - Securing the Components - Balancing Security and Access - The SDLC - The Security SDLC.

UNIT II SECURITY INVESTIGATION **9**

Need for Security - Business Needs - Threats - Attacks - Legal - Ethical and Professional Issues - An Overview of Computer Security - Access Control Matrix - Policy - Security policies - Confidentiality policies - Integrity policies and Hybrid policies.

UNIT III SECURITY ANALYSIS **9**

Risk Management - Identifying and Assessing Risk - Assessing and Controlling Risk - Systems: Access Control Mechanisms - Information Flow and Confinement Problem.

UNIT IV LOGICAL DESIGN **9**

Blueprint for Security - Information Security Policy - Standards and Practices - ISO 17799/BS 7799 - NIST Models - VISA - International Security Model - Design of Security Architecture - Planning for Continuity.

UNIT V PHYSICAL DESIGN **9**

Security Technology - IDS - Scanning and Analysis Tools - Cryptography - Access Control Devices - Physical Security - Security and Personnel.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Illustrate the legal, ethical and professional issues in information security.
CO2: Demonstrate the aspects of risk management.
CO3: Become aware of various standards in the Information Security System.
CO4: Design and implementation of Security Techniques.
CO5: Apply security technologies and practices to secure physical and logical components, including Cryptography, IDS, and physical security measures.

TEXT BOOKS

1. Michael E Whitman, Herbert J Mattord, “Principles of Information Security”, Vikas Publishing House, New Delhi, 2003.
2. Information Security Management: Concepts and Practice" by Bel G. Raggad.
3. Information Security Management, 2nd Edition" by Michael Workman.

REFERENCE BOOKS

1. Micki Krause, Harold F. Tipton, “Handbook of Information Security Management”, Vol. 13, CRC Press LLC, 2004
2. Stuart McClure, Joel Scrambray, George Kurtz, “Hacking Exposed”, Tata McGraw Hill, 2003.
3. Matt Bishop, “Computer Security Art and Science”, Pearson/PHI, 2002.
4. A Comprehensive Guide to Information Security Management and Audit" by Rajkumar Banoth, Gugulothu Narsimha, and Aruna Kranthi Godishala.
5. Information Security Management Handbook, Volume 7, 6th Edition" edited by Richard O'Hanley and James S. Tiller.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	-	-	-	-	3	-	3	-	2	-	-	-	2
CO2	2	2	-	2	-	-	-	-	-	-	2	-	-	2
CO3	2	1	-	-	1	-	1	-	-	-	-	2	-	2
CO4	3	2	3	-	3	-	-	-	-	-	1	-	-	2
CO5	3	2	3	-	3	-	-	-	-	-	1	-	-	2
AVG	**2.4**	**1.8**	**3**	**2**	**2.3**	**3**	**1**	**3**	**-**	**2**	**1.3**	**2**	**-**	2

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

24OAT203 HUMAN COMPUTER INTERACTION **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understand the theoretical dimensions of human factors involved in the acceptance of computer.
- To understand the important aspects of implementation of human computer interfaces.
- To identify the various tools and techniques for interface analysis, design and evaluation.

UNIT I INTRODUCTION **9**

HCI Foundations: Input–output channels - Human memory - Thinking: reasoning and problem solving - Emotion - Individual differences - Psychology and the design of interactive systems - Text entry devices - Positioning - pointing and drawing - Display devices - Devices for virtual reality and 3D interaction - Physical controls - sensors and special devices - Paper: printing and scanning.

UNIT II INTERACTION DESIGNS **9**

Designing - Programming Interactive systems - Models of interaction - Frameworks and HCI - Ergonomics - Interaction styles - Elements of the WIMP interface - The context of the interaction - Experience - engagement and fun - Paradigms for interaction. Cantered Design and testing - Interaction design basics - The process of design - User focus - Scenarios - Navigation design - Screen design and layout, Iteration and prototyping.

UNIT III DESIGN RULES **9**

HCI in the software process - Iterative design and prototyping - Design rules - Principles to support usability - Standards and Guidelines - Golden rules and heuristics - HCI patterns. Implementation support - Elements of windowing systems - Programming the application - Using toolkits - User interface management systems.

UNIT IV ANALYSIS **9**

Evaluation techniques - Evaluation through expert analysis - Evaluation through user participation - Universal design - User support. Models and Theories - Cognitive models -

Goal and task hierarchies - Linguistic models - The challenge of display-based systems - Physical and device models - Cognitive architectures.

UNIT V NOTATIONS **9**

Collaboration and communication - Face-to-face communication - Conversation - Text-based communication - Group working - Dialog design notations - Diagrammatic notations - Textual dialog notations - Dialog semantics - Dialog analysis and design Human factors and security - Groupware - Meeting and decision support systems - Shared applications and artifacts - Frameworks for groupware - Implementing synchronous groupware - Mixed - Augmented and Virtual Reality.

COURSE OUTCOMES

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

CO 1: Design and Develop processes and life cycle of Human Computer Interaction.

CO 2: Analyse product usability evaluations and testing methods.

CO 3: Apply the interface design standards/guidelines for cross cultural and disabled users.

CO 4: Categorize, Design and Develop Human Computer Interaction in proper architectural structures.

CO5: Design collaborative and communicative interfaces, incorporating human factors and security.

TEXT BOOKS

1. A Dix, Janet Finlay, G D Abowd, R Beale, “Human - Computer Interaction”, Pearson Publishers, Third Edition, 2008.
2. Shneiderman, Plaisant, Cohen, Jacobs, “Designing the User Interface: Strategies for Effective Human Computer Interaction”, Pearson Publishers, Fifth Edition, 2018.
3. Interaction Design: Beyond Human-Computer Interaction" (5th Edition) by Jenny Preece, Yvonne Rogers, and Helen Sharp.

REFERENCE BOOKS

1. Jonathan Lazar, “Research Methods in Human–Computer Interaction”, John Wiley & Sons.
2. Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies, and Emerging Applications" (3rd Edition) edited by Julie A. Jacko.
3. The Design of Everyday Things" by Don Norman. "Designing Interactions" by Bill Moggridge.
4. "The Humane Interface: New Directions for Designing Interactive Systems" by Jef Raskin.
5. Human Computer Interaction, https://onlinecourses.nptel.ac.in/noc25_cs38/preview.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	-	3	-	2	-	-	-	-	-	-	2
CO2	2	-	2	-	2	-	3	-	-	-	-	-	-	2
CO3	3	2	3	2	3	-	2	-	-	-	2	-	-	2
CO4	2	2	2	-	2	-	2	-	-	-	-	-	-	2
CO5	2	-	-	-	2	2	2	3	-	-	-	2	-	2
AVG	**2.4**	**2**	**2.3**	**2**	**2.4**	**2**	**2.2**	**3**	**-**	**-**	**2**	**2**	**-**	2

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

24OAT204 COMPUTER APPLICATION IN AGRICULTURES **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To introduce the students to areas of agricultural systems in which IT and computers play a major role.
- To also expose the students to IT applications in precision farming and environmental control systems
- To also expose the students to IT applications in agricultural systems management and weather prediction models.

UNIT I PRECISION FARMING **9**

Precision agriculture and agricultural management – Ground based sensors, Remote sensing, GPS, GIS and mapping software, Yield mapping systems, Crop production modeling.

UNIT II ENVIRONMENT CONTROL SYSTEMS **9**

Artificial light systems, management of crop growth in greenhouses, simulation of CO2consumption in greenhouses, on-line measurement of plant growth in the greenhouse, models of plant production and expert systems in horticulture.

UNIT III AGRICULTURAL SYSTEMS MANAGEMENT **9**

Agricultural systems - managerial overview, Reliability of agricultural systems, Simulation of crop growth and field operations, Optimizing the use of resources, Linear programming, Project scheduling, Artificial intelligence and decision support systems.

UNIT IV WEATHER PREDICTION MODELS **9**

Importance of climate variability and seasonal forecasting, Understanding and predicting world's climate system, Global climatic models and their potential for seasonal climate forecasting, General systems approach to applying seasonal climate forecasts.

UNIT V E-GOVERNANCE IN AGRICULTURAL SYSTEMS **9**

Expert systems, decision support systems, Agricultural and biological data bases,e-commerce, e- business systems & applications, Technology enhanced learning systems and solutions, e- learning, Rural development and information society.

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1: Explain the applications of IT in remote sensing applications such as Drones, etc.

CO2: Greenhouse can be automated.

CO3: Apply IT principles and concepts for management of field operations.

CO4: Discuss about weather models, their inputs, and applications.

CO5: Use the e-governance in agriculture.

TEXT BOOKS

1. National Research Council, "Precision Agriculture in the 21st Century", National Academies Press, Canada, 1997.
2. H. Krug, Liebig, H.P. "International Symposium on Models for Plant Growth, Environmental Control and Farm Management in Protected Cultivation", 1989.
3. Computers in Agriculture" by Manish Kumar Sharma, Anil Bhat & M. Iqbal Jeelani Bhat.

REFERENCE BOOKS

1. Peart, R.M.,and Shoup,W.D.,"Agricultural Systems Management", Marcel Dekker, New York,2004.
2. Hammer,G.L., Nicholls,N.,and Mitchell,C., "Applications of Seasonal Climate", Springer, Germany,2000.
3. ICT & its Applications in Agriculture" by Golla Ravi, MD. Mubeena, Apoorva Veldandi.
4. Communication Technologies in Agriculture" by Dr. P. Jaisridhar & Mrs. Surudhi.
5. Internet and Computers for Agriculture" edited by Dimitre Dimitrov.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	2	-	3	-	2	-	-	-	1	2	-	2
CO2	3	2	2	-	3	-	2	-	-	-	1	2	-	2
CO3	3	3	3	2	3	1	2	-	-	-	3	2	-	2
CO4	2	2	-	2	2	-	3	-	-	-	2	2	-	2
CO5	2	2	2	-	2	-	2	2	1	2	3	2	-	2
AVG	**2.6**	**2.4**	**2.3**	**2**	**2.6**	**1**	**2.2**	**2**	**1**	**2**	**2**	**2**	-	2

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

24OAT205 MOBILE COMPUTING **L T P C**

3 0 0 3

COUSE OBJECTIVES

- To understand the basic concepts of mobile computing.
- To learn the basics of mobile telecommunication system.
- To be familiar with the network layer protocols and Ad-Hoc networks.

UNIT I INTRODUCTION **9**

Introduction to Mobile Computing – Applications of Mobile Computing- Generations of Mobile Communication Technologies- Multiplexing – Spread spectrum -MAC Protocols – SDMA- TDMA- FDMA- CDMA.

UNIT II MOBILE TELECOMMUNICATION SYSTEM **9**

Introduction to Cellular Systems – GSM – Services & Architecture – Protocols – Connection Establishment – Frequency Allocation – Routing – Mobility Management – Security – GPRS- UMTS – Architecture – Handover – Security.

UNIT III MOBILE NETWORK LAYER **9**

Mobile IP – DHCP – AdHoc– Proactive protocol-DSDV, Reactive Routing Protocols – DSR, AODV , Hybrid routing –ZRP, Multicast Routing- ODMRP, Vehicular Ad Hoc networks (VANET) –MANET Vs VANET – Security.

UNIT IV MOBILE TRANSPORT AND APPLICATION LAYER **9**

Mobile TCP– WAP – Architecture – WDP – WTLS – WTP –WSP – WAE – WTA Architecture – WML.

UNIT V MOBILE PLATFORMS AND APPLICATIONS **9**

Mobile Device Operating Systems – Special Constraints & Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone – MCommerce – Structure – Pros & Cons – Mobile Payment System – Security Issues.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO 1: Explain the basics of mobile telecommunication systems.

CO 2: Illustrate the generations of telecommunication systems in wireless networks.

CO 3: Determine the functionality of MAC, network layer and Identify a routing protocol for a given Ad hoc network.

CO 4: Explain the functionality of Transport and Application layers.

CO 5: Develop a mobile application using android/blackberry/ios/Windows SDK.

TEXT BOOKS

1. Jochen Schiller, ―Mobile Communications‖, PHI, Second Edition, 2003.
2. Prasant Kumar Pattnaik, Rajib Mall, ―Fundamentals of Mobile Computing‖, PHI Learning Pvt.Ltd, New Delhi – 2012
3. Mobile Computing: Concepts, Methodologies, Tools, and Applications (6 Volumes) edited by David

REFERENCE BOOKS

1. Dharma Prakash Agarval, Qing and An Zeng, Introduction to Wireless and Mobile systems,Thomson Asia Pvt Ltd, 2005.
2. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, Principles of Mobile Computing, Springer, 2003.
3. William.C.Y.Lee,―Mobile Cellular Telecommunications-Analog and Digital Systems‖, Second Edition,TataMcGraw Hill Edition ,2006.
4. C.K.Toh, ―AdHoc Mobile Wireless Networks‖, First Edition, Pearson Education, 2002.
5. Mobile Computing and Wireless Networks: Concepts, Methodologies, Tools, and Applications (4 Volumes) by Information Resources Management Association.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	-	-	2	-	-	-	-	-	-	-	-	2
CO2	3	2	-	-	2	-	-	-	-	-	-	-	-	2
CO3	3	3	3	2	3	-	-	-	-	-	-	-	-	2
CO4	2	2	-	-	2	-	-	-	-	-	-	-	-	2
CO5	2	2	3	-	3	-	-	-	1	2	2	2	-	2
AVG	**2.6**	**2.2**	**3**	**2**	**2.4**				**1**	**2**	**2**	**2**	**-**	2

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

24OAT206 OBJECT ORIENTED ANALYSIS AND DESIGN **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To introduce the fundamentals of Object-Oriented Analysis and Design (OOAD) using the Unified Process and various UML diagrams.
- To enable students to model software systems using static and dynamic UML diagrams such as class, use-case, sequence, state, and activity diagrams.
- To develop the ability to apply GRASP principles and GoF design patterns to design robust, maintainable, and scalable object-oriented systems.

UNIT I UNIFIED PROCESS AND USE CASE DIAGRAMS **9**

Introduction to OOAD with OO Basics — Unified Process — UML diagrams — Use Case – Case study — the Next Gen POS system, Inception -Use case Modelling — Relating Use cases — include, extend and generalization — When to use Use-cases

UNIT II STATIC UML DIAGRAMS **9**

Class Diagram—- Elaboration — Domain Model — Finding conceptual classes and description classes — Associations — Attributes — Domain model refinement — Finding conceptual class Hierarchies — Aggregation and Composition — Relationship between sequence diagrams and use cases — When to use Class Diagrams

UNIT III DYNAMIC AND IMPLEMENTATION UML DIAGRAMS 9

Dynamic Diagrams — UML interaction diagrams — System sequence diagram — Collaboration diagram — When to use Communication Diagrams — State machine diagram and Modelling –When to use State Diagrams — Activity diagram — When to use activity diagrams Implementation Diagrams — UML package diagram — When to use package diagrams — Component and Deployment Diagrams — When to use Component and Deployment diagrams

UNIT IV DESIGN PATTERNS 9

GRASP: Designing objects with responsibilities — Creator — Information expert — Low Coupling — High Cohesion — Controller Design Patterns — creational — factory method — structural — Bridge — Adapter — behavioural — Strategy — observer –Applying GoF design patterns — Mapping design to code

UNIT V TESTING 9

Object Oriented Methodologies — Software Quality Assurance — Impact of object orientation on Testing — Develop Test Cases and Test Plans

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain OOAD principles and apply the Unified Process in software development.
CO2: Create and analyze static UML diagrams such as class and domain models.
CO3: Model dynamic behaviors using sequence, state, activity, and implementation diagrams.
CO4: Apply design patterns and GRASP principles in object-oriented design.
CO5: Evaluate object-oriented systems through testing and quality assurance methods.

TEXT BOOKS

1. Booch, Grady,"Object-Oriented Analysis and Design with Applications",3rd Edition, Addison-Wesley Professional, 2007.
2. McLaughlin, Brett, Gary Pollice and David West,"Head First Object-Oriented Analysis and Design", O'Reilly Media, 2006.
3. Gamma, Erich, Richard Helm, Ralph Johnsonand John Vlissides. "Design Patterns: Elements of Reusable Object-Oriented Software", Addison-Wesley Professional, 1994.

REFERENCE BOOKS

1. Dr. Nitish Pathak , Dr.Neela, Sharma, "Object-Oriented Analysis and Design with Applications", 3rd Edition,Namya Press,2022.
2. Larman, Craig, "Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development", 3rd Edition, Pearson Education, 2004.

3. Gamma, Erich; Helm, Richard; Johnson, Ralph; Vlissides, John, "Design Patterns: Elements of Reusable Object-Oriented Software", Addison-Wesley Professional, 1994.
4. Fowler, Martin, "UML Distilled: A Brief Guide to the Standard Object Modeling Language", 3rdEdition, Addison-Wesley Professional, 2003.
5. Pressman, Roger S., "Software Engineering: A Practitioner's Approach" 8thEdition, McGraw-Hill Education, 2014.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	-	1	-	-	-	-	2	-	1	-	2
CO2	2	3	3	-	1	-	-	-	2	2	-	1	-	2
CO3	2	3	3	1	1	-	-	-	-	2	-	1	-	2
CO4	3	2	3	-	2	-	-	-	-	1	2	1	-	2
CO5	1	2	2	-	1	-	-	-	-	1	2	1	-	2
AVG	**2.2**	**2.4**	**2.6**	**1**	**1.2**	**-**	**-**	**-**	**2**	**1.6**	**2**	**1**	**-**	2

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

24OMT201 BIOENERGY CONVERSION TECHNOLOGIES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To elucidate on biomass, types, availability, and characteristics.
- To gain knowledge on gasification process.
- To gain knowledge on liquidation process.

UNIT I INTRODUCTION **9**

Biomass: types – advantages and drawbacks – typical characteristics – proximate & ultimate analysis – comparison with coal - Indian scenario - carbon neutrality – biomass assessment studies – typical conversion mechanisms - densification technologies.

UNIT II BIOMETHANATION **9**

Biomethenation process – influencing parameters – typical feed stocks – Biogas plants: types and design, Biogas appliances – burner, luminaries and power generation systems – Industrial effluent based biogas plants.

UNIT III COMBUSTION **9**

Perfect, complete and incomplete combustion – stoichiometric air requirement for bio fuels - equivalence ratio – fixed Bed and fluid Bed combustion.

UNIT IV GASIFICATION, PYROLYSIS AND CARBONISATION **9**

Chemistry of gasification - types – comparison – typical application – performance evaluation –economics. Pyrolysis - Classification - process governing parameters – Typical yield rates. Carbonization – merits of carbonized fuels – techniques adopted for carbonization.

UNIT V LIQUIFIED BIOFUELS **9**

Straight Vegetable Oil (SVO) as fuel - Biodiesel production from oil seeds, waste oils and algae - Process and chemistry - Biodiesel Vs. Diesel – comparison on emission and performance fronts. Production of alcoholic fuels (methanol and ethanol) from biomass – engine modifications

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Estimate the surplus biomass availability of any given area.

CO2: Design a biogas plant for a variety of biofuels.

CO3: Determine and compare the cost of steam generation from biofuels with that of coal and petroleum fuels.

CO4: Analyse the influence of process governing parameters in thermochemical conversion of biomass.

CO5: Synthesize liquid biofuels for power generation from biomass.

TEXT BOOKS

1. Biomass for Bioenergy and Biomaterials, by Nidhi Adlakha, Rakesh Bhatnagar Syed Shams Yazdani, CRC Press; 1st edition (22 October 2021).
2. Bioenergy and Biochemical Processing Technologies, by Augustine O. Ayeni, Samuel EshorameSanni , Solomon U. Oranusi, Springer (30 June 2022).
3. Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, Fundamentals and Applications of Renewable Energy, Indian Edition, Graw Hill; First edition 2020.

REFERENCE BOOKS

1. David Boyles, Bio Energy Technology Thermodynamics and costs, Ellis Hoknood Chichester, 1984.
2. Iyer PVR et al, Thermochemical Characterization of Biomass, M N E S.
3. Khandelwal KC, Mahdi SS, Biogas Technology – A Practical Handbook, Tata McGraw Hill, 1986.
4. Mahaeswari, R.C. Bio Energy for Rural Energisation, Concepts Publication,1997.
5. Tom B Reed, Biomass Gasification – Principles and Technology, Noyce Data Corporation, 1981.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	2
CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	2
CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	2
CO4	3	2	2	-	-	-	-	-	-	-	-	-	-	2
CO5	3	2	2	-	-	-	-	-	-	-	-	-	-	2
AVG	3	2.4	2	-	-	-	-	-	-	-	-	-	-	2

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

24OMT202 AUTOMOTIVE MATERIALS, COMPONENTS, DESIGN AND TESTING **L T P C 3 0 0 3**

COURSE OBJECTIVES

- To study the functional requirements of engine components and suitable materials.
- To learn to design of cylinder and piston components.
- To learn to design of connecting rod and crank shaft.

UNIT I FUNCTIONAL REQUIREMENTS OF ENGINE COMPONENTS AND SUITABLE MATERIALS **9**

Functional requirements of engine components – Piston, piston pin, cylinder liner, connecting rod, crank shaft, valves, spring, engine block, cylinder head, and flywheel. Suitable materials for engine components.

UNIT II DESIGN OF CYLINDER AND PISTON COMPONENTS **9**

Design of connecting rod – Shank design – small end design – big end design – bolts design. Design of overhang crank shaft under bending and twisting – Crank pin design – Crank web design – Shaft design.

UNIT III DESIGN OF CONNECTING ROD AND CRANK SHAFT **9**

Design of connecting rod – Shank design – small end design – big end design – bolts design. Design of overhang crank shaft under bending and twisting – Crank pin design – Crank web design – Shaft design.

UNIT IV DESIGN OF FLYWHEEL AND VALVE TRAIN **9**

Design of valve – inlet valve – exhaust valve - Valve springs – tappet – rocker arm. Determination of mass of flywheel for a given coefficient of fluctuation of speed. Design of flywheel - rim - hub - arm.

UNIT V ENGINE TESTING **9**

Engine test cycles – WLTC – WHSC – WHVC – NRTC – ISO 8178. Dynamometer – Chassis dynamometer - transient dynamometer. Emission measurement technologies and instruments - NOX – Smoke – Particulate matter – CO – CO2 - HC.-Particle counter.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Discuss the requirements of engine components and select suitable materials.
CO2: Apply the concept of design to cylinder and piston components and solve problems.
CO3: Apply the concept of design to Connecting rod and crank shaft and solve problems.
CO4: Apply the concept of design to flywheel and valve train and solve problems.
CO5: Discuss engine teste cycles, dynamometer and emission measurement technologies and Instruments.

TEXT BOOKS

1. Khurmi. R.S. & Gupta. J.K., "A text book of Machine Design", Eurasia Publishing House (Pvt) Ltd, 2001.
2. The Automotive Chassis: Volume 1: Components Design (Mechanical Engineering Series) by Giancarlo Genta and Lorenzo Morello | 24 December 2019.
3. Bhandari V B, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, 2016.

REFERENCE BOOKS

1. Hiroshima Yamagata, "The science and technology of materials in automotive engines",Woodhead Publishing Limited, Cambridge, England.
2. Jain.R.K, "Machine Design", Khanna Publishers, New Delhi, 2005.
3. Lobna A.Elseify, Mohamad Midani, et al, Manufacturing Automotive Components from Sustainable Natural Fiber Composites(SpringerBriefs in Materials), 2021.
4. Andreas Öchsner and Holm Altenbach,Mechanical and Materials Engineering of Modern Structure and Component Design, 2015.
5. George C. Sih, Alberto Carpinteri, et al, Advanced Technology for Design and Fabrication of Composite Materials and Structures:Applications to the Automotive, Marine, Aerospace and Applications of Fracture Mechanics, 2010

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	2	2	-	-	-	-	-	-	-	2	-	2
CO2	3	3	3	2	-	-	-	-	-	-	-	2	-	2
CO3	3	3	2	3	-	-	-	-	-	-	-	2	-	2
CO4	3	3	3	3	-	-	-	-	-	-	-	2	-	2
CO5	3	2	2	2	-	-	-	-	-	-	-	2	-	2
AVG	**3**	**2.8**	**2.4**	**2.4**	-	-	-	-	-	-	-	**2**	-	2

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

24OMT203 GREEN MANUFACTURING DESIGN AND PRACTICES **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To introduce the concept of environmental design and industrial ecology.
- To impart knowledge about air pollution and its effects on the environment.
- To enlighten the students with knowledge about noise and its effects on the environment.

UNIT I DESIGN FOR ENVIRONMENT AND LIFE CYCLE ASSESSMEN **9**

Environmental effects of design -selection of natural friendly material - Eco design - Environmental damage Material flow and cycles – Material recycling – Emission less manufacturing- Industrial Ecology – Pollution prevention – Reduction of toxic emission – design for recycle.

UNIT II AIR POLLUTION SAMPLING **9**

Primary and Secondary Pollutants, Automobile Pollutants, Industrial Pollution, Ambient air quality Standards, Metrological aspects of air Pollution, Temperature lapse Rates and Stability-wind velocity and turbulence-Pump behavior dispersion of air Pollutants-solution to the atmosphere dispersion equation- the Gaussian Plume Model, Air pollution sampling-collection of gaseous air pollutants-collection of particulate pollutants-stock sampling, analysis of air pollutants-sulfur dioxide-nitrogen dixide, carbon monoxide, oxidants and ozone.

UNIT III NOISE POLLUTION AND CONTROL **9**

Frequency and Sound Levels, Units of Noise based power radio, contours of Loudness. Effect of human, Environment and properties, Natural and Anthrogenic Noise Sources, Measuring Instruments for frequency and Noise levels, Masking of sound, Types, Kinetics, Selection of different reactors used for waste treatment, Treatment of noise at source, Path and Reception, Sources of noise, Effects of noise- Occupational Health hazards, thermal Comforts, Heat Island Effects, Radiation Effects.

UNIT IV WATER DEMAND AND WATER QUALITY **9**

Factors affecting consumption, Variation, Contaminants in water, Nitrates, Fluorides, Detergents, taste and odour, Radio activity in water, Criteria, for different impurities in water for portable and non-portable use, Point and non-point Source of pollution, Major pollutants of Water, Water Quality Requirement for different uses, Global water crisis issues.

UNIT V GREEN CO-RATING **9**

Ecological Footprint - Need For Green Co-Rating – Green Co-Rating System – Intent – System Approach – Weightage- Assessment Process – Types Of Rating – Green Co- Benefits – Case Studies Of Green Co- Rating.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain the environmental design and selection of eco-friendly materials.

CO2: Analyse manufacturing processes towards minimization or prevention of air pollution.

CO3: Analyse manufacturing processes towards minimization or prevention of noise pollution.

CO4: Analyse manufacturing processes towards minimization or prevention of water pollution.

CO5: Evaluate green co-rating and its benefits.

TEXT BOOKS

1. Gradel.T.E. and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010.
2. Rao M.N. and Dutta A.K. “Wastewater treatment”, Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006.
3. Gradel.T.E. and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010.

REFERENCE BOOKS

1. Frances Cairncross– Costing the Earth: The Challenge for Governments, the Opportunities for Business – Harvard Business School Press – 1993.
2. World Commission on Environment and Development (WCED), Our Common Future, Oxford University Press 2005.
3. Rao M.N. and Dutta A.K. "Wastewater treatment", Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006.
4. Rao CS Environmental Pollution Control Engineering-, Wiley Eastern Ltd., New Delhi, 2006.
5. Lewis H Bell and Douglas H Bell, Industrial noise control, Fundamentals and applications, Marcel Decker, 1994.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	2
CO2	2	2	2	-	-	-	-	-	-	-	-	-	-	2
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	2
CO4	2	2	2	-	-	-	-	-	-	-	-	-	-	2
CO5	2	2	2	-	-	-	-	-	-	-	-	-	-	2
AVG	**2**	**2**	**2**	-	-	-	-	-	-	-	-	-	-	2

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

24OMT204 SEMICONDUCTOR MANUFACTURING **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To provide the students with a comprehensive understanding of the fundamental principles of semiconductor materials, devices and technology.
- To explore the operational principles of various semiconductor devices, processes involved in the fabrication.
- Apply their knowledge in designing and analyzing basic semiconductor circuits and systems.

UNIT I INTRODUCTION TO SEMICONDUCTOR MATERIALS **9**

Definition and types, comparison with conductors and insulators; bonding and structure - crystal structure (diamond, zinc blende), covalent bonding in semiconductors; energy bands – energy band theory, conduction and valence bands, bandgap and its significance; carrier statistics – electrons and holes, effective mass, fermi level and its significance.

UNIT II SEMICONDUCTOR DEVICES AND THEIR OPERATION **9**

P-N junction – formation and properties, depletion region, forward and reverse bias characteristics; diodes – types and applications; bipolar junction transistors – structure and operation, current gain, common configurations; Field effect transistor – JFETs and MOSFETs, threshold voltage and I-V characteristics, applications.

UNIT III FABRICATION TECHNIQUES **9**

Crystal growth and wafer preparation – czochralski process, wafer slicing and polishing; oxidation – thermal oxidation process, properties of silicon dioxide; photolithography – photoresist application, exposure and development; etching and doping – wet and dry etching techniques, diffusion and ion implantation; thin film deposition – chemical vapor deposition and physical vapor deposition; fabrication for ceramic components – tapecasting, sintering, machining , challenges in processing ceramic materials, integration with semiconductor fabrication process.

UNIT IV CHARACTERIZATION AND TESTING OF SEMICONDUCTORS **9**

Electrical characteristics – I-V and C-V measurements, carrier lifetime and mobility; Optical characterization – photoluminescence and Raman spectroscopy, absorption and reflection measurements; structural characterization – x-ray diffraction, SEM, TEM; Reliability and Failure analysis – stress testing, common failure mechanisms, techniques for failure analysis; characterization of ceramic materials – mechanical testing, thermal properties, electrical properties.

UNIT V CERAMICS IN SEMICONDUCTOR TECHNOLOGY **9**

Overview of applications in semiconductor devices and fabrication processes, comparison with other materials used in semiconductors; ceramic substrates – types of substrates, properties and advantages of ceramic substrates, applications in power electronics, RF components and high frequency devices; ceramic packaging – importance of packaging in semiconductor devices, types of ceramic packaging, advantages, thermal management and reliability; ceramic s in MEMs – role of ceramics in MEMs, common materials and applications; ceramic dielectrics – types of ceramic dielectric materials, properties and applications, role of high k dielectrics for advanced semiconductor devices

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Apply the fundamental concepts of semiconductor physics.

CO2: Analyze and describe the operation of various semiconductor devices.

CO3: Acquire knowledge of the key processes in semiconductor device fabrication.

CO4: Evaluate the properties and performance of semiconductor materials and devices.

CO5: Use of ceramics in semiconductor technology including advancements in materials and fabrication techniques

TEXT BOOKS

1. Peter Y Yu, Manuel Cardona, “Fundamentals of Semiconductors: Physics and Material Properties”.1995
2. Dieter K Schroder, “Semiconductor Material and Device Characterization”.2006
3. Donald A Neamen, “Semiconductor Physics and Devices”.2002

REFERENCE BOOKS

1. Adel S Sedra, Kenneth C Smith, "Microelectronic Circuits".OUP USA 2003.
2. Ben G Streetman, Sanjay Banerjee, "Solid State Electronic Devices", Pearson Education," 2015..
3. Stephen A Campbell, "The Science and Engineering of Microelectronic Fabrication". Oxford Univ Press, 2001.
4. Hong Xiao, "Introduction to Semiconductor Manufacturing Technology",Pearson Education, 2000.
5. C Barry Carter, M Grant Norton, "Ceramic Materials: Science and Engineering", 2019.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	-	3	-	-	-	-	-	-	-	-	-	2
CO2	3	2	-	3	-	-	-	-	-	-	-	-	-	2
CO3	3	2	-	3	-	-	-	-	-	-	-	-	-	2
CO4	3	2	-	3	-	-	-	-	-	-	-	-	-	2
CO5	3	2	-	3	-	-	-	-	-	-	-	-	-	2
AVG	**3**	**2**	-	**3**	-	-	-	-	-	-	-	-	-	2

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

24OMT205 FUTURE ENERGY RESOURCES AND MOBILITY **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To expose the students to various future energy resources and mobility.
- To explore the various bio, solar, wind, fuel cell energy technologies.
- To study the various types of energy storage devices and technologies and them comparison.

UNIT I CURRENT AND FUTURISTIC ENERGY RESOURCES **9**

High Carbon Fuels - Gasoline and Diesel Fuels. Low Carbon Fuels – Ethanol, Methanol, Isobutanol, Dimethyl Ether(DME), Polyoxymethylene Dimethyl Ether (PODE), Compressed and Liquified Natural Gas (CNG & LNG). Zero Carbon Fuels – Hydrogen and Ammonia Fuels. – Physiochemical Properties – Improvements in Fuel Quality as per BS Norms – Current and Future plans on storage and distribution infrastructures.

UNIT II ALTERNATE ENERGY RESOURCES **9**

Fuel Cell stacks – Types – Working, Batteries – Types – Working – Materials, Comparison of Fuel Cell and Battery. Future scopes in Fuel Cell and Batteries.

UNIT III CURRENT AND FUTURE INTERNAL COMBUSTION ENGINES (ICE) FOR MOBILITY **9**

BSVI Qualified ICE Powered Vehicles and Technologies, Conventional Hybrid Vehicle

Technologies, Advanced Combustion Mode enabled ICEs and Hybrids, Hydrogen and Ammonia Fuelled ICEs, Flexi Fuel Engines. Low Carbon Fuelled ICEs. Decarbonisation and De- fossilization.

UNIT IV ALTERNATE ENERGY RESOURCES POWERED MOBILITY 9

Fuel Cell Powered Vehicle Technologies, Battery Powered Electric Vehicle Technologies, Requirements of fueling and charging Infrastructures, Comparison of Merits and Demerits, Life cycle analysis and Carbon credit gained between Alternate and Conventional Fuel powered mobility.

UNIT V DATA ANALYSIS OF CURRENT AND FUTURE MOBILITY APPLICATIONS 9

Case studies in present and future technologies in mobility design and its performance analysis.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain on impact of high and low carbon energy resource on mobility.
CO2: Synergetic knowledge on fuel cells Battery energy sources.
CO3: Knowledge on conventional and future propulsion system.
CO4: Knowledge on alternate energy sources powered mobility.
CO5: Capability to perform data analysis of conventional and future propulsion systems.

TEXT BOOKS

1. Pundir B.P. “I.C. Engines Combustion and Emission”, Narosa Publishing House, 2010.
2. Barclay F.J., “Fuel Cells, Engines and Hydrogen”, Wiley, 2009.
3. Bent Sorensen (Sørensen), Hydrogen and Fuel Cells: Emerging Technologies and Applications, Elsevier, UK 2005.

REFERENCE BOOKS

1. Rakesh_Kumar_Maurya Characteristics and Control of Low Temperature Combustion Engines, Springer - ISSN 0941-5122 ISSN 2192-063X.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
3. Rand D.A.J, Woods, R & Dell RM Batteries for Electric vehicles, John Wiley & Sons 1998
4. HCCI and CAI Engines – Nptel - https://nptel.ac.in/courses/112104033/33 CO PO PS
5. HCCI Diesel Engines - Nptel - https://nptel.ac.in/courses/112104033/34.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	2
CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	2
CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	2
CO4	3	2	2	-	-	-	-	-	-	-	-	-	-	2
CO5	3	2	2	-	-	-	-	-	-	-	-	-	-	2
AVG	3	2.4	2	-	-	-	-	-	-	-	-	-	-	2

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

24OMT206 FAILURE ANALYSIS AND NDT TECHNIQUES **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understating the importance of failure analysis.
- To study the causes of failures, principles of NDT methods.
- To gain knowledge on various test methods.

UNIT I INTRODUCTION TO FAILURE ANALYSIS **9**

Need and scope of failure analysis. Engineering Disasters in history and their failure analysis. Sources of failures. Description & origin of Processing defects. Types of failures- Ductile & Brittle, Fracture Analysis, FMEA. Application of fracture mechanics concepts to design for safety. NDT for failure analysis- an overview.

UNIT II DYE PENETRANT & MAGNETIC PARTICLE INSPECTION **9**

Importance of NDT, Visual Inspection: Tools, applications and limitations, Liquid Penetrant Inspection (LPI): Principles, Requisites of a good penetrant and developer, Types of penetrants and developers, Techniques, procedures, interpretation and evaluation of penetrant test indications, advantages, and limitations, case study. Magnetic Particle Inspection (MPI): Principles, Magnetization- Methods, techniques. Continuous & Residual testing of MPI, System sensitivity, Interpretation of MPI indications, Advantages and limitations, case study.

UNIT III ULTRASONIC TESTING **9**

Principle, type of Ultrasonic waves, mode conversion in ultrasonics, Principle, UT testing methods: Contact testing and immersion testing, normal beam and straight beam testing, angle beam testing, dual crystal probe, Ultrasonic Testing Techniques: Resonance testing, Through transmission technique, Pulse echo testing technique, Instruments used in UT, Transducer types, Reference blocks with artificially created defects, Calibration of equipment, A-Scan, B-scan & C-scan, case study.

UNIT IV EDDY CURRENT TESTING & THERMOGRAPHY **9**

Eddy current Testing: Principles, Physics aspects of ECT- conductivity, permeability, resistivity, inductance, inductive reactance, impedance, Filed factor and lift-off effect, edge effect, end effect, Depth of penetration of ECT, Instrumentation, application of ECT,

advantages, limitations, case study. Thermography: Principles, Contact and non-contact inspection methods, Heat sensitive paints and papers, thermally quenched phosphors, Liquid crystals, techniques for applying liquid crystals, advantage and limitations, Infrared radiation and infrared detectors, applications, case study.

UNIT V RADIOGRAPHY TESTING **9**

Principle, electromagnetic radiation sources, X-ray sources, Production of X-rays, High energy X-ray source, Gama ray source, Properties of X-rays and gamma rays, Inspection techniques, Exposure, Real-time radiography, Films and screens used in radiography, Quality of radiographic film processing, interpretation, evaluation of test results, Computed Tomography, Safety aspects required in radiography, Applications, advantages and limitations, case study.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Discuss on the various failures, their analysis and their importance.

CO2: Adapt the Penetrant testing procedures for evaluating the surface defects.

CO3: Interpret the images and the results obtained from the Thermographic technique and the Eddy current testing.

CO4: Describe the testing procedure and analyze the results obtained in the Ultrasonic inspection.

CO5: Explain the techniques involved in the Radiographic testing and the various advancements in Radiography.

TEXT BOOKS

1. Paul E Mix, “Introduction to Non-destructive testing: a training guide”, Wiley, 2nd edition New Jersey, 2005.
2. ASM Metals Handbook, “Non-Destructive Evaluation and Quality Control”, American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17, 2000.
3. Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing”, Narosa Publishing House, 2009.

REFERENCE BOOKS

1. ASM International, ASM Handbook, Volume 17: Nondestructive Evaluation of Materials, 2018.
2. B. Hull and V. John, Non-Destructive Testing. New York, NY, USA: Springer, 2012.
3. N. Ida, C. Boller, and R. Diederichs, Eds., Handbook of Advanced Nondestructive Evaluation, 2nd ed. Cham, Switzerland: Springer, 2023.
4. Chuck Hellier, “Handbook of Nondestructive Evaluation”, Mc Graw Hill, 2021.
5. G. Lacidogna, Ed., Nondestructive Testing (NDT). Basel: MDPI, 2021.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	2	2	-	-	-	-	-	-	-	-	-	2
CO2	3	-	2	2	-	-	-	-	-	-	-	-	-	2
CO3	3	2	2	2	-	-	-	-	-	-	-	-	-	2
CO4	3	2	2	2	-	-	-	-	-	-	-	-	-	2
CO5	3	2	2	2	-	-	-	-	-	-	-	-	-	2
AVG	3	2	2	2	-	-	-	-	-	-	-	-	-	2

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

24OBT201 HOSPITAL MANAGEMENT **L T P C**

3 0 0 3

COURSE OBJECTIVES

- Understanding Health System Organization.
- To know Regulatory Requirements and Health Care Codes.
- To learn Equipment and Maintenance Management.

UNIT I HEALTH SYSTEM **9**

Health organization of the country, the state, the cities and the region, Health Financing System, Organization of Technical Section.

UNIT II HOSPITAL ORGANISATION AND MANAGEMENT **9**

Management of Hospital organization, Nursing section Medical Sector, Technical Department, Definition and Practice of Management by Objective, Transactional Analysis, Human relation in Hospital, Legal aspect in Hospital Management.

UNIT III REGULATORY REQUIREMENT AND HEAITH CARE CODES **9**

FDA Regulation, joint commission of Accreditation for Hospitals, National Fire Protection Association Standard, IRPC.

UNIT IV EQUIPMENT MAINTENANCE MANAGEMENT **9**

Organizing Maintenance Operations, Paper Work Control, Maintenance Job, Planning Maintenance Work, Measurement and Standards, Preventive Maintenance, Maintenance Budgeting and Forecasting, Maintenance Training.

UNIT V TRAINED TECHNICAL PERSONNEL **9**

Function of Clinical Engineer, Role to be performed in Hospital, Man power Market, Professional Registration, Structure in hospital.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Explain the principles, staffing and marketing processes, discussing their significance.

CO2: Manage their role in effective and efficient management of health care organizations.

CO3: Analyze the various regulations and standards to be followed in hospitals for safety.

CO4: Evaluate various aspects of equipment maintenance.

CO5: Apply the aspects of managing the hospital in terms of staff, marketing and the use of computers.

TEXT BOOKS

1. Cesar A. Caceresand Albert Zara,The practice of Clinical Engineering, Academic Press, 1977.
2. Webster,J.G. and Albert M.Cook, Clinical Engineering Principles and Practices, Prentice Hall Inc. Englewood Cliffs, 1979.
3. Antony Kelly, Maintenance planning and control, Butterworths London, 1984.

REFERENCE BOOKS

1. Hans P feiff,Vera Dammann (Ed.) Hospital Engineering in Developing Countries, Zreport Eschborn, 1986.
2. Jacob Kline, Handbook of Bio Medical Engineering, Academic Press, SanDiego1988.
3. R.C.Goyal, Handbook of Hospital Personal Management, Prentice Hall of India,1993.
4. G. D. Kunders, "Hospitals–Facilities Planning and Management", TMH, New Delhi–5th edition Reprint 2007.
5. Peter Berman, "Health Sector Reforming Developing Countries", Harvard University Press, 1995.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	1	2	1	-	-	1	-	1	-	1	1	-	-	2
CO2	1	2	1	-	-	1	-	1	-	1	1	-	-	2
CO3	1	2	1	-	-	1	-	1	-	1	1	-	-	2
CO4	1	2	1	-	-	1	-	1	-	1	1	-	-	2
CO5	1	2	1	-	-	1	-	1	-	1	1	-	-	2
AVG	**1**	**2**	**1**	**-**	**-**	**1**	**-**	**1**	**-**	**1**	**1**	**-**	**-**	2

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

24OBT202 ASSIST DEVICES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To study the role and importance of machines that takes over the functions of the heart and lungs.
- To study various mechanical techniques that helps a non-functioning heart.
- To learn the functioning of the unit which does the clearance of urea from the blood.

UNIT I HEART LUNG MACHINE AND ARTIFICIAL HEART 9

Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, Blood Handling System, Functioning and different types of Artificial Heart.

UNIT II CARDIAC ASSIST DEVICES 9

Assisted through Respiration, Right and left Ventricular Bypass Pump, Auxiliary ventricle, Open Chest and Closed Chest type, Intra Aortic Balloon Pumping, Prosthetic Cardiac valves.

UNIT III ARTIFICIAL KIDNEY 9

Indication and Principle of Haemodialysis, Dialysate, types of filter and membranes, Different types of hemodialyzers, Wearable Artificial Kidney, Implanting Type.

UNIT IV RESPIRATORY AND HEARING AIDS 9

Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, SISI, masking techniques.

UNIT V RECENT TRENDS 9

Transcutaneous electrical nerve stimulator, bio-feedback, Electrical safety Analyser, Latest use of assistive technology for health care Information technology, Future trends in assistive technology.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Explain the principles and construction of artificial heart.

CO2: Discuss the various mechanical techniques that improve therapeutic technology.

CO3: Explain the functioning of the membrane or filter that cleanses the blood.

CO4: Describe the tests to assess the hearing loss and development of wearable devices for the same.

CO5: Analyze and research on electrical stimulation and bio feedback techniques in rehabilitation and physiotherapy.

TEXT BOOKS

1. Gray E Wnek, Gray L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering – Marcel Dekker Inc New York 2004.
2. John.G. Webster – Bioinstrumentation – John Wiley & Sons (Asia) Pvt Ltd-2004.
3. Joseph D. Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press, 2006.

REFERENCE BOOKS

1. Andreas.F.Vonracum, “Handbook of biomaterial evaluation”, Mc-Millan publishers, 1980.
2. GrayEWnek, GrayLBrowlin, “Encyclopedia of Biomaterials and Biomedical Engineering” Marcel Dekker Inc New York 2004.

3. D.S.Sunder, “Rehabilitation Medicine”, 3rdEdition, Jaypee Medical Publication, 2010.
4. Albert M.Cooka nd WebsterJ.G., Therapeutic Medical Devices, Prentice Hall Inc., New Jersey,1982.
5. KolffW.J., Artificial Organs, John Wiley and Sons, NewYork, 1979.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1	1	-	-	-	-	-	-	-	-	-	2
CO2	3	2	1	1	-	-	-	-	-	-	-	-	-	2
CO3	3	2	1	1	-	-	-	-	-	-	-	-	-	2
CO4	3	2	1	1	-	-	-	-	-	-	-	-	-	2
CO5	3	2	1	1	-	-	-	-	-	-	-	-	-	2
AVG	**3**	**2**	**1**	**1**	-	-	-	-	-	-	-	-	-	2

1-Low, 2-Medium, 3-High, “-” – No correlation

24OBT203 ROBOTICS IN MEDICINE **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To Get introduced to the fundamental of robotics and position analysis.
- Learn about Parallel robots, different types of motions and force analysis.
- Know the basics of trajectory planning, Motion control systems and actuators.

UNIT I FUNDAMENTALS AND POSITION ANALYSIS **9**

Fundamentals, Degrees of freedom, Joints, Coordinates, Reference frames, Programming modes, Collaborative robots, Position analysis – Robots as mechanisms, Conventions, Transformations, Denavit Hartenberg Representation, Degeneracy and Dextrerity, Position analysis of Articulated robot.

UNIT II PARALLEL ROBOTS, DIFFERENTIAL MOTIONS AND FORCE ANALYSIS **9**

Parallel robots, Planar and Spatial parallel robots, Differential relationships, The Jacobian, Large scale motions, Frame vs Robot, Differential motions and change, Hand frame, Operator, Jacobian and Inverse for Screw based and Parallel Robots, Differential operator, Lagarangian mechanics.

UNIT III TRAJECTORY PLANNING, MOTION CONTROL SYSTEMS AND ACTUATORS **9**

Path and Trajectory, Joint Space and Cartesian Space Descriptions and Trajectory Planning, Cartesian, Trajectory Recording, Basics, Steady state error, Root locus, Proportional, Compensators, Multiple IO systems, Characteristics of Hydraulic, Pneumatic, Electric motors, Other actuators.

UNIT IV SENSORS, IMAGE PROCESSING AND ANALYSIS WITH VISION SYSTEMS **9**

Sensor Characteristics, Micro switches, Visible and IR, Touch, Proximity, Transforms – Fourier, Hough, Resolution, Image processing, Segmentation, Region growing and splitting, Object recognition, Specialized lighting, Compression, Colour images.

UNIT V FUZZY CONTROL AND APPLICATIONS IN MEDICINE **9**

Fuzzy control - Crisp vs Fuzzy, Sets, Inference rules, Defuzzification, Simulation, Applications in Biomedical Engineering and rehabilitation, Nanobots in medicine, Cardiac and abdominal procedures with tele operated robots, Orthopedic surgery with cooperative robots

TOTAL:45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Describe the fundamental of robotics and position analysis.

CO2: Outline the functioning of parallel robots, different types of motions and force analysis.

CO3: Portray the basics of trajectory planning, Motion control systems and actuators.

CO4: Recognize and explain the use of various sensors and vision systems in robotics.

CO5: Employ Fuzzy control in robotics and apply it to Robotics in Medicine.

TEXT BOOKS

1. S.B. Niku, Introduction to Robotics, Analysis, Control, Applications, Pearson Education, 2020.
2. Robert Schilling, Fundamentals of Robotics-Analysis and control, Prentice Hall of India, 2003.
3. Fu Gonzales and Lee, “Robotics” , Mc Graw Hill, 1987.

REFERENCE BOOKS

1. Grover, Wiess, Nagel and Oderey, Industrial Robotics, McGraw Hill, 2012.
2. Klafter, Chmielewski and Negin, Robot Engineering, Prentice Hall Of India, 1989.
3. Mittal, Nagrath, Robotics and Control, Tata McGraw Hill publications, 2003.
4. Bijay K. Ghosh, NingXi, T.J.Tarn, Controlling Robotics and Automation Sensor – Based integration, Academic Press, 1999.
5. Mikell P. Groover, Mitchell Weiss, Industrial robotics, technology, Programming and Applications, McGraw Hill International Editions, 1986.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1	1	1	-	-	-	-	-	-	-	-	2
CO2	3	2	1	1	1	-	-	-	-	-	-	-	-	2
CO3	3	2	1	1	1	-	-	-	-	-	-	-	-	2
CO4	3	2	1	1	1	-	-	-	-	-	-	-	-	2
CO5	3	2	1	1	1	-	-	-	-	-	-	-	-	2
AVG	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	2

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

24OBT204 DSP ARCHITECTURE **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To introduce architectural features of programmable DSP Processors of TI and Analog Devices.
- To give practical examples of DSP Processor architectures for better understanding.
- To develop the programming knowledge using Instruction set of DSP Processors.

UNIT I INTRODUCTION TO DIGITAL SIGNAL PROCESSING **9**

Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time- invariant systems, Digital filters, Decimation and interpolation.

UNIT II ARCHITECTURES FOR PROGRAMMABLE DSP DEVICES **9**

Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation UNIT, Programmability and Program Execution, Speed Issues, Features for External interfacing.

UNIT III PROGRAMMABLE DIGITAL SIGNAL PROCESSORS **9**

Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming.

UNIT IV ANALOG DEVICES FAMILY OF DSP DEVICES **9**

Analog Devices Family of DSP Devices – ALU and MAC block diagram, Shifter Instruction, Base Architecture of ADSP 2100, ADSP-2181 high performance Processor.

UNIT V INTERFACING MEMORY **9**

Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Classify RFID systems based on frequency, architecture and performance.

CO2: Define standards for RFID technology.

CO3: Illustrate the operation of various components of RFID systems.

CO4: Describe the privacy and security issues in RFID Systems.

CO5: Discuss the construction and applications of RFID enabled sensor.

TEXT BOOKS

1. Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.
2. A Practical Approach to Digital Signal Processing - K Padmanabhan, R. Vijayarajeswaran, Ananthi. S, New Age International, 2006/2009.
3. Embedded Signal Processing with the Micro Signal Architecture Publisher: Woon-Seng Gan,Sen M. Kuo, Wiley-IEEE Press, 2007.

REFERENCE BOOKS

1. Digital Signal Processors, Architecture, Programming and Applications – B. Venkataramani and M. Bhaskar, 2002, TMH.
2. Digital Signal Processing – Jonatham Stein, 2005, John Wiley.
3. DSP Processor Fundamentals, Architectures & Features – Lapsley et al. 2000, S. Chand & Co.
4. Digital Signal Processing Applications Using the ADSP-2100 Family by The Applications Engineering Staff of Analog Devices, DSP Division, Edited by Amy Mar, PHI.
5. The Scientist and Engineer's Guide to Digital Signal Processing by Steven W. Smith, Ph.D., California Technical Publishing, ISBN 0-9660176-3-3, 1997.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	1	1	1	-	-	-	-	2	1	2	2	-	2
CO2	3	3	1	1	-	-	-	-	2	1	2	2	-	2
CO3	3	3	1	1	-	-	-	-	2	1	2	2	-	2
CO4	3	3	1	1	-	-	-	-	2	1	2	2	-	2
CO5	3	3	1	1	-	-	-	-	2	1	2	2	-	2
AVG	**3**	**2.6**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**1**	**2**	**2**	**-**	2

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

24OBT205 IMAGE PROCESSING TECHNIQUES **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To become familiar with digital image fundamentals.
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To study the image segmentation and representation techniques.

UNIT I DIGITAL IMAGE FUNDAMENTALS **9**

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

UNIT II IMAGE ENHANCEMENT **9**

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

UNIT III IMAGE RESTORATION **9**

Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering .

UNIT IV IMAGE SEGMENTATION **9**

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation Region growing – Region splitting and merging – Morphological processing-erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

UNIT V IMAGE COMPRESSION AND RECOGNITION **9**

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Explain and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.

CO2: Operate on images using the techniques of smoothing, sharpening and enhancement.

CO3: Explore the restoration concepts and filtering techniques.

CO4: Learn the basics of segmentation, features extraction, compression and recognition methods for color models.

CO5: Comprehend image compression concepts.

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.
3. G. R. Sinha and B. C. Patel, Medical Image Processing Concepts and Applications, PHI, 2014.

REFERENCE BOOKS

1. Kenneth R. Castleman, 'Digital Image Processing', Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, 'Digital Image Processing using MATLAB', Pearson Education, Inc., 2011.
3. D,E. Dudgeon and RM. Mersereau, 'Multidimensional Digital Signal Processing', Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, 'Digital Image Processing', John Wiley, New York, 2002.
5. Milan Sonka et al 'Image processing, analysis and machine vision', Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	-	-	-	-	-	-	-	-	-	2	-	2
CO2	3	2	-	-	-	-	-	-	-	-	-	2	-	2
CO3	3	2	-	-	-	-	-	-	-	-	-	2	-	2
CO4	3	2	-	-	-	-	-	-	-	-	-	2	-	2
CO5	3	2	-	-	-	-	-	-	-	-	-	2	-	2
AVG	**3**	**2**	-	-	-	-	-	-	-	-	-	**2**	-	2

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

24OBT206 WIRELESS SENSOR NETWORKS **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understand the fundamentals of wireless sensor network.
- To gain knowledge on the MAC and Routing Protocols of WSN.
- To acquire knowledge on the protocols required for developing real time applications using WSN and 6LOWPAN.

UNIT I INTRODUCTION **9**

Principle of Wireless Sensor Network -Introduction to wireless sensor networks- Challenges, Comparison with ad hoc network, Node architecture and Network architecture, design principles, Service interfaces, Gateway, Short range radio communication standards-IEEE 802.15.4, Zigbee and Bluetooth. Physical layer and transceiver design considerations.

UNIT II MAC AND ROUTING PROTOCOLS **9**

MAC protocols – fundamentals, low duty cycle protocols and wakeup concepts, contention and Schedule-based protocols - SMAC, BMAC,TRAMA, Routing protocols – Requirements, Classification -SPIN, Directed Diffusion, COUGAR, ACQUIRE, LEACH, PEGASIS.

UNIT III 6LOWPAN **9**

6LoWPAN Architecture - protocol stack, Adaptation Layer, Link layers – Addressing, Routing - MeshUnder - Route-Over, Header Compression - Stateless header compression - Context- based header compression, Fragmentation and Reassembly , Mobility – types, Mobile IPv6, Proxy Home Agent, Proxy MIPv6, NEMO –Routing – MANET, ROLL, Border routing.

UNIT IV APPLICATION **9**

Design Issues, Protocol Paradigms -End-to-end, Real-time streaming and sessions, Publish/subscribe, Web service paradigms, Common Protocols -Web service protocols, MQ telemetry transport for sensor networks (MQTT-S), ZigBee compact application protocol (CAP),Service discovery, Simple network management protocol (SNMP), Real-time transport and sessions, Industry- Specific protocols.

UNIT V TOOLS **9**

TinyOS – Introduction, NesC, Interfaces, modules, configuration, Programming in TinyOS using NesC, TOSSIM, Contiki – Structure, Communication Stack, Simulation environment – Cooja simulator, Programming.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Design solutions for WSNs applications.
CO2: Develop efficient MAC and Routing Protocols.
CO3: Design solutions for 6LOWPAN applications.
CO4: Develop efficient layered protocols in 6LOWPAN.
CO5: Use Tiny OS and Contiki OS in WSNs and 6LOWPAN applications.

TEXT BOOKS

1. V. Daniel Hunt, Alber Puglia, Mike Puglia, "RFID: A guide for radio frequency identification", Wiley & Sons, Inc., Publication, 2011.
2. Roy Want, RFID Explained, Springer 2022.
3. Amin Rida, Li Yang, Manos M. Tentzeris, RFID Enabled Sensor Design and Applications, Artech House, 2010.

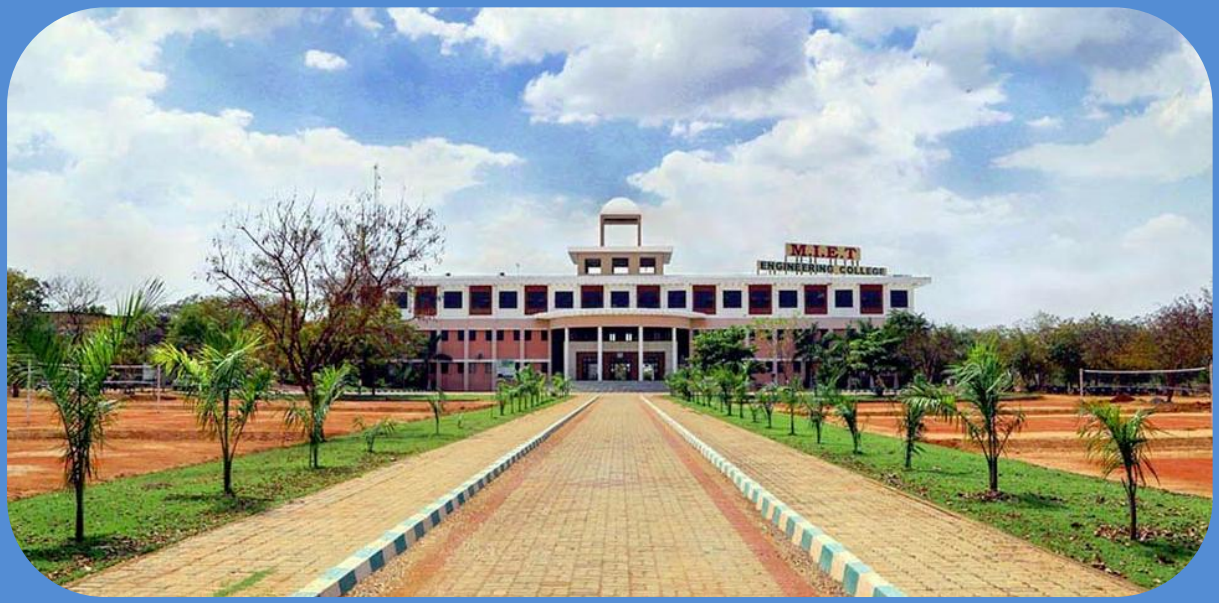
REFERENCE BOOKS

1. Holger Karl, Andreas willig, "Protocol and Architecture for Wireless Sensor Networks", John Wiley Publication, 2006.
2. Anna Forster, "Introduction to Wireless Sensor Networks", Wiley, 2017.
3. Zach Shelby Sensinode and Carsten Bormann, " 6LoWPAN: The Wireless Embedded".
4. Philip Levis, "TinyOS Programming", 2006 –www.tinyos.net.
5. The Contiki Operating System.http://www.sics.se/contiki.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	2	2	2	1	-	-	-	-	2	2	-	2
CO2	3	3	2	2	2	1	-	-	-	-	-	2	-	2
CO3	3	3	3	2	2	1	-	-	-	-	-	3	-	2
CO4	3	3	3	3	2	2	-	-	-	-	-	2	-	2
CO5	2	-	1	1	3	2	-	-	-	-	-	2	-	2
AVG	**2.8**	**2.4**	**2.2**	**2**	**2.2**	**1.4**	**-**	**-**	**-**	**-**	**2**	**2.2**	**-**	2

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