CURRICULUM AND SYLLABUS

B.E. DEGREE (ELECTRICAL AND ELECTRONICS ENGINEERING)

REGULATIONS 2020

CHOICE BASED CREDIT SYSTEM

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2020-2021 ONWARDS

Sri Ramakrishna Institute of Technology
(An Autonomous Institution)
Pachapalayam, Perur Chettipalayam, Coimbatore – 641 010
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SRI RAMAKRISHNA INSTITUTE OF TECHNOLOGY, COIMBATORE – 641010

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

I) VISION OF THE INSTITUTION

Our Vision is to develop into a World Class Technological Institute with centres of excellence in various disciplines by providing quality and value-based education with continuous upgradation of infrastructure, human resources and teaching - learning process.

II) MISSION OF THE INSTITUTION

Our Mission is to produce Quality Engineers, Scientists and Managers equipped with unbounded technical skills, domain knowledge and excellent moral values, for the advancement of the industry, business and for the emancipation of society.

III) VISION OF THE DEPARTMENT

To produce holistic electrical and electronics engineers who excel in interdisciplinary domains.

IV) MISSION OF THE DEPARTMENT

- Enable development of competent EEE graduates through technology-oriented education.
- Empower students with domain knowledge to enhance their creativity skills.

V) PROGRAMME EDUCATIONAL OBJECTIVES (PEO) FOR B.E. ELECTRICAL AND ELECTRONICS ENGINEERING PROGRAMME

PEO1: Graduates of EEE program effectively demonstrate electrical and electronics engineering knowledge and entrepreneurial skills by providing practical solutions.

PEO2: Graduates of EEE program effectively demonstrate professionalism in multi-disciplinary engineering environment, leadership quality and teamwork.

PEO3: Graduates of EEE program make contributions to knowledge and establish best engineering practice through research and development.

PEO4: Graduates of EEE program demonstrate an ethical commitment to the community and the profession through involvement with professional organizations and society.

PEO5: Graduates of EEE program engage in life-long learning as demonstrated through career advancement.

VI) CONSISTENCY OF PEO WITH MISSION OF THE DEPARTMENT

ELEMENTS OF MISSION STATEMENT OF THE PROGRAMME			
PEOs	**PEOs Statement**	**Technology oriented education (M1)**	**Domain Knowledge with creativity (M2)**
PEO1	Graduates of EEE program effectively demonstrate electrical and electronics engineering knowledge and entrepreneurial skills by providing practical solutions	2	3
PEO2	Graduates of EEE program effectively demonstrate professionalism in multi- disciplinary engineering environment, Leadership quality and teamwork.	2	2
PEO3	Graduates of EEE program make contributions to knowledge and establish best engineering practice through research and development.	2	3
PEO4	Graduates of EEE program demonstrate an ethical commitment to the community and the profession through involvement with professional organizations and society.	1	1
PEO5	Graduates of EEE program engage in life-long learning as demonstrated through career advancement.	2	3

VII) PROGRAM SPECIFIC OUTCOMES (PSO) FOR B.E. ELECTRICAL AND ELECTRONICS ENGINEERING PROGRAMME

PSO1: Ability to apply mathematics, science, electrical and electronic knowledge to solve engineering problems in the field of electrical and electronic circuits, electrical instrumentation, signal processing, power systems, power electronics, electrical drives and automation.

PSO2: Ability to design and analyze controllable, reliable and sustainable electrical and electronic systems using mathematical models, computer systems and software knowledge.

VIII) PROGRAM OUTCOMES (POs)

Program Outcomes	**Performance Criteria**	
PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	**PC1**	Apply mathematics principles to obtain solutions to engineering problems
	PC2	Use principles of mathematics, sciences and engineering in solving complex Electrical and Electronics engineering problems.
PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	**PC1**	Able to combine mathematics, scientific and engineering principles to identify and formulate well defined and open ended problems with solutions.
	PC2	Able to break down the complex Electrical and Electronics engineering problems for appropriate solutions based on specific criteria.
PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	**PC1**	Able to evaluate complex problems according to design specifications.
	PC2	Able to design various Electrical and Electronics based on appropriate knowledge and realistic constraints.
	PC3	Able to choose appropriate procedure to design key components of Electrical and Electronics based on specific needs.
PO4. Conduct investigations of	**PC1**	Able to demonstrate the experimental procedures.

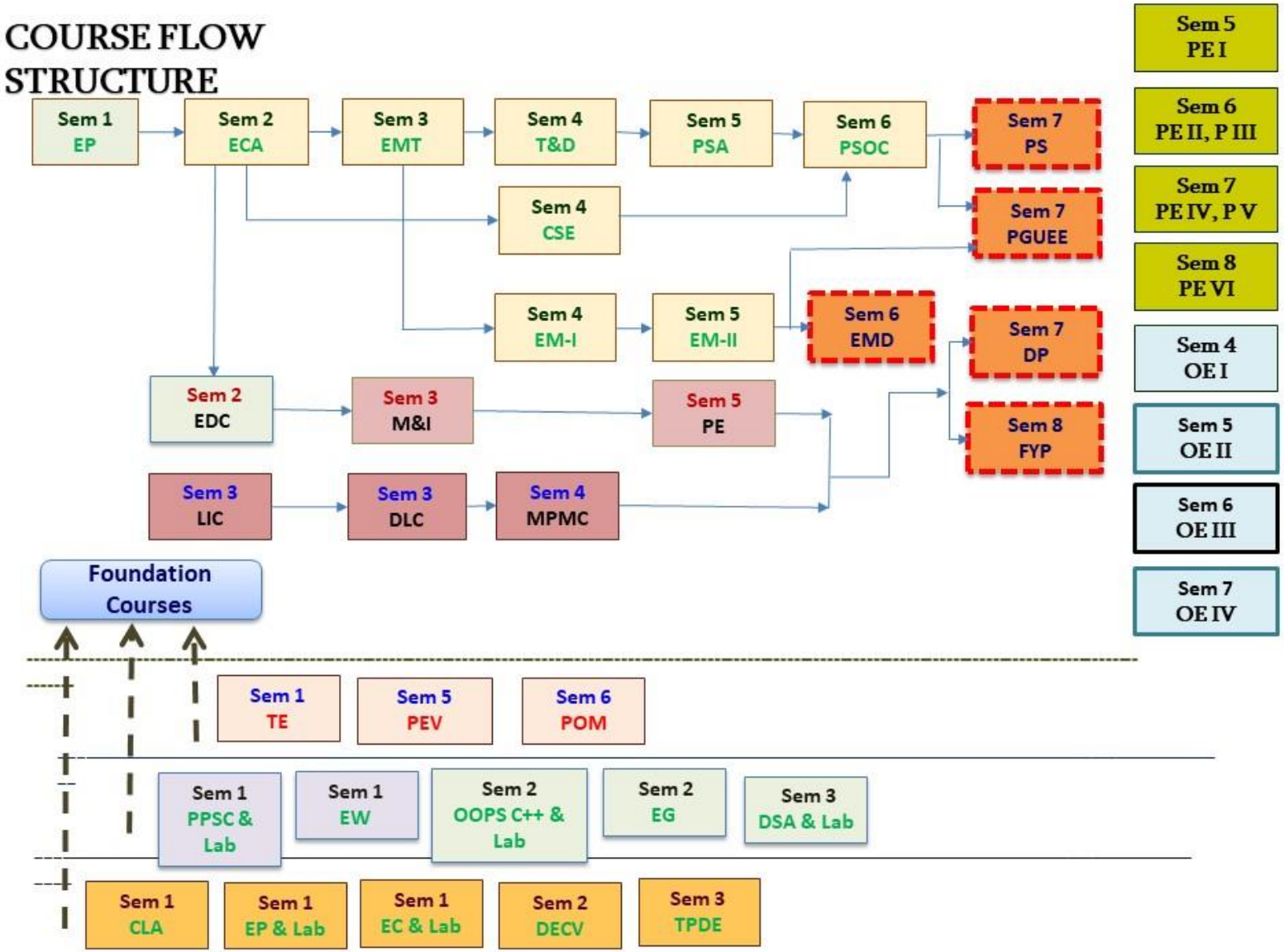
complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	**PC2**	Able to use appropriate sampling techniques to collect samples and suitable methodology to analyze the data.
	PC3	Able to apply statistical procedures to formulate a model with valid conclusions.
PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	**PC1**	Able to use appropriate modeling and simulation software / tools in solving complex Electrical and Electronics engineering problems.
	PC2	Able to use modern equipment and instruments in analysis and design process.
	PC3	Able to use appropriate resources and tools to write technical reports and oral presentations in an effective manner.
PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	**PC1**	Able to understand the global effects due to development of the Product / Policy / Event.
	PC2	Able to recognize the societal needs of their work.
PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	**PC1**	Able to understand the global impacts on environment in context to their profession.
	PC2	Able to recognize the need of sustainability concepts.
PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	**PC1**	Able to understand the ethical and professional issues.
	PC2	Able to apply the ethical codes during documentation process, report writing and oral presentations in their career.
PO9. Individual and team work: Function effectively as an individual,	**PC1**	Able to work individually and with others as a team leader in specific domains.

and as a member or leader in diverse teams, and in multidisciplinary settings.	**PC2**	Able to function effectively as a member of intradisciplinary / interdisciplinary projects.
PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	**PC1**	Able to present information in an appropriate logical order, showing the mastery of terminology to the subject and explains points explicitly with specific explanatory detail.
	PC2	Able to respond related questions correctly.
	PC3	Able to speak clearly and use appropriate technical terms during communication.
PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	**PC1**	Able to apply the appropriate methods for project planning and estimation.
	PC2	Able to accomplish the project successfully.
PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	**PC1**	Able to participate in learning / training exercises to enhance knowledge in engineering.
	PC2	Able to access information from various sources in an effective and efficient manner.

IX) CURRICULUM STRUCTURE

S. No	Course Work - Subject Area	Credits/Semester								Credits-Total	AICTE Requirement
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities and Social Sciences including Management Courses (HSMC)	3	3	-	-	3	-	-	-	9	9 - 12
2	Basic Science Courses *(BS)*	13.5	5.5	4	-	-	-	-	-	23	23 - 27
3	Engineering Science Courses*(ES)*	7	7	3	4.5	-	-	-	-	21.5	21 – 27
4	Professional Core Courses (PC)	-	4	12	17	13	12.5	6	-	64.5	52 - 65
5	Professional Elective Courses (PEC)	-	-	-	-	3	6	6	3	18	18
6	Open Electives (OE)	-	-	3	3	3	3	-	-	12	12
7	Employability Enhancement Courses (EEC)	-	-	-	-	-	-	4	8	12	12
	Total	23.5	19.5	22	24.5	22	21.5	16	11	160	

II) CURRICULUM FLOW



CURRICULUM STRUCTURE (R-2020)

SEMESTER – I

S. No.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	20HSG01	Technical English	HS	2	0	2	4	3
2	20MHG01	Calculus and Linear Algebra	BS	3	1	0	4	4
3	20PHG01	Engineering Physics	BS	3	1	0	4	4
4	20CHG01	Engineering Chemistry	BS	3	1	0	4	4
5	20ITG01	Programming for Problem Solving using C	ES	3	0	0	3	3
PRACTICALS								
6	20PHG02	Engineering Physics Lab	BS	0	0	3	3	1.5
7	20ITG02	Programming in C Laboratory	ES	0	0	4	4	2
8	20MEG02	Engineering Workshop	ES	0	0	4	4	2
			Total	**14**	**3**	**13**	**30**	**23.5**

SEMESTER – II

S. No.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	20HSG02	Universal Human Values II : Understanding Harmony	HS	3	0	0	3	3
2	20MHG02	Differential Equations and Complex Variables	BS	3	1	0	4	4
3	20CSG01	Object Oriented Programming using C++	ES	3	0	0	3	3
4	20EE001	Electric Circuit Analysis	PC	3	1	0	4	4

PRACTICALS								
5	20CHG02	Engineering Chemistry Lab	BS	0	0	3	3	1.5
6	20CSG02	Programming in C++Laboratory	ES	0	0	4	4	2
7	20MEG01	Engineering Graphics	ES	0	0	4	4	2
Total				**15**	**2**	**11**	**28**	**19.5**
8	20AC001	Environmental Science and Engineering	AC	3	0	0	3	-

SEMESTER – III

S. No.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	20MHG03	Transforms and Partial Differential Equations	BS	3	1	0	4	4
2	20EEG02	Electronic Devices and Circuits	ES	3	0	0	3	3
3	20EE002	Electro Magnetic Theory	PC	3	0	0	3	3
4	20EE003	Linear Integrated Circuits and Applications	PC	3	0	0	3	3
5	20EE004	Digital Logic Circuits	PC	3	0	0	3	3
6	20xxExx	Open Elective - I	OE	3	0	0	3	3
PRACTICALS								
7	20EE005	Electric Circuit and Electron Devices Laboratory	PC	0	0	3	3	1.5
8	20EE006	Linear Integrated and Digital Circuits Laboratory	PC	0	0	3	3	1.5
			Total	**18**	**1**	**6**	**25**	**22**

SEMESTER – IV

S. No.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	20EEG06	Microprocessors and Microcontrollerss	ES	3	0	0	3	3
2	20EE007	Control Systems Engineering	PC	3	1	0	4	4
3	20EE008	Transmission and Distribution	PC	3	1	0	4	4
4	20EE009	Electrical Machines -I	PC	3	0	0	3	3
5	20EE010	Measurements and Instrumentation	PC	3	0	0	3	3
6	20xxExx	Open Elective-II	OE	3	0	0	3	3
PRACTICALS								
7	20EEG07	Microprocessors and Microcontrollers Laboratory	ES	0	0	3	3	1.5
8	20EE011	Control and Instrumentation Laboratory	PC	0	0	3	3	1.5
9	20EE012	Electrical Machines Laboratory - I	PC	0	0	3	3	1.5
			Total	**18**	**2**	**9**	**29**	**24.5**

SEMESTER – V

S. No.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	20HMG04	Professional Ethics and Values	HS	3	0	0	3	3
2	20EE013	Power System Analysis	PC	3	1	0	4	4
3	20EE014	Power Electronics	PC	3	0	0	3	3
4	20EE015	Electrical Machines -II	PC	3	0	0	3	3

5	20EEPxx	Professional Elective-I	PE	3	0	0	3	3
6	20xxExx	Open Elective-III	OE	3	0	0	3	3
PRACTICALS								
7	20EE016	Power Electronics Laboratory	PC	0	0	3	3	1.5
8	20EE017	Electrical Machines Laboratory - II	PC	0	0	3	3	1.5
			Total	**18**	**1**	**6**	**25**	**22**

SEMESTER – VI

S. NO.	**COURSE CODE**	**COURSE NAME**	**CATEGORY**	**PERIODS PER WEEK**			**TOTAL CONTACT PERIODS**	**CREDITS**
				L	**T**	**P**		
THEORY								
1	20EE018	Electrical Machine Design	PC	3	1	0	4	4
2	20EE019	Power System Operation and Control	PC	3	0	0	3	3
3	20EE020	Electrical Drives and Control	PC	3	0	2	5	4
4	20EEPxx	Professional Elective – II	PE	3	0	0	3	3
5	20EEPxx	Professional Elective -III	PE	3	0	0	3	3
6	20xxExx	Open Elective-IV	OE	3	0	0	3	3
PRACTICALS								
7	20EE021	Power System Simulation Laboratory	PC	0	0	3	3	1.5
			Total	**21**	**1**	**4**	**27**	**21.5**
8	20AC002	Constitution of India	AC	3	0	0	3	-

SEMESTER – VII

S. NO.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	20EE022	Power Generation and Utilization of Electrical Energy	PC	3	0	0	3	3
2	20EE023	Protection and Switchgear	PC	3	0	0	3	3
3	20EEPxx	Professional Elective – IV	PE	3	0	0	3	3
4	20EEPxx	Professional Elective – V	PE	3	0	0	3	3
PRACTICALS								
5	20EE901	Design Project	EC	0	0	8	8	4
			Total	**12**	**0**	**8**	**20**	**16**

SEMESTER – VIII

S. NO.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	20EEPxx	Professional Elective – VI	PE	3	0	0	3	3
PRACTICALS								
2	20EE902	Final Year Project	EC	0	0	16	16	8
			Total	**3**	**0**	**16**	**19**	**11**

TOTAL NUMBER OF CREDITS: 160

PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE – I

S. NO.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	20EEP01	High Voltage Engineering	PE	0	0	3	3	3
2	20EEP11	Renewable Energy Sources	PE	0	0	3	3	3
3	20EEP34	Introduction to Raspberry Pi	PE	0	0	3	3	3
4	20EEP44	PLC and SCADA	PE	0	0	3	3	3
5	20EEP54	Automotive Electronics	PE	0	0	3	3	3

PROFESSIONAL ELECTIVE – II

S. NO.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	20EEP05	Power Quality	PE	0	0	3	3	3
2	20EEP12	Power Plant Engineering	PE	0	0	3	3	3
3	20EEP23	Switched Mode Power Converters	PE	0	0	3	3	3
4	20EEP42	Biomedical Instrumentation	PE	0	0	3	3	3
5	20EEP32	Introduction to Embedded System	PE	0	0	3	3	3
6	20EEP56	Robot Vision	PE	0	0	3	3	3

PROFESSIONAL ELECTIVE – III

S. No.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	20EEP02	High Voltage Direct Current Transmission	PE	0	0	3	3	3
2	20EEP13	Alternate Energy and Storage Systems	PE	0	0	3	3	3
3	20EEP52	Principles of Robotics	PE	0	0	3	3	3
4	20EEP45	Sensors and Transducers	PE	0	0	3	3	3
5	20EEP55	Introduction to Image Processing	PE	0	0	3	3	3

PROFESSIONAL ELECTIVE – IV

S. NO.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	20EEP04	Smart Grid	PE	0	0	3	3	3
2	20EEP14	Energy Management and Auditing	PE	0	0	3	3	3
3	20EEP35	Digital Signal Processing	PE	0	0	3	3	3
4	20EEP43	Introduction to Industry 4.0	PE	0	0	3	3	3
5	20EEP51	Introduction to Neural Networks	PE	0	0	3	3	3

PROFESSIONAL ELECTIVE – V

S. NO.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	20EEP03	Restructured Power Systems	PE	0	0	3	3	3
2	20EEP15	Design of Photovoltaic Systems	PE	0	0	3	3	3
3	20EEP31	Microcontroller Based System Design	PE	0	0	3	3	3
4	20EEP41	Virtual Instrumentation	PE	0	0	3	3	3
5	20EEP53	Electric Vehicles	PE	0	0	3	3	3

PROFESSIONAL ELECTIVE – VI

S. NO.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	20EEP24	Special Electrical Machines and Controllers	PE	0	0	3	3	3
2	20EEP33	Wearable Electronics	PE	0	0	3	3	3
3	20EEP22	Flexible AC Transmission Systems	PE	0	0	3	3	3
4	20EEP25	Advanced Electrical Drives	PE	0	0	3	3	3
5	20EEP21	Power Electronics for Renewable Energy	PE	0	0	3	3	3

		Systems						

OPEN ELECTIVES

S. NO.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
OFFERED BY DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING								
1	20CSE01	Basics of Python Programming	OE	3	0	0	3	3
2	20CSE02	Introduction to AI	OE	3	0	0	3	3
3	20CSE03	Fundamentals of Data Science	OE	3	0	0	3	3
4	20CSE04	Basics of Internet Programming	OE	3	0	0	3	3
5	20CSE05	Introduction to Soft Computing	OE	3	0	0	3	3
OFFERED BY DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING								
1	20ECE01	Electronic Measurements and Instrumentation	OE	3	0	0	3	3
2	20ECE02	Microcontrollers and its Applications	OE	3	0	0	3	3
3	20ECE03	Introduction to Embedded Systems	OE	3	0	0	3	3
4	20ECE04	Nano Electronics and Sensors	OE	3	0	0	3	3
5	20ECE05	Principles of VLSI Systems	OE	3	0	0	3	3
OFFERED BY DEPARTMENT OF MECHANICAL ENGINEERING								
1	20MEE01	Automotive Fundamentals	OE	3	0	0	3	3
2	20MEE02	Computer Aided Design	OE	3	0	0	3	3
3	20MEE03	Power Plant Engineering	OE	3	0	0	3	3
4	20MEE04	Introduction to Robotics	OE	3	0	0	3	3

5	20MEE05	3D Printing	OE	3	0	0	3	3
OFFERED BY DEPARTMENT OF INFORMATION TECHNOLOGY								
1	20ITE01	Big Data Analytics and its Applications	OE	3	0	0	3	3
2	20ITE02	Cloud Computing Fundamentals	OE	3	0	0	3	3
3	20ITE03	Fundamentals of Internet of Things	OE	3	0	0	3	3
4	20ITE04	Introduction to Database Management Systems	OE	3	0	0	3	3
5	20ITE05	Web Interface Design and Development	OE	3	0	0	3	3
6	20ITE06	Introduction to Data Structures	OE	3	0	0	3	3
7	20ITE07	Principles of Software Engineering	OE	3	0	0	3	3

SYLLABUS

FIRST SEMESTER SYLLABUS

20HSG01	TECHNICAL ENGLISH	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

1. Take part in fluent communication and to use proper grammar in formal writing.
2. Infer analytic based writing, email writing, structures of grammar and to interpret TED talks.
3. Understand various grammatical concepts, extensive writing and to participate in role-play activities.
4. Interpret graphics, reading comprehension and to take part in presentation.
5. Organize technical reports, proposals and resume preparation.

COURSE CONTENT:

Importance of Communication

Listening: Importance of listening in the corporate world. Exposure to structured talks
Speaking: Self-introduction, Peer introduction, Extempore
Reading: Skimming and Scanning, Note-Making
Writing: Parts of Speech, Tense, Subject-Verb Agreement, Prepositions, Instructions Formal Letters (Quotations, Clarification, Placing orders & Complaint letter)

Formal Communication

Listening: Listening to motivational talks / TED talks, Note-taking practice.
Speaking: Describing a product/place, Conversation practice, Telephonic Conversation.
Reading: Reading Comprehension, Reading for specific information.
Writing: Voices, Compound Nouns, Paragraph Writing, Recommendations, Email writing, Analytical and issue based essays.

Writing Strategies

Listening: Listening to Announcements, Listening to Product description and Process
Speaking: Role-Play, Picture description.
Reading: Cloze reading, Introduction to Blogs, Social media etiquette.
Writing: Cause and Effect, Gerunds and Infinitives, Tag Questions, Modal Verbs, Checklist.

Presentation Skills

Listening: Listening to Group Discussion and Interview Skills.
Speaking: Presentation on the technical topic, Sales talk.
Reading: Interpreting pictures of visual graphics.
Writing: If Conditional Clause, Use of sequence words, Process Description.

Technical Communication

Listening: Listening to talks of scientific nature, Listening for specific information.
Speaking: Giving impromptu talks, Giving a summary of an article.
Reading: Journals, Articles both general and technical.
Writing: Purpose and Function, extended definitions Wh- questions, Resume Writing, Report (Industrial visit reports, Accident report, Feasibility Reports) Proposals.

List of Laboratory Exercises

1. Speaking - Self and Peer Introduction
2. Speaking - General Conversation on Business Context
3. Listening to short recordings
4. Listening to conversation
5. Technical Presentation (PPT)

COURSE OUTCOMES:

CO1: Ability to understand listening skills, use proper grammar, proficiency in oral communication and to write in formal English.

CO2: Ability to inculcate the concept of email writing, structures of grammar and to interpret advance listening skills.

CO3: Ability to infer the strategies of academic writing and to use advance *grammar* mechanics.

CO4: Ability to predict graphics, reading comprehension and to participate in presentation.

CO5: Ability to construct technical reports, documentations, proposals, read journals and listen for specific information

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2	-	-	3	3	3	-	-	-	2	-	1
CO2	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2	-	-	3	3	2	-	-	-	2	-	1
CO3	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2	-	-	3	3	3	-	-	-	2	-	1
CO4	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2	-	-	3	3	3	-	-	-	2	-	1

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20HSG01	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2	-	-	3	3	3	-	-	-	2	-	1

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20MHG01	CALCULUS AND LINEAR ALGEBRA	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To explain about functions of several variables which is useful in optimization.
- To make the students understand different methods for integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

COURSE CONTENT:

UNIT I MATRICES

Introduction – Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Stretching of an Elastic Membrane – Vibrating System of two masses on two springs.

UNIT II DIFFERENTIAL CALCULUS

Limit of function – One sided limit – Limit Laws – Continuity – left and right continuity – types of discontinuities – Intermediate Value Theorem – Derivatives of a function - Differentiation rules – Chain rule – Implicit differentiation – logarithmic differentiation – Maxima and minima – Mean value theorem.

UNIT III FUNCTIONS OF SEVERAL VARIABLES

Partial derivatives – Total derivative – Differentiation of implicit functions – Change of variables – Jacobian – Partial differentiation of implicit functions – Taylor's series for functions of two variables Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT IV INTEGRAL CALCULUS

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

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.

COURSE OUTCOMES:

CO1: Ability to solve practical problems that can be expressed as matrix algebra.

CO2: Ability to apply differential calculus tools in solving various application problems.

CO3: Ability to determine maxima and minima of multi variable functions.

CO4: Ability to apply different methods of integration in solving practical problems

CO5: Ability to apply multiple integral ideas in solving areas, volumes and other practical problems.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20MHG01	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-

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20PHG01	ENGINEERING PHYSICS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To know the basic concepts of acoustic and thermal insulation for solving engineering problems
- To make the students effectively to achieve an understanding of mechanics.
- To motivate the students, understand the importance of quantum physics.
- To introduce the basics of oscillations, optics and lasers.
- To enable the students to gain knowledge of electromagnetic waves.

COURSE CONTENT:

UNIT I ACOUSTICS, ULTRASONIC AND THERMAL INSULATION

Classification of Sound - decibel - Weber - Fechner law - Sabine's formula - derivation using growth and decay method - Absorption Co efficient and its determination - factors affecting acoustics of buildings and their remedies - Production of ultrasonic– Piezoelectric generator – Detection of ultrasonic waves – Applications – NDT – pulse echo system through transmission and reflection mode - thermal insulation of buildings.

UNIT II INTRODUCTION TO MECHANICS AND APPLICATIONS

Moment of inertia (M.I) - Radius of gyration - M.I of circular disc, solid cylinder, diatomic molecule - K.E of a rotating body — centre of mass – conservation of linear momentum – Relation between Torque and angular momentum - Torsional pendulum - The concept of gravity – Law of universal gravitation –weigh and weightlessness – Projectile motion – range – height – time.

UNIT III QUANTUM MECHANICS AND QUANTUM COMPUTING

Photons and light waves - Electrons and matter waves - The Schrodinger equation- Time dependent and time independent forms - meaning of wave function - Normalization - particle in an infinite potential well - Introduction to quantum computing - History of quantum computation and quantum information - Quantum bits - Quantum Physics and Computation - Global perspectives - Future directions.

UNIT IV OSCILLATIONS, OPTICS AND LASERS

Simple harmonic motion - resonance - waves on a string - standing waves - travelling waves - Energy transfer of a wave - sound waves - Doppler effect - reflection and refraction of light waves - total internal reflection - interference – Michelson interferometer - air wedge experiment. Laser - characteristics - Spontaneous and stimulated emission - population inversion - CO_2-laser, semiconductor laser - applications - holography.

UNIT V ELECTROMAGNETIC WAVES

Gauss's law – Faraday's law - Ampere's law - The Maxwell's equations - wave equation- Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves.

COURSE OUTCOMES:

CO1: Ability to understand the concepts of acoustic and thermal insulation to solve engineering problems.

.**CO2:** Ability to understand the importance of mechanics and gravitation force for engineering applications.

CO3: Ability to use the basics of quantum physics and computations in engineering field

.**CO4:** Ability to understand the concepts of wave optics and laser for engineering application.

CO5: Ability to apply the concepts of propagation of electromagnetic waves to solving engineering problems.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20PHG01	-	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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20CHG01	ENGINEERING CHEMISTRY	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To know the basic concepts of electrochemistry for solving engineering problems
- To provide knowledge on batteries and fuel cells
- To impart solid foundation in photochemistry for doing instrumental chemical analysis
- To understand the importance of water treatment for industrial and domestic use that satisfy the requirements and need for the society
- To introduce nano chemistry in order to incorporate it in the field of engineering and technology

COURSE CONTENT:

Electrochemistry

Electrochemical cells – Nernst Equation (Problems), Electrode potential – Representation of a cell -Galvanic Cell-Construction and working - Electrodes – Standard Hydrogen Electrode (SHE), Saturated Calomel Electrode (SCE) and Glass Electrode –Electrochemical Series and its applications - Conductometric titrations (Acid -Base Titration).

Batteries

Batteries – Characteristics – Current, Power, Capacity, Classification of batteries – Primary (Dry and Alkaline battery) – Secondary batteries (Lead acid and Nickel – Cadmium) and Flow batteries (Hydrogen – Oxygen and Methanol – Oxygen fuel cells) – Modern batteries – Lithium-Ion batteries – Applications.

Photochemistry and Spectroscopy

Photochemistry: Laws of photochemistry - Grotthuss-Draper law, Stark-Einstein law and Lambert-Beer Law (derivation and problems). Photo physical processes – Jablonski diagram. Chemiluminescence, photo-sensitization and photoquenching– mechanism and examples. Spectroscopy: Electromagnetic spectrum - absorption of radiation - electronic, vibrational and rotational transitions. Atomic absorption spectroscopy, UV-Vis and IR spectroscopy-principles, instrumentation (Block diagram) and applications.

Water treatment

Importance of water – Water sources – Impurities – Carbonate and Non-Carbonate Hardness (simple problems) – Potable water and its specifications, Steps involved in treatment of potable water – Disinfection methods – Internal Conditioning (Phosphate, Calgon, Carbonate and Colloidal conditioning method) - External Conditioning – Demineralisation process - Zeolite process– Desalination (Reverse Osmosis).

Nanochemistry

Basics-distinction between molecules, nanomaterials and bulk materials; size-dependent properties. Types –nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Characterization - Scanning Electron Microscope and Transmission Electron Microscope - Principle and instrumentation (block diagram). Properties (optical, electrical, mechanical and magnetic) and Applications of nanomaterials - medicine, agriculture, electronics and catalysis.

COURSE OUTCOMES:

CO1: Ability to understand the basics of electrochemistry and role of reference electrodes.

.**CO2:** Ability to understand the construction, working and applications of various batteries.

CO3: Ability to apply the laws of photochemistry in spectral analysis of chemical substances.

CO4: Ability to identify quality of water for domestic and industrial purposes through analysis of water quality parameters

CO5: Ability to apply basic concepts of Nanoscience and Nanotechnology as a key component in Engineering

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO4	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20CHG01	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-

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20ITG01	PROGRAMMING FOR PROBLEM SOLVING USING C	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course provides an introduction to computer hardware. The course further deals with problem solving techniques and their implementations through syntax and semantics of C language.

COURSE CONTENT:

Fundamentals of Computing

Basic concepts of computer organizations, Generation and classification of computers, Number System Representation, Fundamentals of algorithms, Pseudo code, Flow charts.

C Language Fundamentals

Introduction to C programming, Structure of a C program, Compilation and Linking Processes, Character Set, Identifiers, Keywords, Data Types, Constant and Variables, Statements, Expressions, Operators, Precedence of operators, Input-Output Operations, Control Structures, Decision Making, Branching & Looping. Application: Solving Simple Scientific and Mathematical Problems.

Arrays and Strings

Introduction to Arrays, One Dimensional Array, Multidimensional Array. Application: Matrix Operations, Sorting, Searching, Sum of Series and Statistical Problems. String Manipulation, String Arrays. Application: Solving problems using String Functions.

Functions and Pointers

User Defined and Standard Functions, Formal and Actual arguments, Function Prototypes, Parameter Passing, Call-by-Value, Call-by-Reference, Recursion. Application: Math Functions, Computation of Sine Series, Random Number Generation, Tower of Hanoi and Factorial using Recursive Functions. Pointers, Pointer Variables, Pointer Arithmetic, Passing Parameters by Reference, Pointer to Pointer, Pointers to Functions, Dynamic Memory Allocation. Application: Card shuffling and Dealing Simulation using Pointers.

Structures, Unions and File Handling

Declaration of Structures, Nested Structure, Pointer to Structure, Declaration of Unions, Pointer to Union, Application: Student Records. Storage Classes, Pre-Processor Directives. Files -Types of File Processing: Sequential Access, Random Access. Application: Transaction Processing Program.

COURSE OUTCOMES:

CO1: Ability to apply the concepts of algorithm, pseudo code and flow chart to solve problems

CO2: Ability to build control structures to solve problems

CO3: Ability to choose data structures for managing user data

CO4: Ability to apply memory and I/O management constructs of C

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	-	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	-	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	-	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20ITG01	-	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

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20PHG02	ENGINEERING PHYSICS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

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

COURSE CONTENT:

List of Experiments

1. Determination of velocity of sound and compressibility of liquid – Ultrasonic Interferometer.
2. Determination of thermal conductivity of a bad conductor using Lee's Disc method.
3. Determination of Young's modulus by non - uniform bending method.
4. Determination of Young's modulus by uniform bending method.
5. Determination of rigidity modulus of a wire and moment inertia of a disc – Torsional pendulum.
6. Determination of dispersive power of prism using spectrometer.
7. Determination of wavelength of a spectral line using spectrometer grating.
8. Determination of thickness of thin sheet / wire – Air wedge.
9. Determination angle of divergence and wavelength using laser.
10. Determination of the size of micro particles using diode laser with its accessories.
11. Determination of acceptance angle and numerical aperture of an optical fibre.
12. Determination of energy band gap of a semiconductor by using p-n junction diode.

COURSE OUTCOMES:

CO1: Ability to determine the modulus of given material, acceptance angle in optical fibre and velocity of sound.

CO2: Ability to determine the thermal conductivity of bad conductors and band gap of a semiconductor

CO3: Ability to determine the angle of divergence, wavelength of laser and spectral lines.

CO4: Ability to determine the particle size using laser, dispersive power of material and thickness of thin wire.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	-	-		-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20PHG02	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

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20ITG02	PROGRAMMING IN C LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

This course provides guidance to find solutions for engineering problems by developing computer applications using C language.

LIST OF EXPERIMENTS:

1. Problem Solving Techniques (Algorithm, Pseudo code, Flowcharts).
2. Program using Simple Statements and Expressions.
3. Scientific Problem-Solving using Decision Making and Looping.
4. Program using Single and Multidimensional Array.
5. Program using String, Math Inbuilt Functions.
6. Program using User Defined Functions (string & array manipulation) and Storage Classes.
7. Program using Recursive Function.
8. Program using Dynamic Memory Allocation.
9. Program using Structures and Unions.
10. Program using Files.

COURSE OUTCOMES:

CO1: Ability to find solution methodology using different problem-solving techniques

CO2: Ability to use appropriate data types and control structures for solving a given problem

CO3: Ability to apply the various concepts of C programming for solving engineering problems

CO4: Ability to analyse the problem-solving techniques which is appropriate for solving real world problems

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	-	-		-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20ITG02	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

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1. Behrouz A. Forouzan, Richard F. Gilberg, “Computer Science: A Structured Programming Approach Using C”, 3rd Edition, Course Technology Inc, 2005.
2. Byron Gottfried S. “Programming in C”, Third Edition, (Indian Edition), Tata McGraw Hill, 2010.
3. Balagurusamy E. “Programming in ANSI C”, Eighth Edition, Tata McGraw Hill Education.
4. Paul Deitel, Harvey Deitel “C How to Program”, Seventh Edition, Pearson Education Asia, 2012.

20MEG02	ENGINEERING WORKSHOP	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

This course aims to make the students understand about various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering by providing practical experience

COURSE CONTENT:

I. Civil Engineering Practice Lab

Buildings: Study of plumbing and carpentry components of residential and industrial buildings.

PLUMBING WORKS

a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, and elbows in household fittings.

b) Study of pipe connections requirements for pumps and turbines.

c) Preparation of plumbing line sketches for water supply and sewage works.

Hands-on-exercise:

a) Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

b) Demonstration of plumbing requirements of high-rise buildings.

WOOD WORK

1. Study of the joints in roofs, doors, windows and furniture.
2. Studying common industrial trusses using models.

Hands-on-exercise:

Wood work, joints by sawing, planning and cutting.

II. Mechanical Engineering Practice Lab

Welding & Sheet metal

1. Preparation of arc welding of butt joints, lap joints, tee joints and corner joints.
2. Sign board fabrication by the application of knowledge gained through welding process
3. Forming of simple objects using sheet metal – Trays.

Machining practices

Metal Hammer fabrication using Simple turning, taper turning, drilling taping practice.

Study

1. Assembling a centrifugal pump
2. Assembling a blower
3. Assembling an air conditioner

Demonstration

1. Demonstration on foundry operations.

III. Electrical Engineering Practice Lab

1. Familiarization of wiring tools, lighting accessories of CFL and incandescent lamps, types and selection of Fuse and MCB.
2. Study of various types of wiring systems
    a. Wiring of one lamp controlled by one switch.
    b. Wiring of one lamp controlled by two SPDT Switch and one 3 pin plug socket independently.
    c. Wiring of fluorescent lamp controlled by one switch from panel with MCB.
3. Study of wiring of different household appliances
    a. Iron-Box wiring.
    b. Fan Regulator wiring.
    c. Emergency Lamp wiring.
4. Familiarization with measuring instruments to measure current, voltage and power in AC/DC circuits.

IV. Electronics Engineering Practice Lab

1. Study of Electronic Components and instruments– Resistors, Capacitors, Inductors, Diodes and multimeter.
2. Measurement of AC signal parameters (voltage, period, frequency) using CRO.
3. Measurement of ripple factor of half wave rectifier and full wave rectifier.
4. Study of logic gates –AND, OR, XOR and NOT.
5. Soldering practice using general purpose PCB – Components, Devices and Circuits

COURSE OUTCOMES:

CO1: Ability to make various joints in carpentry and select suitable tools for plumbing

CO2: Ability to fabricate products by selecting suitable tools for machining, metal joining and sheet metal processes

CO3: Ability to understand the fundamental electrical parameters, protective devices, domestic wiring and accessories.

CO4: Ability to understand the basic principles of electronic components and to apply them in the design of simple electronic circuits.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	-	-		-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20MEG02	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

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1. Bawa H.S., “Workshop Practice”, Tata McGraw – Hill Publishing Company Limited, New Delhi, 2009.
2. Chapman, William. Workshop Technology Part 1, Part 2. Routledge, 2019.
3. Uppal S. L., Electrical Wiring & Estimating, Khanna Publishers---fifth edition, 2003.
4. John H. Watt, Terrell Croft: American Electricians' Handbook: A Reference Book for the Practical Electrical Man - McGraw-Hill, 2002.
5. Thomas L. Floyd and Steve Wetterling, “Laboratory Exercises for Electronic Devices”, Pearson Education Limited, Tenth Edition, 2017.

SECOND SEMESTER SYLLABUS

20HSG02	UNIVERSAL HUMAN VALUES II: UNDERSTANDING HARMONY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the need for value education.
- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understand (or developing clarity) harmony in the human being, family, society and nature/existence strengthening of self-reflection.
- Development of commitment and courage to act.
- Infer holistic understanding on professional ethics and humanistic universal order.

COURSE CONTENT:

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

Purpose and motivation for the course, recapitulation from Universal Human Values-I, Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation as the process for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority,5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!
Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - happiness and physical facility, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Health.

Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship
Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in he society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics:

a. Ability to utilize the professional competence for augmenting universal human order

b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems,

c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

Case studies of typical holistic technologies, management models and production systems,

Strategy for transition from the present state to Universal Human Order:

a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers

b. At the level of society: as mutually enriching institutions and organizations , Sum up.

COURSE OUTCOMES:

CO1: Ability to become more aware of themselves, and their surroundings (family, society, nature)

CO2: Ability to become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

CO3: Ability to have better critical skill.

CO4: Ability to become sensitive to their commitment towards what they have understood (human values, human relationship and human society).

CO5: Ability to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-	-	-	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20HSG02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-	-	-	-

TEXT BOOKS:

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana,G P Bagaria, 2nd Revised Edition, Excel Books,New Delhi, 2019.ISBN 978-93-87034-47-1
2. Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, RR Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2.

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2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews.
7. Economy of Permanence - J C Kumarappa.
8. Bharat Mein Angreji Raj – Pandit Sunderlal.
9. Rediscovering India - by Dharampal.
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi.
11. India Wins Freedom - Maulana Abdul Kalam Azad.
12. Vivekananda - Romain Rolland (English).
13. Gandhi - Romain Rolland (English).

20MHG02	DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To introduce the concept of differential equations used in engineering problems.
- To familiarize the concepts of vector calculus arises in many engineering problems.
- To provide the knowledge of analytic functions and its mapping property.
  To acquaint the students with complex and contour integration techniques used in real integrals.
- To develop the students to make use of Laplace transform techniques in ordinary differential equations.

COURSE CONTENT:

UNIT I SECOND AND HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS

Linear equations of second and higher order with constant coefficients – Homogenous equations of Euler's and Legendre's type – Method of variation of parameters – First order Simultaneous linear equations with constant coefficients – Applications: Electric circuits, Simple harmonic motions.

UNIT II VECTOR CALCULUS

Gradient and directional derivative – Divergence and curl - Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's theorem, Gauss divergence theorem and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT III ANALYTIC FUNCTION

Analytic functions – Necessary and sufficient conditions for analyticity– Properties – Harmonic conjugates – Construction of analytic function – Conformal mapping – Mapping by functions – Bilinear transformation $w = c + z,\ az,\ \frac{1}{z},\ z^2$.

UNIT IV COMPLEX INTEGRATION

Line integral – Cauchy's Integral theorem– Cauchy's Integral formula – Taylor's and Laurent's series – Singularities – Residues – Cauchy Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour with no pole on real axis.

UNIT V LAPLACE TRANSFORM

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 function – Transform of periodic functions. Inverse Laplace transform – Convolution theorem – Initial and final value theorems – Application to solution of linear ordinary differential equations with constant coefficients.

COURSE OUTCOMES:

CO1: Ability to apply higher order linear differential equations in real life applications.

CO2: Ability to solve problems in the domain of fluid dynamics using vector calculus.

CO3: Ability to construct analytic functions and use their conformal mapping property in application problems.

CO4: Ability to apply the Cauchy's integral formula and residue theorem to evaluate real and complex integrals.
CO5: Ability to apply Laplace transforms techniques to solve ordinary differential equations.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20MHG02	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-

TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2016.
2. Grewal. B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi, 2016.

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1. Ravish R Singh and Mukul Bhatt, "Engineering Mathematics", 1st Edition, Tata McGraw Hill Education, New Delhi, 2016.
2. Srimanta Paul and Subodh C. Bhunia, "Engineering Mathematics", Oxford University Press, 1st Edition, 2015.
3. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi, 2012.

20CSG01	OBJECT ORIENTED PROGRAMMING USING C++	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course provides an insight on the basic principles of Object Oriented Programming using C++ and its applications in real world scenarios.

COURSE CONTENT:

Fundamentals of OOP and C++

Structural versus object-oriented Programming - Elements of object oriented programming-benefits of OOP – Structure of C++ program - Variables - Tokens - Keywords – Identifiers - Type modifiers - Type casting - Input and Output - Data Types and Expressions - Operators - Flow of control - Arrays, Strings and Pointers.

Classes and Objects

Classes and Objects - Class specification: Class Members, Access Specifier, Scope resolution operator- Class Instantiation - Accessing class members- Passing and returning objects - Array of objects – Constructors: Parameterized constructors - Default arguments – Copy Constructor - Constructor overloading, Destructors - new, delete operators - "this" pointer - Friend classes and friend functions.

Overloading and Inheritance

Function overloading - Operator overloading: Overloadable operators - Unary operator overloading - Binary operator overloading, Overloading the Operator Using Friend Function - Inheritance: Base class and derived class relationship - Derived class declaration - Types of inheritance - Member accessibility - Constructors in derived class.

Virtual functions and Generic Programming

Virtual Functions: Need for virtual function - Pointer to derived class objects - Pure virtual functions - Abstract classes – Virtual Destructors, Generic programming with templates: Function templates - class templates

I/O Streams and Exception handling

Streams: Formatted and unformatted data – Manipulators - Files: Opening and Closing a file - File modes - File pointers and their manipulation, Sequential access to a file - Random access to a file - Reading and Writing files, Exception handling: Exception handling constructs - Handling exceptions.

COURSE OUTCOMES:

CO1: Ability to understand the concepts of Object-Oriented Programming.

CO2: Ability to choose appropriate Object-Oriented features for solving various problems.

CO3: Ability to develop C++ application for real world scenarios.

CO4: Ability to apply the concepts of Exception handling, generic programming and file handling in programmes using C++

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	-	-	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	-	-	2	3	2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20CSG01	-	-	2	3	2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

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1. Herbert Schildt, “C++ The Complete Reference”, 5th Edition, Tata McGraw Hill, New Delhi,
2. Bjarne Stroustrup, “The C++ Programming Language”, 4th Edition, Addison-Wesley, 2013.
3. Deitel and Deitel, “C++ How to Program”, 10th Edition, Prentice Hall India Learning Private Limited, 2018.
4. Robert Lafore, “Object Oriented Programming in C++”, 4th edition, Pearson India, 2002.
5. Stanley B. Lippman and Josee Lajoie, “C++ Primer”, 5th Edition, Pearson Education, New Delhi, 2013.
6. E.Balagurusamy, “Object Oriented Programming with C++”, 6th Edition, Tata McGraw Hill, 2013.

20EE001	ELECTRIC CIRCUIT ANALYSIS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

This course provides the basic electric circuit analysis techniques such as Ohm's law, Kirchhoff's Law, Mesh, Nodal and various network theorems for solving the electric circuit problems in DC and AC circuits with single phase and three phase.

COURSE CONTENT:

DC Circuit Concepts

Electrical elements and their classification– Charge, Current, Voltage, Power and Energy– Ohm's law – KCL and KVL–Independent and dependent sources– Series and Parallel circuits– Voltage and current division in Series and Parallel Circuits– Source Transformation –Star to Delta conversion and Delta to Star conversion- constant current and constant voltage systems.

AC Circuit Concepts

A.C. Single Phase Circuits– Sinusoidal Voltage and Current – RMS Value – Form Factor, Peak Factor – Phasor representation of Sinusoidal Voltage–Phasor relationship for R, L, and C, impedance and Admittance, Phasor Diagrams, AC Circuit Power Analysis, Instantaneous Power, Average Power, apparent Power and Power Factor, Complex Power.

Network Analysis and Theorems

Mesh and nodal analysis with Voltage and Current source for DC and AC circuits. Theorems: Superposition theorem -Thevenin's theorem - Norton's theorem - Reciprocity and Maximum Power Transfer theorem for AC and DC circuits.

Transient Response, Resonance and Coupled Circuits

Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input. Resonance: Series Resonance– Parallel resonance. Coupled circuits: mutual inductance – coefficient of coupling–dot convention.

Three Phase Circuits

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

COURSE OUTCOMES:

CO1: Ability to apply basic circuital laws and techniques to simplify DC electrical networks

CO2: Ability to recall basic terms, definitions and power relations related to DC and AC circuits.

CO3: Ability to apply mesh, nodal analysis and network theorems to determine the behavior of the given DC and AC circuit.

CO4: Ability to compute the transient response and resonant frequency response of series and parallel RLC circuits

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO3	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EE001	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

REFERENCES:

1. Charles K. Alexander and Matthew N. O. Sadiku, “Fundamentals of Electric Circuits”, McGraw–Hill Companies, Fifth Edition, 2013.
2. Richard C. Dorf, James A. Svoboda, “Dorf's Introduction to Electric Circuits”Wiley, Ninth Edition, 2018.
3. Hayt W. H. and Kemmerly J. E., “Engineering Circuit Analysis”, McGraw Hill, New York, Eighth edition, 2012.
4. R. L. Boylestad, “Introductory Circuit Analysis”, Upper Saddle River, N.J.: Prentice Hall, Twelfth edition, 2010.
5. Mahmood Nahvi, Joseph A Edminister, “Electric Circuits”, McGraw Hill Education, Fifth Edition, 2010.
6. J. O. Bird, “Electrical Circuit Theory and Technology”, Oxford, New York: Newnes, Revised second edition, 2010.

20CHG02	ENGINEERING CHEMISTRY LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- To make the students to understand the basic principles of volumetric analysis
- To impart skills in analysis of various water quality parameters
- To enable the students to gain exposure in corrosion studies
- To familiarize the students with water of crystallization of hydrated compounds and molecular weight determination of polymers
- To develop experimental skills of students through instrumental chemical analysis

List of Experiments

1. Estimation of acidity of industrial effluent by conductometric titration.
2. Determination of corrosion rate by weight loss method.
3. Determination of water of crystallization of $CuSO_4.5H_2O$
4. Estimation of hardness of water by complexometric method.
5. Determination of DO content of water sample by Winkler's method.
6. Determination of molecular weight of polyvinyl alcohol using Ostwald Viscometer.
7. Determination of strength of Hydrochloric acid using pH method.
8. Determination of Alkalinity in the given water sample.
9. Estimation of iron content of the given solution using potentiometer.
10. Conductometric precipitation titration using Barium chloride and Sodium Sulphate
11. Determination of strength of acids in a mixture using conductivity meter.
12. Determination of Chloride content in the given water sample by Argentometric method.

COURSE OUTCOMES:

CO1: Ability to demonstrate analytical techniques for the quality assessment of domestic and industrial waste water.
CO2: Ability to apply experimental chemistry for the investigation of corrosion related problems in industrial field
CO3: Ability demonstrate determination of molecular weight of polymeric materials so as to use
them for various engineering applications.
CO4: Ability to make use of titrimetric analysis for estimating the amount of metal ions present in unknown substances.
CO5: Ability to analyse the given sample using various instrumental methods.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	1	-	-	1
CO2	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	1	-	-	1
CO3	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	1	-	-	1
CO4	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	1	-	-	1

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20CHG02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	1	-	-	1

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1. Beran J.A , "Laboratory Manual for Principles of General Chemistry", Wiley publications,10th Edition, 2014.
2. Manoj Kumar Solanki, "Engineering Chemistry Laboratory Manual", Educreation publishing, 2019.
3. Jeffery G. H, and Basset J., "Vogel's text book of quantitative chemical analysis", Prentice Hall, 5th Edition, 2012.

20CSG02	PROGRAMMING IN C++ LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

This course provides an practical experience on the concepts of Object Oriented Programming using C++ programming language.

LIST OF EXPERIMENTS:

1. Programs using Objects and Classes
2. Programs using Constructors and Destructors
3. Programs using friend function & friend class.
4. Programs using Function Overloading
5. Programs to overload unary & binary operators as member function & non-member function
6. Programs using types of inheritance
7. Programs using virtual functions
8. Programs using Function and class templates
9. Programs using Files and Streams
10. Programs using Exception handling

COURSE OUTCOMES:

CO1: Ability to apply the concept related to Classes and Objects in simple programs

CO2: Ability to apply the concepts of polymorphism to achieve enhanced functionalities of functions and operator.

CO3: Ability to deploy inheritance in simple C++ programs

CO4: Ability to design simple applications that support File Processing

CO5: Ability to develop programs that are capable of handling Exceptions

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	-	-		-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO5	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20CSG02	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

REFERENCES:

1. Herbert Schildt, "C++ The Complete Reference", 5th Edition, Tata McGraw Hill, New Delhi,
2. Bjarne Stroustrup, "The C++ Programming Language", 4th Edition, Addison-Wesley, 2013.
3. Deitel and Deitel, "C++ How to Program", 10th Edition, Prentice Hall India Learning Private Limited, 2018.
4. Robert Lafore, "Object Oriented Programming in C++", 4th edition, Pearson India, 2002.
5. Stanley B. Lippman and Josee Lajoie, "C++ Primer", 5th Edition, Pearson Education, New Delhi, 2013.
6. E.Balagurusamy, "Object Oriented Programming with C++", 6th Edition, Tata McGraw Hill, 2013.

20MEG01	ENGINEERING GRAPHICS	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

The objectives of this course are to impart knowledge to interpret engineering drawings and to enable the students to communicate the concepts, ideas, and basic designs through graphical representations as per related engineering conventions and standards.

COURSE CONTENT:

Curve Constructions and Orthographic Projection

Lettering – Types of lines – Dimensioning – 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 these curves. Principles of Orthographic projection – Layout of views Orthographic projection of simple Engineering components using first angle Projection. Drawing of multiple views from pictorial views of objects

Projection of Points, Lines and Plane Surfaces

Projection of points – Projection of straight lines (only First angle projections) inclined to both the principal planes – Determination of true lengths and true inclinations by rotating line method and trapezoidal method and traces – Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method

Projection of Solids

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

Projection of Sectioned Solids and Development of Surfaces

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, cylinder and cone. Development of lateral surfaces of solids with cut-outs and holes.

Isometric and Perspective Projections

Principles of isometric projection – isometric scale – isometric projections of simple solids and truncated solids – Prisms, pyramids, cylinders, cones – Perspective projection of simple solids prisms, pyramids and cylinder by visual ray method and vanishing point method.

COURSE OUTCOMES:

CO1: Ability to understand the concepts and conventions of engineering graphics to apply for engineering applications.

CO2: Ability to understand the concept of projection and construct orthographic views of points, planes, straight lines and solids.

CO3: Ability to build orthographic projection of solids and develop the lateral surfaces.

CO4: Ability to develop multi-aspect technical sketches, perspective, sectional views for simple objects

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20MEG01	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

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2. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Publications, Bangalore, 2017.
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5. K.V. Natarajan, A text book of Engineering Graphics, Dhanalakshmi Publishers, Chennai, 2016.
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7. 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, 2015.
8. Sekkilar.S.M., “Engineering Graphics” Alpha Science International Ltd, 2018.

20AC001	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
		3	0	0	-

COURSE OBJECTIVE:

To understand the basic knowledge about environment and their chemistry, to apply the knowledge in environmental pollution control and management, to create awareness about various technologies to control/ reduce all environmental related problems.

COURSE CONTENT:

Fundamentals of Environmental Science

Introduction- Definition-environment, Environmental science, Environmental engineering- Components of environment - Atmosphere, lithosphere, hydrosphere and biosphere - types of environment – Natural – man – made - Environmental education- objectives, importance and scope - Need for public awareness.

Chemistry of the Environment

Hydrological cycle- concept of DO, BOD and COD- chemical and photochemical reactions in the atmosphere - ozone chemistry - formation and depletion of ozone layer - acid rain mechanism of formation and effects - Photochemical smog and sulfurous smog. Greenhouse effect, global warming- causes, effects and control measures.

Renewable energy and environment

Introduction - Renewable and non - renewable energy sources - Principles of generation of hydro power, tidal energy, ocean thermal energy conversion, wind power - wind mill - wind farm geothermal energy and solar energy (solar collectors, photovoltaic modules, solar ponds) - Bioenergy: methods to produce energy from biomass - impact of renewable and non - renewable energy sources on the environment.

Environmental Pollution and control

Introduction - Air pollution – sources - major air pollutants – effects and control - Air Pollution control technologies - cyclone separator and electrostatic precipitator –water pollution – sources - major water pollutants - effects and control of water pollution - waste water treatment - Noise pollution –sources- effects and control- Solid waste management – sources, classification, causes and effects -management and control measures of solid wastes - Hazardous waste management - role of an individual in prevention of pollution.

Human population and the Environment

Population growth - variation among nations - Population explosion – Family Welfare Programme -Environment and human health - Human Rights - Value Education - HIV/AIDS -Women and Child Welfare - Role of Information Technology in Environment and human health.

COURSE OUTCOMES:

CO1: Ability to understand the basic knowledge about environment and their chemistry.

CO2: Ability to select suitable renewable resources for domestic and industrial applications to meet the growing energy demand.

CO3: Ability to apply the knowledge in environmental pollution control and management.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	1	-	2	-	-	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	1	-	2	-	-	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20AC001	-	-	1	-	2	-	-	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-

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1. George Tchobanoglous, Howard S. Peavy, Donald R. Rowe., "Environmental Engineering", McGraw Hill Education, 1st Edition, 2013.
2. Henry J.G. and Heinke G.W., "Environmental Science and Engineering", Prentice Hall, 2nd Edition, 2007.
3. Masters G.B., "Introduction to Environmental Engineering and Science", Pearson Education, 3rd Edition, 2008.
4. Tyler Miller G., "Environmental Science", Cengage Learning, 11th Edition, 2015
5. Smriti Srivastava., "Energy Environment & Ecology", S.K.Kataria & Sons, 2nd Edition, 2013.

THIRD SEMESTER SYLLABUS

20MHG03	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To introduce the effective mathematical tools for the solutions of partial differential equations that model physical processes.
- To introduce Fourier series analysis which is central to many applications in engineering.
- To develop the analytic solutions for partial differential equations used in engineering by Fourier series.
- To acquaint the student with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic.
- To develop Z- transform techniques which will perform the same task for discrete time systems as Laplace Transform, a valuable aid in analysis of continuous time systems.

COURSE CONTENT:

Partial Differential Equations

Formation of PDE by elimination of arbitrary constants and functions – Solutions of first order equations – Standard types and Equations reducible to standard types – Singular solutions –Lagrange's linear equation – Solution of second and higher order homogeneous and non-homogeneous linear equations with constant coefficients.

Fourier Series

Dirichlet's conditions – Expansion of periodic functions into Fourier series – Change of interval – Fourier series for even and odd functions – Half-range expansions – Root mean square value of a function – Parseval's identity – Harmonic analysis.

Boundary Value Problems

Classification of second order linear partial differential equations – method of separation of variables - Solutions of one-dimensional wave equation – one dimensional heat equation – Steady state solution of two-dimensional heat equation –Fourier series solutions.

Fourier Transform

Statement of Fourier integral theorem (without proof) – Fourier transform pairs – Fourier Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

Z - Transform

Z-transforms – Elementary properties – Inverse Z-transform (using partial fraction and residues)- Initial and final value theorem– Convolution theorem – Formation of difference equations – Solution of difference equations using Z - transform.

COURSE OUTCOMES:

CO1: Ability to solve partial differential equations which arise in application problems.

CO2: Ability to analyze the functions as an infinite series involving sine and cosine functions and obtain the solutions of the partial differential equations using it.

CO3: Ability to obtain Fourier transforms for the functions which are needed for solving application problems.

CO4: Ability to manipulate discrete data sequences using Z transform techniques.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	3	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	3	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO3	3	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO4	3	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20MHG03	3	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-

TEXT BOOKS:

1. Erwin Kreyszig, “Advanced Engineering Mathematics”, Wiley India, 10th Edition, 2016.
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1. Andrews, L.C and Shivamoggi, B, "Integral Transforms for Engineers" SPIE Press, 1999.
2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
3. Veerarajan T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 3rd Edition, 2012.
4. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.

20EEG02	ELECTRONIC DEVICES AND CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge about the structure and application of basic electronic devices.
- To learn about the operation of different electronic devices.

COURSE CONTENT:

PN diode and its applications

Energy band structure of conductors, Semiconductors, Insulators – Carrier concentration in an intrinsic and extrinsic semiconductors PN junction diode-VI characteristics, Rectifiers – Half Wave and Full Wave Rectifier and Bridge rectifier, Zener diode characteristics-Zener Reverse characteristics – Zener as regulator LED, LCD characteristics and applications.

Special Diodes

Schottky diode -Tunnel diode, Varactor diode- Construction, working and characteristics – SCR- Construction, Two transistor equivalent circuit , Characteristics, Applications- DIAC and TRIAC- Construction, working and characteristics – UJT – Operation , Equivalent Circuit and Applications - Fundamentals of light – LDR, LED – LASER - LCD – Photodiode -Photo transistor.

BJT and its Applications

Structure and working of bipolar junction transistor – input and output characteristics of CB, CC and CE configurations – Comparison of CB,CE and CC Configuration, h parameter model - Hybrid-π model, Differential amplifiers.

FET and its Applications

Types of FET - Comparison of FET and BJT - Operation of JFET - Drain and Transfer Characteristics of JFET -MOSFET -principle of operation -Enhancement and Depletion mode of MOSFET – Characteristics of MOSFET.

Oscillators

Oscillators– Classification, Barkhausen Criterion, LC- Hartley, Colpitts, RC- phase shift, Wien bridge.

COURSE OUTCOMES:

CO1: Ability to understand the characteristics of various semiconducting devices.

CO2: Ability to identify and select appropriate electronic device for specific application.

CO3: Ability to build the electronic system using the characteristics of various electronic devices

CO4: Ability to analyze the different Oscillator and various special semiconducting devices

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO3	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2
CO4	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EEG02	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2

REFERENCES:

1. Robert Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory”, Pearson Prentice Hall, 11th Edition, 2012.
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5. David A. Bell, “Electronic Devices and Circuits”, Prentice Hall of India Private Limited, New Delhi, 5th Edition, 2012.

20EE002	ELECTRO MAGNETIC THEORY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To impart knowledge on the concepts of electrostatics, magneto statics and its applications.

COURSE CONTENT:

Electrostatics I

Basic Vector operations, Coordinate Systems, Coulomb's law, Electric field intensity, electric fields due to point, line, surface and volume charge distributions, Electric flux , Electric flux density, Gauss law, Applications of Gauss Law.

Electrostatics II

Electric potential– Potential gradient, Potential due to point, line and dipoles, dipole moment, Energy density, Current and current density, Continuity of current equation, Conductor properties, Nature of Dielectrics, Polarization in dielectrics, Dielectric constant and Dielectric strength, Boundary conditions, Poisson's and Laplace equations, Capacitance, Energy stored in capacitor.

Magneto statics

Biot- Savart Law, Ampere's Circuital Law, Magnetic flux and Magnetic flux density, The Scalar and Vector magnetic potentials, Force on a moving charge and current elements, Force and Torque on closed circuit, magnetic materials, Magnetization, Permeability, Magnetic boundary conditions, Inductance- Inductance of solenoids and toroids.

Electro Dynamic Waves

Magnetic Circuits, Faraday's law, Transformer and motional EMF, Conduction current and Displacement current, Maxwell's equations (differential and integral form), Relation between field theory and circuit theory.

Electro Magnetic Waves

Wave parameter- velocity, intrinsic impedance, propagation constant, Wave propagation in free space, Wave propagation in Dielectrics, Propagation in good conductors, Power and the Poynting Vector, 5G Spectrum.

COURSE OUTCOMES:

CO1: Ability to understand the concepts of electrostatics, electrical potential, energy density, conductors and dielectrics.

CO2: Ability to understand the concepts of magneto statics, magnetic flux density and magnetic materials.

CO3: Ability to apply the principles of electro statics and magneto statics in deriving the expression of capacitance and inductance for power line conductors.

CO4: Ability to analyze Maxwell's equation, faradays laws and poynting vector for Electrical and communication applications.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EE002	2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

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2. William H. Hayt, John A.Buck, “Engineering Electromagnetics”, McGraw Hill, New York, 8th edition, 2011.
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20EE003	LINEAR INTEGRATED CIRCUITS AND APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the basic building blocks of Operational Amplifier Circuits.
- To learn the concept of linear and non-linear applications of operational amplifiers.
- To study the analysis of OPAMP applications.
- To inculcate the concepts of IC fabrication and special function ICs.

COURSE CONTENT

IC fabrication

IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities. Realisation of monolithic ICs and packaging. Fabrication of diodes, capacitance, resistance and FETs.

OPAMP Basics

Basic information of op-amps, Ideal Operational Amplifier, General operational amplifier stages, Internal circuit of OPAMP, IC 741.

OPAMP Characteristics

Ideal and practical OPAMP characteristics, DC characteristics, AC characteristics.

Applications of OPAMP

Adder, Subtractor, inverting amplifier, non-inverting amplifier, Integrator, Differentiator, V-to-I and I-to-V converters, clipper and clamper. Comparators, Zero-crossing detector, Schmitt trigger. D/A converter (R- 2R ladder and weighted resistor types), A/D converter - Dual slope, successive approximation and flash types.

Non-Linear applications of OPAMP

Functional block, characteristics of 555 Timer and its PWM application, IC 723 Voltage regulators IC-566 voltage controlled oscillator, IC 565-phase locked loop, Opto couplers and fibre optic IC.

COURSE OUTCOMES:

CO1: Ability to understand the DC and AC characteristics of operational amplifiers

CO2: Ability to illustrate the fabrication of IC and concept of linear and non-linear applications of operational amplifiers.

CO3: Ability to build the electronic system using opamp and special application ICs.

CO4: Ability to analyze opamp applications.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-	-	-	3
CO2	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-	-	-	3
CO3	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-	-	-	3
CO4	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-	-	-	3

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO 6		PO7		PO8		PO9		PO10			PO1 1		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EE003	-	3	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3

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1. D. Roy Choudary, S.B. Jain, “Linear Integrated Circuits”, New Age publishers, Third edition, 2014.
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3. Gayakwad R.A., “Op-amps & Linear Integrated Circuits”, Prentice Hall of India, New Delhi, Fourth Edition, 2009.
4. Muhammad H. Rashid, “Linear Integrated Circuits”, Cengage Learning, First Edition, 2014.
5. Jacob Millman, Christos C.Halkias, Chetan D Parikh, “Integrated Electronics - Analog and Digital circuits and system”, McGraw Hill, Second Edition, 2017.

20EE004	DIGITAL LOGIC CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the fundamentals of combinational and sequential digital circuit.
- To impart the implementation of combinational circuits using Gates and to design various synchronous and asynchronous circuits
- To acquire the basic knowledge of digital simulation techniques for development of application-oriented logic circuit

COURSE CONTENT:

Boolean Algebra and Minimisation

Binary system, Boolean algebra and logic gates: Boolean functions, Canonical and standard forms-Digital logic gates- Integrated circuits, NAND and NOR implementation. Minimisation using K-maps & Quine McCluskey method.

Combinational Circuits

Adder, Subtractor, Comparators, Code Converters, Encoders, Decoders, Multiplexers and Demultiplexers.

Sequential Circuits

Flip flops - SR, D, JK and T, shift registers, counters- ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, state assignments analysis and design of synchronous sequential circuits, state diagram; state reduction, FSM.

Programmable Logic Devices

Introduction to Programmable Logic Devices: PROM – PLA –PAL, CPLD-FPGA.

Design of Combinational and Sequential Circuits using VHDL

Introduction to VHDL: Design –combinational logic – Types – Operators – Packages (Examples: adders, flip flops, counters, encoders, decoder, Multiplexers, De-Multiplexers).

COURSE OUTCOMES:

CO1: Ability to understand the fundamentals of combinational and sequential digital circuits.

CO2: Ability to analyze combinational logic circuits and sequential logic circuits.

CO3: Ability to design combinational logic circuits and sequential logic circuits.

CO4: Ability to develop VHDL code for the design and implementation of digital circuits and systems.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	-	3	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO3	-	3	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO4	-	3	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EE004	-	3	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3

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2. Thomas L Floyd, “Digital fundamentals”, Pearson Education Limited, 11 th Edition, 2015
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4. Charles H. Roth, Larry L Kinney, “Fundamentals of Logic Design”, 7th Edition – CL Engineering, 2015.
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20EE005	ELECTRIC CIRCUIT AND ELECTRON DEVICES LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- To learn the fundamentals of electric circuits and its theorems.
- To study the basic electronic components and observe its characteristics.

LIST OF EXPERIMENTS

1. Verification of Kirchhoff's current law and voltage law.
2. Verification of Mesh analysis and Nodal analysis.
3. Verification of Thevenin's theorem and Norton's theorem.
4. Verification of Super position theorem.
5. Measurement of Phase difference between Voltage and Current by CRO Method.
6. Characteristics of PN junction diode and Zener diode
7. Single phase half wave and full wave rectifiers
8. Characteristics of Transistor under common emitter configuration
9. Characteristics of JFET and UJT
10. Characteristics of photo diode, photo transistor

COURSE OUTCOMES:

CO1: Experimentally verify various electric circuit laws.

CO2: Verify various electric circuit analysis methods and circuit theorems.

CO3: Experimentally verify and analyze the operations of half wave and full wave rectifiers.

CO4: Analyze the characteristics of various electronic devices and components.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	3	1	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO2	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO3	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO4	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EE005	-	3	1	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3

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20EE006	LINEAR INTEGRATED AND DIGITAL CIRCUITS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- To learn about the characteristics of operational amplifier.
- To design digital logic circuits.

LIST OF EXPERIMENTS:

1. OPAMP based amplifier circuits:
   a) Inverting amplifier.
   b) Non-inverting amplifier and voltage follower
   c) Differential amplifier and Instrumentation amplifier.
2. Design of Adder-subtractor circuits.
3. Square wave oscillator/ tri-angular wave oscillator.
4. OPAMP based RC –phase shift oscillator
5. IC 555 timer IC based astable multi-vibrator.
6. Design and implementation of Adders and Subtractors.
7. Design and implementation of code converters and 2Bit Magnitude Comparator.
8. Design and implementation of Multiplexer and De-multiplexer.
9. Design and implementation of encoder and decoder.
10. Design and implementation of Shift register and Counter.

COURSE OUTCOMES:

CO1: Ability to apply the principles of an operational amplifier for linear and non- linear applications.
CO2: Ability to analyze the performance of an oscillators and multivibrators circuit.
CO3: Ability to demonstrate the knowledge by designing analog circuits & digital circuits
CO4: Ability to design combinational circuits using various Digital Integrated IC's.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	3	1	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO2	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO3	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO4	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EE006	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3

REFERENCES:

1. D. Roy Choudary, S.B. Jain, “Linear Integrated Circuits”, New Age publishers, Third edition, 2014.
2. David A. Bell, “Operational amplifiers& Linear ICs”, Oxford University Press, Third Edition, 2013.
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FOURTH SEMESTER SYLLABUS

20EEG06	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the instruction set and features of 8086 & 8051.
- To inculcate the skill of developing simple applications using 8086, 8051 & Arduino and to introduce commonly used peripheral interfacing.

COURSE CONTENT:

Introduction to 8086 Processor

8086 architecture, Pin diagram, Signal descriptions of 8086, Register organization, memory segmentation, memory organization, timing diagrams, Interrupts, Data Transfer Schemes.

8086 Programming

Instruction formats, Addressing modes, instruction set. Simple programs involving logical, branch and call instructions, Sorting, evaluating arithmetic expressions, string manipulations.

8051 Microcontroller

Functional block diagram, Pin Configuration, Memory Organization, Special Function Registers. Instruction format and addressing modes, Interrupt structure, Timer, I/O ports, Serial communication. Usage of IDE for assembly language programming.

Peripheral Interfacing

Study of Architecture and programming of ICs: 8255 PPI, Interfacing of A/D and D/A converter with 8086. Interfacing of sensors, LED, LCD, keyboard, Stepper Motor and DC Motor with 8051.

Introduction to Advanced Architecture

Basics of Embedded C Programming, Programming practices of Arduino controller for Electrical Engineering Applications, Overview of Advanced Processors and Controllers.

COURSE OUTCOMES:

CO1: Ability to understand the architecture, instruction set and addressing modes of 8086, 8051 and peripheral Interfacing devices.

CO2: Ability to identify and select appropriate Microprocessor/ Microcontroller to meet specified performance requirements.

CO3: Ability to develop hardware and software to interface the microprocessor/ microcontroller to required peripherals for specific applications.

CO4: Ability to illustrate the features of advanced processors and develop applications using Arduino.

CO5: Ability to understand the architecture, instruction set and addressing modes of 8086, 8051 and peripheral Interfacing devices.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	-	2	1	-	-	-	2	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	-	2	2	-	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO4	-	2	-	3	1	-	3	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO 6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EEG06	-	2	2	3	1	-	3	-	-	-	-	3	-	-	-	-	-	-	-	3	2	-	-	-	-	-	-	-	3	-

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20EE007	CONTROL SYSTEMS ENGINEERING	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

- To understand the concepts of mathematical modeling, feedback control, state space representation and stability analysis in Time and Frequency domains.

COURSE CONTENT:

System Representation and Modeling

Classification of control systems, Open loop and closed loop systems - Control system components- Differential equation and Transfer function - Modelling of electric systems, translational and rotational mechanical systems, Electromechanical systems - Analogous systems - Block diagram reduction techniques - Signal flow graphs.

Time domain and Stability Analysis

Time response of First and Second order system- Performance Specifications in the Time domain- Steady state error and Generalized error constants – Stability: BIBO stability, Routh-Hurwitz stability criterion and Root Locus: Root-locus technique, Steps in obtaining a root-locus.

Frequency Response Analysis

Frequency Domain Specifications - Correlation between time and frequency responses for second order systems – Gain Margin and Phase Margin- Polar plot, Bode plot- Nyquist Stability criterion.

Design of Compensators and Controllers

Lead compensator, lag compensator, lead-lag/lag-lead compensators, Design of compensator using root locus- Basic modes of feedback control: Proportional, Integral, Derivative- Tuning (Ziegler-Nichols tuning-Step Response).

Concepts of State Space Modelling

Concepts of state variables- State space model – Canonical state model – Transfer function from state model – Solution of state equations – State transition matrix – Concept of Controllability and Observability.

COURSE OUTCOMES:

- **CO1:** Ability to understand the concept of open loop, closed loop systems and to determine the transfer function of physical system
- **CO2:** Ability to analyze the system's behavior in time-domain, frequency-domain and stability of the system.
- **CO3:** Ability to design the compensator and to control the system using PID controller.
- **CO4:** Ability to understand the concept of state space modelling for physical system.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	1	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	-	1	1	2	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO3	-	1	-	2	-	2	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO4	-	1	-	2	-	2	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EE007	1	1	1	2	-	2	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3

REFERENCES:

1. Nise N.S, “Control System Engineering”, John Wiley & Sons, 6 th Edition, 2013.
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20EE008	TRANSMISSION AND DISTRIBUTION	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

- To study the structure of power system and line parameters for modelling and analysing the performance of transmission line.
- To learn about the construction, operation of various insulators, cables and the mechanical design of transmission lines for various weather conditions and outline of substations.

COURSE CONTENT:

Structure of Power System

Structure of electric power system: generation, transmission and distribution; overhead and underground systems – voltage tolerances - interconnection–Need and applications of EHVAC and HVDC transmission-Introduction to FACTS.

Transmission Line Parameters

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-Self and mutual GMD; skin and proximity effects-Effects of earth on the capacitance of the transmission line - corona discharge, factors affecting corona

Modelling and Performance of Transmission Lines

Classification of lines–short line, medium line and long line-Evaluation of A,B,C,D constants equivalent circuits – Nominal π and T model analysis, 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.

Insulators and Cables

Types of insulators - voltage distribution in insulator string – string efficiency - improvement of string efficiency – testing of insulators - Underground cables-Types of cables, Parameters of cable, Grading of cables, Power factor and heating of cables, Capacitance of 3-core belted cable, D.C cables.

Mechanical Design of Lines and Distribution

Catenary curve - sag and tension calculations for different weather conditions (effect of ICE loading and wind loading) – Supports at different levels – Stringing chart – Distribution systems -AC Distribution Systems – Feeders, distributors and service mains Radial and ring main systems- Types of distributors - Calculation of voltage in distributors with concentrated and distributed loads – Concentrated and Distributed loads fed at both ends -Load balancing Introduction to Public and industrial distribution systems - Substation Layout (AIS,GIS) - Different methods of grounding.

COURSE OUTCOMES:

CO1: Ability to understand the terms in power system structure, line parameters, insulators and cables used for transmitting and distributing the electrical power.

CO2: Ability to apply line parameter concept and to find the parameter values, regulation and efficiency in various transmission and distribution lines

CO3: Ability to evaluate the String efficiency and sag calculations to model the transmission and distribution lines for various applications.

CO4: Ability to design the transmission lines for various weather conditions and outline of substations.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2
CO2	2	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2
CO3	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2
CO4	2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EE008	2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2

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4. Luces M.Fualkenberry, Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 2007.
5. J.Brian, Hardy and Colin R.Bayliss, 'Transmission and Distribution in Electrical Engineering',Newnes;Fourth Edition,2012.

20EE009	ELECTRICAL MACHINES -I	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To study the fundamentals of energy conversion, generation of DC voltage.
- To lean the construction, principle of operation, characteristics and testing of DC machines and Transformers.

COURSE CONTENT:

Magnetic Circuits & Electromechanical Energy Conversion

Introduction to magnetic circuits –Laws governing magnetic circuits- Magnetically induced EMF– AC operation of magnetic circuits – Energy in magnetic systems – Field energy & Co energy – Force and torque equations- Single and Multiple excited systems– Magnetic fields in rotating machines.

DC Generators

Constructional features of DC machine – Principle of operation of DC generator – Armature winding-EMF equation – Types of excitation – Characteristics of DC generators – Armature reaction –Commutation –Interpoles, Compensating winding- Parallel operation of DC generators.

DC Motors

Principle of operation of DC motors-Back EMF – Torque equation –Types of DC motors-characteristics of DC motors – Starting and speed control of DC motors – Losses and efficiency – Braking-Applications of DC Motor.

Transformers

Principle of operation – Constructional features of single phase and three phase transformers – EMF equation – Transformer on No load and Load –Phasor diagram - Equivalent circuit – Regulation - Three phase transformer connections -Parallel operation of single phase and three phase transformer- Auto transformer-Tap changing transformers.

Testing of DC Machines & Transformers

Losses and efficiency –Condition for maximum efficiency – Testing of DC machines: Brake test, Swinburne's test, Retardation test, Hopkinson's test.Testing of transformer: polarity test, load test, open circuit and short circuit test, Sumpner's test – All day efficiency.

COURSE OUTCOMES:

- **CO1:** Ability to understand the construction and working principles of electrical machines and transformers.
- **CO2:** Ability to apply the principles of DC machines and transformers for resolving no- load and load characteristics.
- **CO3:** Ability to analyze the losses, performance and efficiency in DC machines and transformers.
- **CO4:** Ability to evaluate the performance characteristics of DC machines and transformers for the different level of utilization in Industries.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	3	1	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	3	1	2	2	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO3	3	2	2	2	-	-	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	2	2	2	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EE009	3	2	2	2	-	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3

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2. Dr. P.S. Bhimbra, “Electrical Machinery”, Khanna Publishers, 7th edition, 2017.
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20EE010	MEASUREMENTS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the operation and construction of all types of electrical and electronics measuring instruments.

COURSE CONTENT:

Electronic Measurements and Instruments

Functional elements of an instrument- Errors in measurement - Static characteristics: Accuracy, Precision, Sensitivity and Resolution - dynamic characteristics: speed of response and fidelity - Electronic voltmeter – Digital Voltmeter – Multimeter.

Electrical Measurements and Instruments

Moving iron: attraction and repulsion type instruments-Moving coil instruments: Permanent magnet moving coil instruments - Dynamometer type moving coil Instruments-Extension of ranges, use of shunts and Instrument Transformers-Dynamometer type wattmeter - Energy meters-Measurement of power using Instrument Transformers-Power factor meter.

Measurement of R-L-C

DC potentiometer: Loading effect, standardization & Laboratory type (Crompton's) – AC potentiometer: Drysdale (polar type) type & Gall-Tinsley (coordinate) type- Resistance measurement – Kelvin double bridge, Wheatstone bridge. Measurement of inductance and capacitance – Maxwell, Anderson, and Schering bridge-Measurement of Earth resistance- Megger.

Transducers

Elements of Instrumentation systems - Transducers – Classifications, Principle of operation of Resistance potentiometer, Strain Gauge, Inductive and capacitive transducers, LVDT, Piezo-electric transducers. Hall effect sensors, and photo sensors-Measurement of Pressure- Measurement of Temperature: Resistance thermometers, thermistors and thermocouples- Measurement of optical sensors.

Storage and Display Devices

Magnetic disk and tape – Recorders, digital plotters and printers, CRT display, digital CRO, LED, LCD & Dot matrix display – Data Loggers.

COURSE OUTCOMES:

CO1: Ability to understand the basic principles of various measuring meters and instruments.

CO2: Ability to identify the various parameters that are measurable in electronic instrumentation.

CO3: Ability to select various measuring meters and instruments for real time application.

CO4: Ability to employ appropriate instruments to measure given sets of parameters.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	3	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO3	3	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EE010	3	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

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2. Helfrick& Cooper, “Modern Electronic Instrumentation and Measurement Techniques”, Prentice Hall of India, 5th Edition, 2005.
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5. J. B. Gupta, “A course in Electrical & Electronic Measurement & Instrumentation”, S K Kataria & Sons, 2007.

20EEG07	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVE:

- To learn the design aspects of I/O and Memory Interfacing circuits.

LIST OF EXPERIMENTS:

1. Simple arithmetic operations: addition / subtraction / multiplication / division (8086).
2. Programming with control and looping Instructions: (8086)
   a) Ascending / Descending order
   b) Programs using Rotate instructions
3. Keyboard and Seven Segment Display Interfacing with 8086.
4. Simple arithmetic operations: addition / subtraction / multiplication / division (8051).
5. Programs using control and looping Instructions.
   a) Maximum / Minimum of numbers
   b) Programs using subroutines
6. Programming I/O Port 8051
   a) Study on interface with A/D & D/A
   b) Study on interface with DC & AC motor.
7. Traffic light controller.
8. ADC and DAC Interfacing.
9. Stepper Motor Interfacing.
10. Mini project development with processors.

COURSE OUTCOMES:

CO1: Ability to develop assembly language programs to perform arithmetic and logical operations using 8086 microprocessor.

CO2: Ability to develop assembly language programs to perform arithmetic and logical operations using 8051 microcontroller.

CO3: Ability to interface the necessary peripherals for application development with microprocessor/ microcontroller.

CO4: Ability to identify, define a real time problem and develop microcontroller-based solution.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO2	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO3	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO4	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EEG07	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3

REFERENCES:

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20EE011	CONTROL AND INSTRUMENTATION LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVE:

- To provide knowledge on analysis and design of control system along with basics of instrumentation.

LIST OF EXPERIMENTS:

1. Transfer function of Speed control of DC shunt motor.
2. Time domain response of a second order system for step input.
3. Frequency response analysis using bode plot.
4. Stability analysis of linear system using root locus
5. Design of PID Controller for second order systems
6. Design of compensator
7. Dynamics of Sensors and transducer
   a) Resistance Temperature Detector (RTD)
   b) Strain gauge
   c) Pressure transducer
   d) Optical sensor
8. Bridge Networks –AC and DC Bridges
9. Signal conditioning using ADC and DAC
10. Power and Energy Measurement

COURSE OUTCOMES:

CO1: Ability to analyze the physical systems represented in transfer function.

CO2: Ability to describe and design step response for first and second order system with unity feedback.

CO3: Ability to design controllers, compensators using MATLAB software.

CO4: Ability to identify various measuring equipments/meters and to predict correctly their expected performance through different calibration methods.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO2	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO3	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO4	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EE011	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3

REFERENCES:

1. Nise N.S, “Control System Engineering”, John Wiley & Sons, 6th Edition, 2013.
2. Nagarath I.J and Gopal M, “Control Systems Engineering”, New age international publishers, New Delhi, 2017.
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4. Moorthy, D.V.S., “Transducers and Instrumentation”, Prentice Hall of India Pvt. Ltd., 2nd edition, 2012.
5. H.S.Kalsi, “Electronic Instrumentation”, The McGraw-hill companies, 3rd edition, 2012.

20EE012	ELECTRICAL MACHINES LABORATORY - I	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVE:

- To give hands on training for measuring DC /AC electrical parameters using instruments on static and dynamic electro mechanical energy conversion devices through conducting basic tests on DC machines and transformers and to study their performance.

LIST OF EXPERIMENTS:

1. Open circuit and load characteristics of a separately excited DC Generator and DC Shunt Generator.
2. Load test on DC shunt motor and DC series motor.
3. Load test on DC Compound motor.
4. Swinburne's test and speed control of DC shunt motor.
5. Hopkinson's test on DC Machine.
6. Load test on single-phase transformer.
7. Open circuit and short circuit tests on single phase transformer.
8. Sumpner's test on single phase transformers.
9. Separation of no-load losses in single phase transformer.
10. Study of starters and 3-phase transformers connections.

COURSE OUTCOMES:

CO1: Ability to analyses the characteristics of DC Generators using various tests.

CO2: Ability to analyses the performance of DC machines with direct and indirect loading test.

CO3: Ability to analyses the performance of transformers using various tests

CO4: Ability to understand the different three phase connections.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO2	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO3	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO4	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EE012	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3

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FIFTH SEMESTER SYLLABUS

20HMG04	PROFESSIONAL ETHICS AND VALUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

COURSE CONTENT:

HUMAN VALUES

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

ENGINEERING ETHICS

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.

ENGINEERING AS SOCIAL EXPERIMENTATION

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

SAFETY, RESPONSIBILITIES AND RIGHTS

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.

GLOBAL ISSUES

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.

COURSE OUTCOMES:

- **CO1:** Ability to identify an ethical issue and assess variety of moral issues using ethical theories in engineering.
- **CO2:** Ability to analyze engineering, social experimentation and engineers as responsible experimenters.
- **CO3:** Ability to infer engineer's safety and their responsibilities, professional rights, employee rights, and intellectual property rights.
- **CO4:** Ability to interpret various types of ethics like business ethics, environmental ethics and computer ethics.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20HMG04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-

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2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.
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4. World Community Service Centre, ‘Value Education’, Vethathiri publications, Erode, 2011.
5. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2009.

20EE013	POWER SYSTEM ANALYSIS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

- To learn about the various power system studies which are essential for the planning and operation of the power system.
- To inculcate knowledge about short circuit response of the power system under symmetrical and unsymmetrical fault conditions.
- To study the stability of the power system.

COURSE CONTENT:

Modelling of Power System

Basic structure of power system, restructuring of power system; Modeling of Generator, transformer, transmission line and load; per-unit system, per phase analysis; Power system representation - Network matrices: Admittance matrix, Impedance matrix; Sparse Matrix techniques for large scale power systems

Load Flow Study

Development of static load flow equations; Iterative power flow solution using Gauss-Seidal Method, Newton-Raphson Method and Fast decoupled load flow method; Case study – Power flow analysis of standard IEEE test system

Symmetrical Fault Analysis

Fundamentals of symmetrical fault analysis - Computations of short circuit capacity, post fault voltages and currents for balanced fault by Thevenin's theorem and Bus impedance Matrix method; Case study – Short circuit analysis of standard IEEE test system

Unbalanced Fault Analysis

Symmetrical components, Sequence impedance, Sequence networks of power system components - Solution of Single-line to ground fault, Line-line fault and Double line to ground fault.

Power System Stability

Classification of power system stability; Single Machine Infinite Bus (SMIB) system: Development of swing equation, Equal area criterion, determination of critical clearing angle and time; Multi Machine stability analysis; Solving swing Equation by Modified Euler method and Runge-Kutta fourth order method.

COURSE OUTCOMES:

CO1: Ability to understand the modelling of power system components.

CO2: Ability to choose and apply various numerical methods to solve the power flow problem.

CO3: Ability to analyze the power system under balanced and unbalanced fault conditions.

CO4: Ability to assess the stability of power system when it is subjected to a fault.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	2	3	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	2	2	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	3	2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	2	3	2	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EE013	2	2	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

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20EE014	POWER ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To get an overview of different types of power semiconductor devices and their dynamic characteristics and understand their various application.
- To understand the operation, characteristics, configurations ,control techniques and performance parameters of rectifiers, choppers and AC controllers
- To understand different configurations and modulation techniques used for inverters

COURSE CONTENT:

Power Semi-Conductor Devices

Study of working of switching devices, SCR, TRIAC, GTO, BJT, MOSFET, IGBT and IGCT- Static and Switching characteristics: SCR, MOSFET and IGBT - Triggering and commutation circuit for SCR- Introduction to Firing and snubber circuits.

Phase Controlled Converters

Single Phase Half wave and Full wave Fully controlled converters for R,RL,RLE loads– performance parameters –Three Phase Half wave and Full Wave Fully controlled Converters-R,RL Loads (No analysis) --Effect of source inductance—Dual converters, Applications-light dimmer, Solar PV systems.

DC To DC Converters

Step-down and step-up chopper-control strategy– Buck, Boost, Buck- Boost regulator, Introduction to types of choppers-A, B, C, D and E -Switched mode regulators, Introduction to Resonant Converters, Voltage to Frequency Converters Basics, Applications-Battery operated vehicles.

Inverters

Single phase and three phase voltage source inverters (both120° mode and 180° mode)– Voltage& harmonic control--PWM techniques: Multiple PWM, Sinusoidal PWM, modified sinusoidal PWM – Introduction to space vector modulation –Single phase Current source inverter, Applications-Induction heating, UPS.

AC To AC Converters

Single phase and Three phase AC voltage controllers–Control strategy- Power Factor Control – Multistage sequence control -single phase to single phase and single phase to three phase cyclo converters –Introduction to Matrix converters, Applications –welding.

COURSE OUTCOMES:

CO1: Ability to understand the operation of uncontrolled and controlled converters, DC-DC switching regulators and inverters.

CO2: Ability to apply suitable control technique to regulate the output of various converters and inverters.

CO3: Ability to analyze the characteristics, control and switching techniques of converters, DC-DC switching regulators and inverters.

CO4: Ability to choose the appropriate power electronic circuit for a specific application.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	3	-	3	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	-	3	-	3	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EE014	-	3	-	3	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

REFERENCES:

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20EE015	ELECTRICAL MACHINES -II	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide a basic understanding of AC machinery fundamentals, machine parts and helps to gain motors - construction the skills for operating AC machines.
- To equip students with ability to understand and analyse the phasor diagrams and equivalent circuits of AC Induction and Synchronous Machines

COURSE CONTENT:

Synchronous Generators

Constructional details – Types of rotors –winding factors- emf equation – Synchronous reactance, Armature reaction – Phasor diagrams of non-salient pole synchronous generator connected to infinite bus--Synchronizing and parallel operation – Synchronizing torque -Change of excitation and mechanical input- Voltage regulation – EMF, MMF, ZPF and A.S.A methods – steady state power angle characteristics– Two reaction theory –slip test -short circuit transients - Capability Curves.

Synchronous Motors

Principle of operation – Torque equation – Operation on infinite bus bars - V and Inverted V curves – Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power developed-Hunting – natural frequency of oscillations – damper windings- synchronous condenser.

Three phase Induction Motors

Constructional details – Types of rotors –- Principle of operation – Slip –cogging and crawling- Equivalent circuit – Torque-Slip characteristics - Condition for maximum torque – Losses and efficiency – Load test - No load and blocked rotor tests - Circle diagram – Separation of losses – Double cage induction motors –Induction generators – Synchronous induction motor.

Starting and Speed Control of Three phase Induction Motors

Need for starting – Types of starters – DOL, Rotor resistance, Autotransformer and Star-delta starters – Speed control – Voltage control, Frequency control and pole changing – Cascaded connection-V/f control – Slip power recovery scheme-Braking of three phase induction motor: Plugging, dynamic braking and regenerative braking.

Single Phase Induction Motor

Constructional details of single phase induction motor – Double field revolving theory and operation – Equivalent circuit – No load and blocked rotor test – Performance analysis – Starting methods of single-phase induction motors – Capacitor-start capacitor run Induction motor-Shaded pole induction motor.

COURSE OUTCOMES:

CO1: Ability to comprehend the construction, principle of operation and types of Induction and Synchronous Machines.

CO2: Ability to comprehend the starting, braking and speed control methods of Induction Machines.

CO3: Ability to comprehend the starting methods of Synchronous Machines.

CO4: Ability to analyze performance of Induction and synchronous machines using different techniques.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	-	3		3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EE015	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

REFERENCES:

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2. Dr. P.S. Bhimbra, “Electrical Machinery”, Khanna Publishers, 7th edition, 2017.
3. M. G. Say, ‘Performance and Design of Alternating Current Machines’, CBS Publishers & Distributors Pvt. Ltd., New Delhi, 3rd Edition, 2002.
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20EE016	POWER ELECTRONICS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVE:

- To study the VI characteristics of SCR, TRIAC, MOSFET and IGBT.
- To analyze the performance of converter, step-up, step-down choppers, inverters and AC voltage controllers by simulation and experimentation.

LIST OF EXPERIMENTS:

1. Gate Pulse Generation using R, RC and UJT
2. Characteristics of SCR and TRIAC
3. Characteristics of MOSFET and IGBT
4. AC to DC half wave-controlled converter for R load
5. AC to DC full wave-controlled Converter for R load
6. Step down and step up MOSFET based choppers
7. IGBT based single phase PWM inverter for R load
8. IGBT based three phase PWM inverter for R load
9. AC Voltage controller
10. Simulation of PE circuits (1Φ&3Φsemiconverter, 1Φ&3Φfullconverter, dc-dc converters, ac voltage controllers for R, RL, RLE loads).

COURSE OUTCOMES:

CO1: Ability to analyze the characteristics of MOSFET, SCR, IGBT devices.

CO2: Ability to analyze the output characteristics of the DC-AC, AC-DC and AC-AC converters practically.

CO3: Ability to simulate various power electronic circuits and analyse their characteristics.

CO4: Ability to correlate the theoretical and practical analysis of the converters.

CO5: Ability to analyze the characteristics of MOSFET, SCR, IGBT devices.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO2	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO3	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO4	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO5	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EE016	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3

REFERENCES:

1. M.H. Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Education, Fourth Edition, New Delhi, 2013.
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20EE017	ELECTRICAL MACHINES LABORATORY - II	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- To give the students an insight into the constructional details of the induction and synchronous machines with a view for better understanding of their working principles.
- To equip the students to test and evaluate the performance of induction and synchronous machines by conducting appropriate experiments.

LIST OF EXPERIMENTS:

1. Load test on three-phase induction motor
2. No-load and blocked rotor test on three-phase induction motor
3. Load test on single-phase induction motor
4. No-load and blocked rotor test on single phase-phase induction motor
5. Load test on three-phase alternator
6. Regulation of three-phase alternator by E.M.F and M.M.F methods
7. Regulation of three-phase alternator by ZPF methods
8. Synchronization of three-phase alternator with infinite bus bar
9. V and inverted V-curves of synchronous motor
10. Speed Control on three-phase induction motor

COURSE OUTCOMES:

CO1: Ability to estimate or test the performance of induction and synchronous machines by conducting suitable experiments and report the results.

CO2: Ability to experiment and analyze the speed control techniques for three-phase induction motors.

CO3: Ability to experiment synchronization of alternators and power exchange with the grid to get convinced with their usage at conventional power generation stations

CO4: Ability to analyze the V and Inverted V curves of synchronous motors

CO5: Ability to estimate or test the performance of induction and synchronous machines by conducting suitable experiments and report the results.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO2	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO3	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO4	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EE017	-	3	1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3

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5. Deshpande M V, “Electrical Machines”, PHI Learning Pvt. Ltd., New Delhi, 2011.

SIXTH SEMESTER SYLLABUS

20EE018	ELECTRICAL MACHINE DESIGN	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- This course offers the preliminary instructions and techniques to design the main dimensions and other major part of the transformer and DC and AC rotating machines.
- The course also provides the students with an ability to understand the step by step procedure for the complete design of electrical machines.

COURSE CONTENT:

Magnetic Circuit Design:

General concepts in the design of rotating machines-output equation-Magnetic and electric loadings-Common design features of all rotating machines-Conducting, insulating and magnetic materials used in electrical apparatus - mmf calculation for the magnetic circuit of rotating machines-Leakage reactance calculation.

Design of Field and Armature Windings

Armature winding –output equation-Choice of specific loadings-Choice of poles-design of conductors, winding, slot, air gap, field poles and field coils, commutator and brush-Predetermination of efficiency, temperature rise and open circuit characteristics from design data.

Design of Transformers

Output equation-Design of core and coils for single phase and three phase transformers-Design of tank and cooling tubes-Predetermination of circuit parameters, magnetising current, losses, efficiency, temperature rise and regulation from design data).

Design of Induction Motor

Output equation-Choice of specific loadings-Design of stator-Design of squirrel cage and slip ring rotors-Stator and rotor winding designs-Predetermination of circuit parameters, magnetising current, efficiency and temperature rise from design data.

Design of Synchronous Machines

Constructional features of synchronous machines-SCR-Output equation-specific loadings-Main Dimensions-Stator design-Design of salient pole field coil.

COURSE OUTCOMES:

- **CO1:** Ability to understand the basic principles of magnetic circuits in relation of DC machines and AC machines
- **CO2:** Ability to design rotor, stator, and their windings for DC machines.
- **CO3:** Ability to design the main dimensions of the transformer.
- **CO4:** Ability to design a cooling mechanism for the transformer.
- **CO5:** Ability to design rotor, stator, and their windings for induction machines.
- **CO6:** Ability to design rotor, stator, and their windings for synchronous machines.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO3	-	3	-	3	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO4	-	3	-	3	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO5	-	3	-	3	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO6	-	3	-	3	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EE018	1	3	1	3	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3

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2. Sen, S.K., 'Principles of Electrical Machine Design with Computer Programmes', Oxford and I.B.H Publishing Co. Pvt. Ltd, 2nd Edition, 2006.
3. Rai, H.M., 'Principles of Electrical Machines Design', Sathya Prakash Publications, 3rd Edition, 1994.
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20EE019	POWER SYSTEM OPERATION AND CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To familiarize various aspects of power system operation and load forecasting techniques.
- To understand the control techniques as applied to power system for the normal operating condition.

COURSE CONTENT:

Introduction

System load variation, Reserve requirements, Load forecasting techniques, Economics of power generation, Electrical tariff and its types, Basic control in power system

Automatic Load frequency Control

Fundamentals of speed governing mechanism and modeling, Speed-load characteristics, Load sharing between two synchronous machines in parallel, concept of control area, LFC control of a single area system and two area system, Static and dynamic analysis of uncontrolled and controlled cases, state variable model.

Automatic Voltage Regulator

Automatic Voltage Regulator (AVR) and Excitation control, Modelling, Static and dynamic analysis of uncontrolled and controlled cases, Power system stabilizer.

Unit Commitment and Economic Dispatch

Statement of Unit Commitment (UC) problem, constraints in UC, solution methods: Priority-list methods, forward dynamic programming approach. Economic dispatch, solution by direct method and λ iteration method. Base point and participation factors, Economic dispatch controller added to LFC control.

Computer control of Power System

Energy control Centre, System hardware configuration, SCADA and EMS functions, state estimation, security analysis and control. Various operating states.

COURSE OUTCOMES:

- **CO1:** Ability to understand the fundamentals of power system operation and control techniques.
- **CO2:** Ability to understand the application of computer control in Power system.
- **CO3:** Ability to apply suitable techniques to improve the performance of the power system operation and control.
- **CO4:** Ability to analyze the Unit Commitment and Economic Dispatch problems.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	2	3	2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	2	3	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EE019	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

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20EE020	ELECTRICAL DRIVES AND CONTROL	L	T	P	C
		3	0	2	4

COURSE OBJECTIVE:

- 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, induction and synchronous AC drives.
- To analyze and design the current and speed controllers for a closed loop solid state DC motor drive.

COURSE CONTENT:

Drive Characteristic

Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, starting & stopping – typical load torque characteristics – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors

Solid State DC Motor Drive

Steady state analysis of the single and three phase converter fed separately excited DC motor drive–continuous conduction – Time ratio and current limit control – 4 quadrant operation of converter and chopper fed drive-Applications

Induction Motor Drive

Solid State stator voltage control–V/f control– Rotor Resistance control-qualitative treatment of slip power recovery drives-closed loop control— vector control.

Synchronous Motor Drives

Solid state V/f control and self-control of synchronous motor: Margin angle control and power factor control-Permanent magnet synchronous motor.

Design of Controllers for Drives

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.

List of Experiments:

1. Speed control of Converter fed DC motor
2. Speed control of Chopper fed DC motor
3. Micro controller-based speed control of Stepper motor
4. V/f control of three-phase induction motor
5. Speed control of BLDC motor

COURSE OUTCOMES:

CO1 Ability to understand the operation and characteristics of electric drives.

CO2 Ability to apply the power electronic control strategies for speed control in DC and AC drives.

CO3 Ability to analyze the characteristics and conventional speed control methods of motors used in DC and AC drives.

CO4 Ability to analyse the design aspects of controllers for electric drives.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	-	3	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO4	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EE020	3	-	3	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	3	3

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20EE021	POWER SYSTEM SIMULATION LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVE:

To provide better insight of power system analysis through digital simulation.

COURSE CONTENT:

1. Computation of Parameters and Modeling of Transmission Lines
2. Formation of Bus Admittance and Impedance Matrices and Solution of Networks.
3. Load Flow Analysis: Solution of load flow and related problems using Gauss-Seidel Newton Raphson and Fast Decoupled Method.
4. Fault Analysis-Symmetrical and Unsymmetrical faults.
5. Solution to Unit commitment problem.
6. Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System
7. Transient Stability Analysis of Multi machine Power Systems
8. Study of Electromagnetic Transients in Power Systems
9. Load – Frequency Dynamics of Single- Area and Two-Area Power Systems
10. Economic Dispatch in Power Systems

COURSE OUTCOMES:

CO1: Ability to compute the transmission line parameters and its performance.

CO2: Ability to build the network matrix and solve the load flow problem.

CO3: Ability to analyze the faults and transient stability of the given power system network.

CO4: Ability to solve the economic dispatch problem using appropriate techniques.

CO5: Ability to analyze the load frequency characteristic for step load change.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	2	3	1	3	2	2	3	1	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	2	3	1	3	2	2	3	1	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	3	1	3	2	2	3	1	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1
CO4	2	3	1	3	2	2	3	1	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO5	2	3	1	3	2	2	3	1	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EE021	2	3	1	3	2	2	3	1	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1

REFERENCES:

1. Olle. I. Elgerd, “Electric Energy Systems Theory – An Introduction, Tata McGraw Hill Publishing Company Ltd, New Delhi, Second Edition, 2003.
2. L.L. Grigsby, “The Electric Power Engineering, Hand Book, CRC Press & IEEE Press, 2001.
3. Allen.J.Wood and Bruce F.Wollenberg, “Power Generation, Operation and Control”, John Wiley & Sons, Inc., 2003.
4. P. Kundur, “Power System Stability & Control”, McGraw Hill Publications, USA, 2007.
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20AC002	CONSTITUTION OF INDIA	L	T	P	C
		3	0	0	-

COURSE OBJECTIVES:

To enable the students to understand the Historical Background of Indian constitution as well as to interpret the Fundamental Duties and its legal status. It further enables them to understand the Scope of the Right to Life and Personal Liberty.

COURSE CONTENT:

Historical perspective of the Constitution of India

Meaning of the constitution law and constitutionalism - Historical perspective of the Constitution of India - Salient features and characteristics of the Constitution of India

Fundamental rights and legal status

Scheme of the fundamental rights - The scheme of the Fundamental Duties and its legal status -The Directive Principles of State Policy – Its importance and implementation

The constitution powers

Federal structure and distribution of legislative and financial powers between the Union and the States - Parliamentary Form of Government in India – The constitution powers and status of the President of India - Amendment of the Constitutional Powers and Procedure

Constitutional amendments

The historical perspectives of the constitutional amendments in India - Emergency Provisions: National Emergency, President Rule, Financial Emergency- Local Self Government-Constitutional Scheme in India

Right to Life and Personal Liberty

Scheme of the Fundamental Right to Equality - Scheme of the Fundamental Right to certain Freedom under Article 19 - Scope of the Right to Life and Personal Liberty under Article 21

COURSE OUTCOMES:

CO1: Ability to understand and abide by the rules of the Indian constitution.

CO2: Ability to comprehend the constitutional rights & fundamental rights.

CO3: Ability to understand the form of Government in India.

CO4: Ability to comprehend the Parliamentary System and the Constitutional Scheme in India.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20AC002	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-

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SEVENTH SEMESTER SYLLABUS

20EE022	POWER GENERATION AND UTILIZATION OF ELECTRICAL ENERGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the concept of conventional power generation to meet the higher energy demand in various sector.
- To impart knowledge on the electric traction its operation and running of traction drives.
- To learn about different illumination concepts, heating, welding mechanism and the energy conservation methods in various loads.

COURSE CONTENT:

Power Generation

Introduction to conventional power generation – thermal power plant – hydro power plant – diesel engine power plant – gas power plant – gas turbine power plant – nuclear power plant – total installed capacity – power plants in India – Distributed generation.

Electric Drives and Traction

Fundamentals of electric drive – block diagram – factors governing selection of an electric motor. Traction – Different types and systems of traction – power supply for electric traction -

Track electrification - typical speed time curve – motors used for electric traction – control of traction motors – mechanical consideration and control equipment.

Illumination

Introduction - definition and meaning of terms used in illumination engineering – laws of illumination – polar curves – photometry – Integrating sphere – Measurement of illumination – Sources of light – Arc lamps – Incandescent lamp – Gaseous discharge lamp – principles of light control – design of lighting schemes – factory lighting - street lighting – flood lighting – methods of lighting calculations - UPS- energy saving lamps, LED.

Heating and Welding

Heating – modes of transfer of heat – types of electric heating - advantages of electric heating - resistance heating - arc furnaces - induction heating - dielectric heating – Eddy current heating - Welding - types - resistance welding - arc welding – ultrasonic welding – Electron beam welding – laser beam welding – electrodes – equipment's used for electric welding - power supply for resistance and arc welding.

Energy Auditing and Management

Introduction to tariff – factors affecting framing of tariff – types of tariffs – Definition for energy management – need for energy management – Designing of an energy management programme – definition for energy audit – objectives of energy audit – types of energy audit – equipment's required for energy audit.

COURSE OUTCOMES:

- **CO1:** Ability to understand the operation and working of various conventional power plants.
- **CO2:** Ability to comprehend the electric traction, illumination, heating and electric welding with its energy conversion methods.
- **CO3:** Ability to apply the appropriate energy saving concept in illumination, heating and electric welding.
- **CO4:** Ability to analyze the characteristic features of electric traction motors.
- **CO5:** Ability to design interior and exterior illumination system for domestic, commercial, industrial consumers and heating element.
- **CO6:** Ability to understand the concept of energy auditing and tariff.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO3	2	3	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO4	2	3	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
CO5	2	3	2	2	1	-	3	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO6	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EE022	2	3	2	2	1	-	3	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3

REFERENCES:

1. J.B.Gupta, “Utilisation Electric power and Electric Traction”, S.K.Kataria and sons, 2000.
2. C.L.Wadhwa, “Generation, Distribution and Utilisation of Electrical Energy”, New Age international Pvt.Ltd, 2003.
3. N.V. Suryanarayana, “Utilisation of Electric Power”, Wiley Eastern Limited, New Age
4. International Limited, 1993.
5. H.Partab, Art and Science of Utilisation of Electrical Energy”, Dhanpat Rai and Co., New Delhi-2004.

20EE023	PROTECTION AND SWITCHGEAR	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the principle of protective schemes and various faults in the Power System Scenario.
- To expose the students to principles of protection of power system with various protection relays.
- To familiarize the various types of the circuit breakers, the arc quenching phenomena and the protection against over voltages.

COURSE CONTENT:

Protection Schemes

Principles and need for protective schemes – nature and causes of faults – types of faults– fault current calculation — Zones of protection and essential qualities of protection. Methods of Neutral grounding.

Electromagnetic Relays

Operating principles of relays - Torque equation – R-X diagram – Electromagnetic Relays – Over current, Directional, Distance, Differential, Negative sequence and Under frequency relays.

Apparatus Protection

Application of Current transformers and Potential transformers in protection schemes – Sources of error. Protection of transformer, generator, motor, bus bars and transmission line.

Static Relays and Numerical Protection

Static relays – Phase, Amplitude Comparators – Synthesis of various relays using Static comparators – Block diagram of Numerical relays – Over current protection, transformer differential protection, distance protection of transmission lines.

Circuit Breakers

Physics of arcing phenomenon and arc interruption - DC and AC circuit breaking – re-striking voltage and recovery voltage - rate of rise of recovery voltage - current chopping - interruption of capacitive current - resistance switching- Response time and characteristics of Circuit Breakers-Types of circuit breakers – air, oil, SF6 and vacuum circuit breakers,– Rating and selection of Circuit breakers.

COURSE OUTCOMES:

CO1: Ability to understand the causes of faults, the effects of lightning phenomenon and protection schemes of power systems.

CO2: Ability to demonstrate the operation of different relays used in the power system.

CO3: Ability to illustrate the static relays using comparators and analyse the numerical relays.

CO4: Ability to identify the suitable relay for power system protection.

CO5: Ability to apply the appropriate protection scheme for power system apparatus.

CO6: Ability to analyze the performance of different circuit breaker in power system protection.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	2	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	2	1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	1	3	-	3	1	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	1	3	-	3	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO5	2	1	2	3	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO6	2	2	3	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EE023	2	3	3	3	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-

REFERENCES:

1. Badri Ram, Vishwakarma D N., “Power System Protection and Switchgear”, Tata McGraw Hill Publishing House Limited, 2 nd Edition, New Delhi, 2011.
2. Soni, M.L., Gupta, P.V., Bhatnagar, U.S. and Chakrabarti, A., “A Text Book on Power Systems Engineering”, Dhanpat Rai & Sons Company Limited, New Delhi, 2008.
3. Wadhwa, C.L., “Electrical Power Systems”, New Age International Publishers Limited, 2006, New Delhi, 6th Edition, 2010.
4. Y G Paithankar and S R Bhide, “Fundamentals of Power System Protection”, Prentice Hall of India Pvt. Ltd., 2 nd Edition, New Delhi, 2010.
5. Sunil S. Rao, “Switchgear and Protection”, Khanna publishers, New Delhi, 2012.

20EE901	DESIGN PROJECT	L	T	P	C
		0	0	8	4

COURSE OBJECTIVES:

- To impart and improve the design capability of the student using advanced electrical and electronics engineering software and hardware.

COURSE CONTENT:

This course conceives purely a design problem in any one of the disciplines of Electrical and Electronics Engineering; e.g., Power and Energy, Embedded Systems, Robotics and Automation etc., The design problem can be allotted to either an individual student or a group of students comprising of not more than three. The students will be guided by internal and external supervisors. The external supervisor will be appointed by head of the department after consultation with Industry-Institute interaction cell. At the end of the course the group should submit a complete report on the design problem consisting of the data given, the design calculations, specifications if any, complete set of circuit design along with hardware and software as a product developed to solve a societal issue/ design problem identified.

COURSE OUTCOMES:

CO1: Ability to Select and use appropriate research methods, to access existing data sources.

CO2: Ability to Select and apply appropriate experimental methodologies and tools to generate or analyse data with particular emphasis on industrial needs.

CO3: Ability to Plan and implement the course of action as a team, identifying targets and organizing resources

CO4: Ability to Apply design principles for sustainable product design and development.

CO5: Ability to Understanding impacts of the diverse professional, social, and ethical effects of the design.

CO6: Ability to Use various forms of communication in written and oral forms to interact with the industry and community.

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2	-	-	-	2	3	3	3	2	3	1	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	-	-	-	3	3	-	-	-	3
CO4	3	2	-	-	3	3	-	-	-	-	-	-	-	-	-	2	3	-	1	1	-	-	2	-	-	1	-	-	3	2
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3	-	-	3	3	-	-	-	-	-	-	-	-	-	-	3
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3	-	-	3	3	3	3

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EE901	3	2	3	2	3	3	3	2	3	1	3	3	3	2	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3

EIGHTH SEMESTER SYLLABUS

20EE902	FINAL YEAR PROJECT	L	T	P	C
		0	0	16	8

COURSE OBJECTIVES:

- To allow students to complete research and / or development project via an individual work or team work.
- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.
- To enhance students' skills pertaining to scientific and technical report writing and presentation.

COURSE CONTENT:

The student individually or in a group of 2 to 3, works on a specific topic approved by the project review committee constituted by the head of the department under the guidance of a faculty member who is familiar in this area of interest. The students can select any topic which is relevant to the area of Electrical and Electronics Engineering. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The progress of the project is evaluated based on a minimum of three reviews by the project review committee. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated based on the report and the viva-voce examination by a panel of examiners including one external examiner.

COURSE OUTCOMES:

CO1: Ability to identify the problem for doing a project after extensive literature review.

CO2: Ability to identify and select appropriate Techniques/ Tools / Resources for implementing the Project.

CO3: Ability to apply the knowledge of mathematics, science, engineering and computing techniques to solve the problem.

CO4: Ability to work as a member or leader in a multidisciplinary team to manage the project, apply ethical principles and commit to individual responsibilities.

CO5: Ability to design the hardware/ simulation for the project

CO6: Ability to implement and test the hardware / simulation results and interpret the results

COURSE ARTICULATION MATRIX:

COs	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	3		3	-	-	-	-	-	-	-	-	-	-	-	3	3	-
CO2	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3		3	3	-
CO3	-	-	-	-	3	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	3	3	-	3	-	-	3	-	-	1	-
CO5	-	-	-	-	-	3			-	-	3	3		-	-	-	-	-		-	-	3	-	-	-	-	3	-	-	3
CO6	-	-	-	-	-	-	3	3	-	-	3	3	3	-	-	-	-	-	3	-	-	3		3	-	-	-	-	-	3

COs, POs, and PSOs ARTICULATION MATRIX:

Course	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO1	PSO2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
20EE902	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE - I

20EEP01	HIGH VOLTAGE ENGINEERING	L	T	P	C
		3	0	0	3

Course Objective:

- To study about the over voltages, its causes and effects in the power system
- To understand the breakdown in solid, liquid and gaseous dielectric
- To be familiar with various generation and measurement techniques of high voltage.
- To impart knowledge on testing methods of high voltage apparatus

Course Content:

Introduction to Over Voltages

Causes Of Over Voltages and Its Effects on Power System, Lightning, Switching Surges and Temporary Over Voltages, Corona and Its Effects, Bewley's Lattice Diagram, Protection Against Over Voltages.

Dielectric Breakdown

Properties of Dielectric Materials, Gaseous Breakdown in Uniform and Non-Uniform Fields, Corona Discharges, Vacuum Breakdown. Conduction And Breakdown in Pure and Commercial Liquids, Maintenance of Oil Quality, Breakdown Mechanisms in Solid and Composite Dielectrics.

Generation of High Voltages and Currents

Generation of High DC Voltage, Rectifiers, Voltage Multipliers, Van De Graff Generator, Generation of High Impulse Voltage, Single and Multistage Marx Circuits, Generation of High AC Voltages, Cascaded Transformers, Resonant Transformer and Tesla Coil, Generation of Switching Surges, Generation of Impulse Currents, Triggering and Control of Impulse Generators.

Measurement of High Voltages and Currents

High Resistance with Series Ammeter, Dividers, Resistance, Capacitance and Mixed Dividers , Peak Voltmeter, Generating Voltmeters , Capacitance Voltage Transformers, Electrostatic Voltmeters, Sphere Gaps, High Current Shunts, Digital Techniques in High Voltage Measurement.

Testing & Insulation Coordination

High Voltage Testing of Electrical Power Apparatus , Power Frequency, Impulse Voltage and DC Testing of Insulators, Circuit Breakers, Bushing, Isolators and Transformers, Insulation Coordination.

Course outcomes:

CO1: To explain the causes for overvoltage and protection against overvoltage
CO2: To develop equivalent circuit models of the different high voltage generators.
CO3: To illustrate the different high voltage and current measurement techniques
CO4: To analyze breakdown in solids, liquids gases and testing of high voltage apparatus

References:

1. S.Naidu and V. Kamaraju, "High Voltage Engineering", Tata McGraw Hill, Fifth Edition, 2013.
2. Subir Ray, "An Introduction to High Voltage Engineering", PHI Learning Private Limited, New Delhi, Second Edition, 2013.
3. L.L. Alston, "High Voltage Technology", Oxford University Press, First Edition, 2011.
4. C.L. Wadhwa, "High Voltage Engineering", New Age International Publishers, Third Edition, 2010.
5. E. Kuffel and W.S. Zaengl, J.Kuffel, "High Voltage Engineering Fundamentals", Newnes Second Edition, Elsevier, 2005.

20EEP11	RENEWABLE ENERGY SOURCES	L	T	P	C
		3	0	0	3

Course Objective:

To impart knowledge on various non- conventional energy sources, its operation and application.

Course Content:

Solar Energy

Solar Radiation - Measurements of Solar Radiation, Flat Plate and Concentrating Collectors, Solar Direct Thermal Applications, Solar Thermal Power Generation, Fundamentals of Solar Photo Voltaic Conversion, Solar Cells, Solar PV Power Generation, Solar PV Applications.

Wind Energy

Wind Energy Estimation, Types of Wind Energy Systems, Performance, Site Selection, Details of Wind Turbine Generator.

Ocean Energy

Ocean Thermal Energy Conversion (OTEC) - Principle of Operation, Development of OTEC plants, Tidal and Wave energy, Potential and Conversion Techniques, Mini-Hydel Power Plants.

Biomass

Principles of Bio-Conversion, Anaerobic/Aerobic Digestion, Types of Bio-Gas Digesters, Gas Yield, Combustion Characteristics of Bio-Gas, Utilization for Cooking.

Geothermal and Fuel Cell

Geothermal Energy Resources, Types of Wells, Methods of Harnessing Geothermal Energy, Scope in India. Fuel Cell- Classification, Working and Application.

Course Outcomes:

CO1: Ability to understand the concept of energy conversion from solar, wind energy.

CO2: Ability to identify the role of biomass in energy conversion using different methods of generation of biogas.

CO3: Ability to demonstrate the power generation using fuel cell, Geo thermal, Ocean thermal, Tidal and Wave energy.

CO4: Ability to Apply the concept of energy conservation techniques for the betterment of power generation and power system.

References:

1. Jefferson W. Tester, Elisabeth M. Drake, Michael J. Driscoll, Michael W. Golay, William A. Peters, “Sustainable Energy: Choosing Among Options”, MIT Press, 2012.
2. Krzysztof Iniewski, “Smart Grid & Infrastructure Networking”, TATA McGraw-Hill, 2012.
3. Bin Wu, Yongqiang Lang, Navid Zargari, Samir Kouro, “Power Conversion and Control of Wind Energy Systems”, John Wiley & Sons, 2011.
4. Clark W Gellings, “The Smart Grid, Enabling Energy Efficiency and Demand Side Response”, The Fairmont Press, 2009.
5. John Twidell and Tony Weir, “Renewable Energy Resources”, Routledge, 2005.

20EEP34	INTRODUCTION TO RASPBERRY PI	L	T	P	C
		3	0	0	3

Course Content:

Introduction to Raspberry Pi

Basic Functionality, Setting and Configuration, Differentiating Raspberry Pi from other Platforms, Over Clocking, Component Overview.

Linux Commands

Implications of Operating System on Raspberry Pi Behaviour, Overview of Linux, Terminal Commands, Apt-Get-Update, Apt-Get-Upgrade, Navigating File System, Managing Process, Text Based User Interface through Shell, Overview of Graphic User Interface

Programming Raspberry Pi

Introduction to Python programming, Python Expressions, Strings, Functions, Function Arguments, Lists, List Methods, Control Flow, NumPy, Python Installation Package(PIP), Customized Libraries; C++ programming**:** Basic C++ programming approach, Header File Structure and Library Organization, Cross Compiler and Its Configuration.

Communication Protocols for Raspberry Pi

Communication Facilities on Raspberry Pi (12C, SPI, UART), Working with RPi, Wired and Wireless Communication, TCP IP Configurations, SSH, Putty Terminal Usage, Node-RED, MQTT Protocol Using Node-RED, Visual Editor on RPi.

Interfacing Using Raspberry Pi

GPIO library, Interfacing of Sensors and Actuators, DC, Servo, Stepper, Motor Drivers, Motor Shields, Camera Interfacing, Remote Data Logging, Interfacing Constraints.

Course Outcomes:

- **CO1:** Ability to wire Raspberry Pi and create a fully functional computer.
- **CO2:** Ability to use Python-based IDE and trace and debug Python code on the device
- **CO3:** Ability to measure physical parameter using sensors.
- **CO4:** Ability to implement various communication protocols for wired and wireless communication.
- **CO5:** Ability to interfaces different motors and create robots.

References:

1. Gary Mitnick, “Raspberry Pi 3: An Introduction to Using with Python Scratch, Java Script and More”, Create Space Independent Publishing Platform, 2017.
2. Tim Cox, “Raspberry Pi for Python Programmers Cookbook”, Packt Publishing Limited, Second Revised Edition, 2016.
3. Eben Upton and Gareth Halfacree, “Raspberry Pi User Guide”, John Wiley & Sons, 2016.
4. Richard Grimmet, “Raspberry Pi Robotic Projects”, Third Revised edition, Packt Publishing, 2013.

20EEP44	PLC and SCADA	L	T	P	C
		3	0	0	3

Course Objectives:

To be familiar with the fundamentals of Programmable logic controller and ladder logic components, SCADA, DCS and various types of communication protocols.

Course Content:

Programmable Logic Controller (PLC) Basics

Overview of PLC Systems, Parts of PLC –Input/Output Modules, Power Supplies and Isolators. Fundamental PLC Wiring Diagram, Relays, Switches, Transducers, Sensors, Seal-In Circuits.

PLC Programming

Fundamentals of Logic, Program Scan, Relay Logic, PLC Programming Languages, Construction of PLC Ladder Diagram, Basic Components and their Symbols, Timers, Counters, Math Instructions, Data Manipulation Instructions, Analog PLC Operation, PID Control of Continuous Process, Sequencer Instruction, Connecting PLC to Computer, Application of PLC, Bottle Filling System.

SCADA

Introduction, Supervisory Control and Data Acquisition Systems (SCADA), SCADA HMI Essentials, SCADA Components, SCADA Configuration and Software, HMI hardware and software.

Distributed Control Systems

DCS, Various Architecture, Comparison, Local Control Unit, Process Interfacing Issues, Communication Facilities, Low and High-Level Engineering and Operator Interfaces, Case Studies in DCS.

FIELD BUS

MODBUS, HART Protocol, Profibus, Profinet, Foundation Fieldbus, H1 and HSE.

Course Outcomes :

CO1: Ability to understand the fundamentals of Programmable logic controller and ladder logic components.

CO2: Ability to develop ladder logic programs using various applications

CO3:Ability to understand the fundamentals of SCADA and DCS

CO4: Ability to remember the various types of communication protocols.

References:

1. Tom Mejer Antonsen, “PLC Controls with Ladder Diagram (LD), Monochrome”, Books on Demand, Dänemark, 2021.
2. Chanchal Dey and Sunit Kumar Sen, “Industrial Automation Technologies”, CRC Press, 2020.
3. Frank Lamb, “Advanced PLC Hardware & Programming”, Automation Consulting, LLC, 2019.
4. Dilip Patel, “Introduction Practical PLC (Programmable Logic Controller) Programming”, GRIN Verlag, 2018.
5. Kunal Chakraborty, Palash De and Indranil Roy, “Industrial Applications of Programmable Logic Controllers and SCADA”, Anchor Academic Publishing, 2016.

20EEP54	AUTOMOTIVE ELECTRONICS	L	T	P	C
		3	0	0	3

Course Content:

Automotive Fundamentals Overview

Evolution of Automotive Electronics, Automobile Physical Configuration, Survey of Major Automotive Systems, Engine Control, Ignition System - Spark plug, High voltage circuit and distribution, Spark pulse generation, Ignition Timing, Transmission, Drive Shaft, Differential, Suspension, Brakes, Steering System, Starter Battery –Operating principle.

The Basics of Electronic Engine Control

Electronic Engine Control – Exhaust Emissions, Fuel Economy, Concept of an Electronic Engine control system, Definition of General terms, Definition of Engine performance terms, Engine mapping, Effect of Air/Fuel ratio, spark timing and EGR on performance, Control Strategy, Electronic Fuel control system, Analysis of intake manifold pressure, Electronic Ignition.

Automotive Sensors

Airflow rate sensor, Strain Gauge MAP sensor, Engine Crankshaft Angular Position Sensor, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Shielded Field Sensor, Engine Coolant Temperature (ECT) Sensor, Exhaust Gas Oxygen (O2/EGO) Lambda Sensors, Piezoelectric Knock Sensor

Vehicle Motion Control

Typical Cruise Control System, Digital Cruise Control System, Digital Speed Sensor, Throttle Actuator, Digital Cruise Control configuration, Cruise Control Electronics (Digital only), Antilock Brake System (ABS)

Future Automotive Electronic Systems

Alternative Fuel Engines, Electric and Hybrid Vehicles, Fuel Cell Powered Cars, Collision Avoidance Radar Warning Systems, Low Tire Pressure Warning System, Heads Up Display, Speech Synthesis, Automatic Driving Control.

Course Outcomes

CO1: Ability to understand the fundamentals of vehicle systems and regulations.
CO2: Ability to identify various components of a vehicle and explain its functions.
CO3: Ability to gain fundamental knowledge to develop electronic controls for automotive subsystems.
CO4: Ability to illustrate the features of future automotive electronics systems and its controls

References:

1. William B. Ribbens, “Understanding Automotive Electronics”, Sixth Edition, Elsevier Publishing, 2017
2. Robert Bosch Gmbh (Ed.) Bosch, “Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive”, Fifth Edition, John Wiley& Sons Inc., 2007.
3. Barry Hollembeak, “Automotive Electricity, Electronics and Computer Controls”, Delmar Publishers, 2001.
4. Richard K. Dupuy, “Fuel System and Emission Controls”, Check Chart Publication, 2000.
5. Ronald. K. Jurgon, “Automotive Electronics Handbook”, McGraw-Hill, 1999.
6. Tom Denton, “Automobile Electrical and Electronics Systems”, Edward Arnold Publishers, 2000

PROFESSIONAL ELECTIVE - II

20EEP05	POWER QUALITY	L	T	P	C
		3	0	0	3

Course Objective:

To impart knowledge about the power quality issues ,its causes, standards and their monitoring techniques .

Course Content:

Introduction

Terms and Definitions: Overloading, Under Voltage, Over Voltage, Concepts of Transients, Short Duration Variations, Long Duration Variations, Sag, Swell, Voltage Imbalance, Voltage Fluctuation, Power Frequency Variations, International Standards of Power Quality.

Voltage Sags and Interruptions

Sources of Sags and Interruptions, Estimating Voltage Sag Performance, Thevenin's Equivalent Source, Analysis and Calculation of Various Fault Condition, Voltage Sag Due to Induction Motor Starting, Estimation of Sag Severity, Mitigation of Voltage Sags, Active Series Compensators, Static Transfer Switches and Fast Transfer Switches.

Over Voltages

Sources of Over Voltages, Capacitor Switching, Lightning, Ferro Resonance, Mitigation of Voltage Swells, Surge Arresters, Low Pass Filters, Power Conditioners. Lightning Protection, Shielding, Line Arresters, Protection of Transformers and Cables, Introduction to Computer Analysis Tools for Transients.

Harmonics

Harmonic Sources from Commercial and Industrial Loads, Locating Harmonic Sources, Power System Response Characteristics, Effect of Harmonics, Harmonic Distortion, Voltage and Current Distortion, Harmonic Indices, Inter Harmonics, Resonance, Harmonic Distortion Evaluation, Devices for Controlling Harmonic Distortion, Passive and Active Filters, IEEE and IEC Standards.

Power Quality Monitoring

Monitoring Considerations, Monitoring and Diagnostic Techniques for Various Power Quality Problems, Modelling of Power Quality Problems using Mathematical Simulation Tools, Power Line Disturbance Analyzer, Quality Measurement Equipment, Harmonic / Spectrum Analyzer, Flicker Meters, Disturbance Analyzer.

Course Outcomes:

CO1: To understand the power quality problems, its causes and standards.
CO2: To analyze the voltage variations and source of harmonics ,
CO3: To evaluate the harmonics index to adopt proper mitigation method
CO4: To apply appropriate techniques for the power quality monitoring

References:

1. Roger. C. Dugan, Mark. F. Mc Granaghan, Surya Santoso, Wayne Beaty H, "Electrical Power Systems Quality", Tata McGraw-Hill Education, 2012.
2. Arrillaga J, Watson N. R. and Wood A. R., "Power System Harmonic Analysis", John Wiley & Sons, Second Edition, 2008.
3. Bollen M H J, "Understanding Power Quality Problems (Voltage Sags and Interruptions)", Standard Publishers Distributors, 2001.
4. Arrillaga J, Watson N R, Chen S, "Power System Quality Assessment", John Wiley & Sons, 2000.
5. Heydt G.T, "Electric Power Quality", Stars in a Circle Publications, 1994.

20EEP12	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

Course Objective:

To impart knowledge on Principle of working , operation and application of various conventional and non- conventional energy generation system.

Course Content:

Coal Based Thermal Power Plants

Rankine Cycle, Improvisations, Layout of Modern Coal Power Plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam and Heat Rate, Subsystems of Thermal Power Plants, Fuel and Ash Handling, Draught System, Feed Water Treatment. Binary Cycles and Cogeneration Systems.

Diesel Gas Turbine and Combined Cycle Power Plants

Otto, Diesel, Dual & Brayton Cycle – Analysis & Optimization, Components of Diesel and Gas Turbine Power Plants, Combined Cycle Power Plants, Integrated Gasifier based Combined Cycle Systems.

Nuclear Power Plants

Basics of Nuclear Engineering, Layout and Subsystems of Nuclear Power Plants, Working of Nuclear Reactors, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety Measures for Nuclear Power Plants.

Power From Renewable Energy

Hydro Electric Power Plants – Classification, Typical Layout and Associated Components Including Turbines. Principle, Construction and Working of Wind, Tidal, Solar Photo Voltaic, Geothermal, Biogas and Fuel Cell Power Systems.

Economic and Environmental Issues of Power Plants

Power Tariff Types, Load Distribution Parameters, Load Curve, Comparison of Site Selection Criteria, Relative Merits & Demerits, Capital and Operating Cost of Different Power Plants. Pollution Control Technologies Including Waste Disposal Options for Coal and Nuclear Power Plants.

Course outcome :

CO1: Ability to identify the energy scenario in national and international context.

CO2: Ability to understand conventional energy based power plants, its functions, flow lines and issues related to them.

CO3: Ability to understand the operation of non-conventional energy based power plants and its role in energy sustainability.

CO4: Ability to analyze and solve energy and economic related issues in power sector.

References:

1. EI- Wakil M. M, “Power Plant Technology”, McGraw-Hill, 2nd Edition, 2014.
2. Culp A. W., “Principles of Energy Conversion”, McGraw Hill, Second Edition, 2014.
3. Nag P.K, “Power Plant Engineering”, Tata McGraw-Hill, 2014.
4. G. D. Rai, “Introduction to Power Plant Technology”, Khanna Publishers, Third Edition, 2014.
5. T. Morse Frederick, “Power Plant Engineering”, Prentice Hall of India, Third Edition, 2014.
6. Arora S. C, Domkundwar S, “A Course in Power Plant Engineering”, Dhanpat Rai, Third Edition, 2012.

20EEP23	SWITCHED MODE POWER CONVERTERS	L	T	P	C
		3	0	0	3

Course Objective

- To impart knowledge to the students about the reactive elements in power electronic systems and the principle of Switched Mode Power Conversion.
- To analyze performance of Non-Isolated, Isolated and Resonant DC-DC converters.

Course Content:

Basic Converter Circuits

Buck Regulator, Buck- Boost Regulator, Boost Regulator, Cuk Converters, Resonant Converters, Choice of Switching Frequency.

Isolated SMPS

Fly Back Converter, Forward Converter, Half-Bridge and Full Bridge Converters, Push-Pull Converter and SMPS With Multiple Outputs, Choice of Switching Frequency.

Control Aspects

PWM Controllers, Isolation in Feedback Loop, Power Supplies with Multiple Output, Stability Analysis Using Bode Diagrams

Design Considerations

Selection Of Output Filter Capacitor, Selection of Energy Storage Inductor, Design of High Frequency Inductor and High Frequency Transformer, Selection of Switches. Snubber and Driver Circuit Design Considerations.

Electro Magnetic Interference

EMI Filter Components, Conducted EMI Suppression, Radiated EMI Suppression, Measurement, Protection- Over Current Protection, Over Voltage Protection, Inrush Current Protection. Thermal Model- Thermal Resistance, Cooling Considerations, Selection of Heat Sinks.

Course outcomes:

CO1: Ability to Understand the operation primitive switched mode power converter
CO2: Ability to Illustrate the use and steps in designing the reactive elements used in switched mode power conversion
CO3: Ability to Analyze the various configurations of a Non-Isolated DC to DC converters
CO4: Ability to Analyze the various configurations of a Isolated DC to DC converters
CO5: Ability to Analyze the resonant type DC to DC converters and its variations

References:

1. Robert. W. Erickson, D. Maksimovic, “Fundamentals of Power Electronics”, Springer International Publishing, Third Edition, 2020
2. V. Ramanarayanan, “Course Material on Switched Mode Power Conversion”, IISc, First Edition, 2009
3. H. W. Whittington, B. W. Flynn and D. E. MacPherson, “Switched Mode Power Supplies, Design and Construction”, Universities Press, Second Edition, 2009.
4. Mohan N., Undeland T and Robbins W., “Power Electronics Converters, Application and Design”, John Wiley & Sons; Third edition , 2003
5. Umanand L., Bhat S.R, “Design of Magnetic Components for Switched Mode Power Converters”, New Age International Publisher, First Edition,1992

20EEP42	BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

Course Objective:

- To impart knowledge on the basic concepts of Sensors, transducers and bio amplifier used in medical field, devices used for medical imaging and telemetry, therapeutic devices for ailments related to cardiology, pulmonology and neurology
- To study about electrical and non-electrical physiological parameters from various diagnostic measurement and electrical safety in diagnostic equipment's.

Course Content:

Physiology

Cell and its Structure, Resting and Action Potential, Propagation of Action Potentials, The Heart and Cardiovascular System, Physiology of the Respiratory System, Nervous System, Central Nervous System and Peripheral Nervous System, Electrode Theory – Bio-Potential Electrodes, Transducers for Biomedical Applications.

Electrophysiology Measurement

ECG, EEG, EMG, ERG, EOG, Lead System and Recording Methods, Typical Waveforms, Electrical Safety in Medical Environment, Shock Hazards, Leakage Current, Instruments to Protect Against Electrical Hazards.

Nonelectrical Parameter Measurement

Measurement of Blood Pressure, Blood Flow and Cardiac Output, Plethysmography, Measurement of Heart Sounds, Gas Analysers, Blood Gas Analysers, Oximeters.

Medical Imaging and Telemetry

X-ray Machine, Echocardiography, Computer Tomography, MRI, Diagnostic Ultrasound, PET, SPECT, Thermograph, Biotelemetry.

Assisting and Therapeutic Device

Pacemakers, Defibrillators, Ventilator, Anaesthesia Machine, Nerve and Muscle Stimulator, Heart Lung Machine, Kidney Machine, Audiometers, Diathermy, Endoscopes, Lasers in Biomedicine.

Course Outcomes

CO1: Ability to explain the basic concepts of Sensors, transducers and bio amplifier used in medical field.

CO2:Ability to analyze the electrical and non-electrical physiological parameters from various diagnostic measurement and electrical safety in diagnostic equipment's.

CO3: Ability to be familiar to various techniques and devices used for medical imaging and telemetry.

CO4: Ability to choose the suitable therapeutic devices for ailments related to cardiology, pulmonology and neurology

References:

1. Nabil Derbel and Olfa Kanoun, “Advanced Systems for Biomedical Applications”, Springer, 2021.
2. Mesut Sahin, “Instrumentation Handbook for Biomedical Engineers”, CRC Press, 2020.
3. Sachan, “Principles of Transducers & Biomedical Instrumentation”, Amazon digital Services LLC-KDP, 2019.
4. Andrew G. Webb, “Principles of Biomedical Instrumentation”, Cambridge University Press, 2018.
5. R. Ananda Natarajan, “Biomedical Instrumentation and Measurements”, Prentice Hall India Pvt., Limited, 2015.

20EEP32	INTRODUCTION TO EMBEDDED SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

To impart knowledge on the functional building blocks of embedded systems, the concepts of real time operating systems and the devices and buses used for embedded networking.

Course Content:

Introduction to Embedded Systems

Structural Units in Embedded Processor, Characteristics of Embedded Computing Applications, Challenges in Embedded Computing Design, Selection of Embedded Processor, DMA, Memory Devices, Memory Management Methods, Timer and Counting Devices, Watchdog Timer, Real Time Clock.

Embedded Networking

Introduction, I/O Device Ports & Buses, Serial Bus Communication Protocols, RS232 Standard, RS 485, CAN Bus, Serial Peripheral Interface (SPI), Inter Integrated Circuits (I2C), Parallel Port Communication Protocols, ISA/PCI Bus Protocols, Need for Device Drivers.

Embedded Firmware Development Environment

Embedded Product Development Life Cycle, Objectives, Different Phases of EDLC, Issues in Hardware-Software Co-Design, EDLC Design Patterns, Modelling of EDLC - Data Flow Graph, State Machine Model, Sequential Program Model, Concurrent Model, Object Oriented Model.

Real Time Operating System (RTOS)

Introduction to Basic Concepts of RTOS, Task, Process and Threads, Interrupt Routines in RTOS, Multi-Processing and Multitasking, Pre-Emptive and Non-Pre-Emptive Scheduling, Inter Process Communication, Priority Inversion, Priority Inheritance.

Software Development Tools

Introduction to Assembler, Compiler, Cross Compiler, Linker, Integrated Development Environment, Simulator, Emulator, Debugging Strategies, Logic Analyser, In-Circuit Emulator.

Course Outcomes:

CO1: Ability to Understand the functional building blocks of embedded systems,
CO2: Ability to Understand the buses used in embedded networking
CO3: Ability to Understand the firmware development process, embedded co designing and the concepts of real time operating systems.
CO4: Ability to Illustrate the I/O programming concepts and scheduling mechanism in real time product development

References:

1. K V Shibu, “Introduction to Embedded Systems”, McGraw Hill Education India Private Limited, Second Edition, 2017.
2. Raj Kamal, “Embedded System, Architecture, Programming, Design”, McGraw Hill, 2013.
3. Frank Vahid and Tony Givargis, “Embedded System Design: A Unified Hardware/Software Introduction”, John Wiley, 2006.
4. Arnold S. Berger, “Embedded Systems Design: An Introduction to Processes, Tools, and Techniques”, CMP books, 2005.
5. Steve Heath, “Embedded Systems Design”, Newnes Publications, Second Edition, 2002.

20EEP56	ROBOT VISION	L	T	P	C
		3	0	0	3

Course Content

Introduction to Robot Vision

Components of vision system, classification of robotic sensors, architecture of robotic vision system, vision sensors, Industrial applications of vision-controlled robotic systems.

Image Processing

Basic image representation, Digitization, Gray Image, Image enhancement and filtering , Binary image, Edge Image. Geometric properties of image, Segmentation, Region growing. Object descriptors, image area, center of gravity, moments.

Stereo and Colour Vision

Stereo image processing: distance from triangulation, unified stereo imaging for distance estimation. Perception of colour, colour interpolation, enhancement of colour images.

Object Recognition

Representation and description: boundary following, chain codes, polygonal approximation, skeletons. Patterns and Pattern Classes.

Applications

Robot vision for industrial robots and autonomous robots, bin picking applications, obstacle avoidance, robot navigation, human robot interactions

Course Outcomes

CO1: Ability to understand the issues involved in robotic vision and perception.

CO2: Apply the technique of image processing edge detection, image segmentation and feature extraction

CO3: Ability to understand object and pattern recognition concepts

CO4: Understand the application of robots using imaging technique in material handling and obstacle detection.

References

1. Gonzalez R C., Woods R.E., “Digital Image Processing”, Pearson, Education, Inc. Fourth Edition, 2018.
2. Jain A.K., “Fundamentals of Digital Image Processing”", Prentice Hall of India, 2018.
3. K.S. Fu, R.C. Gonzalez, C.S.G. Lee, Robotics Control and Sensing, Mc Graw Hill International Edition, 2000.
4. Ramesh C. Jain, Rangacher Kasturi, Brian G. Schunck, Introduction to Machine Vision, McGraw-Hill Education, 1995
5. Berthold K P Horn, Robot Vision, MIT Press 1986

PROFESSIONAL ELECTIVE- III

20EEP02	HIGH VOLTAGE DIRECT CURRENT TRANSMISSION	L	T	P	C
		3	0	0	3

Course Objective:

- To impart knowledge on the concept of HVDC transmission, their converters, controllers for HVDC converters.
- To be familiar with reactive power ,harmonics control and power flow analysis in DC systems

Course Content:

Introduction

DC Power Transmission Technology, Comparison of AC and DC Transmission, Application of DC Transmission, Description of DC Transmission System, Planning for HVDC Transmission, Modern Trends in HVDC Technology, DC Breakers, Operating Problems.

Analysis of HVDC Converters

Line Commutated Converter, Analysis of Graetz Circuit with and without Overlap, Pulse Number, Choice of Converter Configuration, Converter Bridge Characteristics, Analysis of 12 Pulse Converters, Analysis of VSC Topologies, Firing Schemes.

Converter and HVDC System Control

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.

Reactive Power and Harmonics Control

Reactive Power Requirements in Steady State, Sources of Reactive Power, SVC and STATCOM, Generation of Harmonics, Design of AC and DC Filters, Active Filters.

Power Flow Analysis in DC Systems

Per Unit System for DC Quantities, DC System Model, Inclusion of Constraints, Power Flow Analysis, Case Study.

Course Outcomes:

CO1: To understand the concept HVDC transmission, its operation and challenges.
CO2: To analyze characteristics and performance of HVDC converters.
CO3: To understand the converter control characteristics to design HVDC converter
CO4: To understand the reactive power ,harmonics and control methods
CO5: To develop the model of DC system and analyze its power flow

References:

1. Uhlmann E, “Power Transmission by Direct Current”, Springer Science and Business Media Publications, 2012.
2. Rao S, “EHV,AC, HVDC Transmission and Distribution”, Khanna Publications, 1999
3. Arrillaga.J, “High Voltage Direct Current Transmission”, IET, Second edition, 1998.
4. Padiyar K.R, “HVDC Power Transmission Systems: Technology and System Interactions”, New Age International Publications, 1990.
5. Edward Wilson Kimbark, “Direct Current Transmission”, Wiley, Inter-science Publication, 1971.

20EEP13	ALTERNATE ENERGY AND STORAGE SYSTEMS	L	T	P	C
		3	0	0	3

Course Objective:

To study about the various energy storage systems used for alternate energy conversion system

Course Content:

Introduction

Introduction to Energy Storage Technologies, Types and Necessity of Energy Storage, Application with Renewable Energy, Comparison, Emerging Needs for Electrical Energy Storage.

Thermal Storage System

Thermal Storage System – Types, Simple Water and Rock Bed Storage System, Pressurized Water Storage System, Simple Units, Packed Bed Storage Units.

Batteries and Fuel Cell

Fundamental Concept of Batteries, Principles of Electrochemical Storage, Types, Measuring of Battery Parameters, Series and Parallel connection, Applications, Fuel Cell – History of Fuel Cell, Types, Working and Applications.

Hydrogen Fuel

Sources of Hydrogen, Hydrogen Production, Gas Clean-up, Various Methods of Hydrogen Storage, Integrated Gasification Combined Cycle (IGCC)

Alternative Energy Storage Technologies

Flywheel, Super Capacitors – Principles, Methods, Applications. Compressed Air Energy Storage, Concept of Hybrid Energy Storage.

Course Outcomes:

CO1: Ability to understand the importance of Energy storage for Alternate energy sources

CO2: Ability to identify the thermal storage systems for renewable energy application

CO3: Ability to understand the fuel cell, hydrogen cell, types of batteries ,its parameters and connection for good performance

CO4: Ability to analyze the various alternative energy storage technologies to improve the performance of renewable energy conversion

References:

1. Ru-Shi Liu, Lei Zhang, Xueliang Sun, Hansan Liu and Jiujun Zhang, “Electrochemical Technologies for Energy Storage and Conversion”, John Wiley & Sons, 2012.
2. Ibrahim Dincer and Null, “Thermal Energy Storage: Systems and Applications”, John Wiley & Sons 2011.
3. Dell Ronald M& David A.J Rand, “Understanding Batteries”, Royal Society of Chemistry, 2007.
4. James Larminie And Andrew Dicks, “Fuel Cell Systems Explained”, Wiley, 2003.
5. David Linden and Thomas B. Reddy, “Hand Book of Batteries”, Tata McGraw-Hill, Third Edition, 2002.

20EEP52	PRINCIPLES OF ROBOTICS	L	T	P	C
		3	0	0	3

Course Content:

Introduction

Classification of Robots Based on Geometry, Workspace, Actuation, Control and Application - Advantages and Disadvantages of Robots - Robot Components: Link, Joint, Manipulator, Wrist, End-effector : Gripper – Types, Actuator and Sensor - Configuration Space – Joint Space – Workspace, Robot Specifications: Number of Axes: Internal and External (7-axis robot) - Capacity and Speed, Reach and Stroke, Tool Orientation, Repeatability, Precision and Accuracy, Operating Environment.

Transformations

Degrees of Freedom – Matrix Representation: Representation of a Point and Vector in Space, Global and Local Coordinate Axes - Homogeneous Transformation Matrices – Transformations: Representation of Pure Translation, Representation of Pure Rotation - Representation of Combined Transformations -Inverse of Transformation Matrices - Euler Angles – Roll, Pitch, Yaw Angles - Quaternions – Spinors and Rotators.

Forward Kinematics

Denavit- Hartenberg Notation - Transformation Between Two Adjacent Coordinate Frames Forward Kinematics of Two, Three, Four, Five and Six Axis Robots.

Inverse Kinematics

Decoupling Technique - Inverse Transformation Technique - Inverse Position: Geometric Approach – Inverse Orientation - Inverse Kinematics of Two, Three, Four, Five and Six axis Robots.

Velocity Kinematics

Angular Velocity – Linear Velocity - Jacobian representation of Linear and Angular Velocity Calculation of Jacobian for Two, Three and Four Axis Robots - Inverse Jacobian - Singularities: Wrist and Arm Singularities -Manipulability - Induced Joint Torques and Forces.

Course Outcomes:

CO1: Understand the evolution of robot technology and mathematically represent different types of robots.
CO2: Get exposed to the case studies and design of robot machine interface.
CO3: Understand manipulator and gripper operation
CO4: Develop kinematic and path planning equations for standard configurations
CO5: Familiarize various control schemes of Robotics control

References:

1. Mark W. Spong, Seth Hutchinson, M. Vidyasagar, “Robot Modelling and Control”, Wiley, 2020.
2. Tadej Bajd, Matjaž Mihelj, Marko Munih, “Introduction to Robotics”, Springer, 2013.
3. Niku S B, “Introduction to Robotics, Analysis, Control, Applications”, John-Wiley & Sons Inc, 2011.
4. Reza N Jazar, “Theory of Applied Robotics”, Springer, 2010.
5. Saha S K, “Introduction to Robotics”, Tata McGraw Hill Education Pvt. Ltd, 2010.
6. Robert J. Schilling, “Fundamentals of Robotics, Analysis and Control”, PHI Learning, 2009.

20EEP45	SENSORS AND TRANSDUCERS	L	T	P	C
		3	0	0	3

Course Objective:

To be familiar the basics of sensors for various applications, transducers and measurement, signal conditioning and data acquisition systems and error calculation of signals

Course Content:

Introduction to Sensors and Transducer

Basics of Measurement, Classification of Errors, Error Analysis, Static and Dynamic Characteristics of Transducers, Performance Measures of Sensors, Classification of Sensor, Sensor Calibration Techniques, Sensor Output Signal Types.

Motion, Proximity and Ranging Sensors

Motion Sensors, Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT, RVDT, Synchro, Microsyn, Accelerometer, GPS, Bluetooth, Range Sensors – RF Beacons, Ultrasonic Ranging, Reflective Beacons, Laser Range Sensor (LIDAR).

Force, Magnetic and Heading Sensors

Strain Gauge, Load Cell, Magnetic Sensors –Types, Principle, Requirement and Advantages: Magneto Resistive, Hall Effect, Current Sensor Heading Sensors, Compass, Gyroscope, Inclinometers.

Optical, Pressure and Temperature Sensors

Photo Conductive Cell, Photo Voltaic, Photo Resistive, LDR, Fiber Optic Sensors, Pressure – Diaphragm, Bellows, Piezoelectric – Tactile Sensors, Temperature – IC, Thermistor, RTD, Thermocouple, Acoustic Sensors – Flow and Level Measurement, Radiation Sensors, Smart Sensors, Film Sensor, MEMS and Nano Sensors, Optical Sensors.

Signal Conditioning and DAQ Systems

Amplification, Filtering, Sample and Hold Circuits, Data Acquisition: Single Channel and Multichannel Data Acquisition, Data Logging, Applications, Automobile, Aerospace, Home Appliances, Manufacturing, Environmental Monitoring.

Course Outcomes:

CO1: Ability to understand the basics of sensors, transducers and measurement and error calculation of signals

CO2:Ability to choose the appropriate sensors for measuring motion, proximity, force, magnetic and ranging.

CO3: Ability to understand the different sensors used for measuring optical, pressure, temperature and heading.

CO4: Ability to understand the fundamentals of signal conditioning and data acquisition systems.

References:

1. Sergey Yurish, “Advances in Measurements and Instrumentation”, IFSA Publishing, 2019.
2. Robert B. Northrop, “Introduction to Instrumentation and Measurements”, CRC Press, 2018.
3. Halit Eren and John G. Webster, “Measurement, Instrumentation, and Sensors Handbook”, CRC Press, 2018.
4. Shobh Nath Singh, “An Introduction to Sensors and Instrumentations”, Alpha Science International Limited, 2017.
5. S. Vijayachitra, “Transducers Engineering”, Prentice Hall India Pvt., Limited, 2016.

20EEP55	INTRODUCTION TO IMAGE PROCESSING	L	T	P	C
		3	0	0	3

Course Content:

Fundamentals of Digital Image Processing
Introduction , Steps in Digital Image Processing, Components of Image Processing System, Elements of Visual Perception, Image Sampling and Quantization, Basic Relations Between Pixels, Arithmetic Operators, Image Transforms DFT – Properties DWT Properties.

Image Enhancement
Intensity Transformation, Functions, Histogram Processing, Spatial Filtering, Correlation and Convolution, Smoothing Filters, Sharpening Filters.

Image Restoration
Noise Models, Restoration in the Presence of Noise only –Spatial Filtering, Linear Position – Invariant Degradation, Inverse Filtering, Wiener Filtering.

Image Segmentation
Edge detection, Thresholding, Region Based Segmentation, Region Growing, Region Splitting, and Merging, Watershed Algorithm, Active Contour Models, Texture Feature Based Segmentation, Applications of Image Segmentation.

Image Description
Boundary Following, Chain Codes, Boundary Segments, Signatures, Skeletons, Fourier Descriptors, Shape Numbers, Statistical Moments, Texture Descriptors- Principle Components for Description.

Course Outcomes
CO1: Ability to understand the fundamental concepts of image processing.
CO2: Ability to comprehend image enhancement and image restoration
CO3: Ability to understand segmentation of images and its types.
CO4: Ability to comprehend the various concepts used in image description.

References:

1. Gonzalez R C., Woods R.E., “Digital Image Processing”, Pearson, Education, Inc. Fourth Edition, 2018.
2. Jain A.K., “Fundamentals of Digital Image Processing”", Prentice Hall of India, 2018.
3. Sridhar S, "Digital Image Processing", Oxford University Press, New Delhi, 2013.
4. Jayaraman S, Esakkirajan S, Veerakumar T, "Digital Image Processing", Tata McGraw Hill, New Delhi, 2015.
5. William K. Pratt, “Digital Image Processing”, Wiley India, Fourth Edition 2011.
6. John C.Russ, “The Image Processing Handbook”, CRC Press, 2007.

PROFESSIONAL ELECTIVE - IV

20EEP04	SMART GRID	L	T	P	C
		3	0	0	3

Course Objective:

To comprehend conventional and modern techniques for the operation and real & reactive power control of power system

Course Content:

Communication Technologies for Power System

Fiber Optical Networks, Wide Area Network(WAN) Based on Fiber Optical Networks, IP Based Real Time Data Transmission, Substation Communication Network, Zigbee.

Information System for Control Centers (ICCS)

Power Line Communication (PLCC), ICCS Configuration, ICCS communication Network, ICCS Time Synchronization, E-Commerce of Electricity, Global Information System(GIS), Global Positioning System (GPS).

Integration, Control and Operation of Distributed Generation

Distributed Generation Technologies and its Benefits, Distributed Generation Utilization Barriers, Distributed Generation Integration to Power Grid.

Monitoring the Smart Grid

Load Dispatch Centers, Wide Area Monitoring System(WAMS), PMU, Smart Sensors/Telemetry, Advanced Metering Infrastructure (AMI), Smart Metering, Smart Grid System Monitoring, Cyber Security, Communication Infrastructure and Technologies, Self-Healing.

Micro grid and Hybrid Power Systems

Integration of Distributed Energy Sources – Concept and Operation, Control and Protection of Micro Grid, Islanding and Anti Islanding Detecting Techniques, Integration of Conventional and Non-Conventional Energy Sources.

Course Outcomes:

CO1: To explore various advanced technologies for improving the performance of the power system operation.

CO2: To understand modern techniques used for integration ,control of Distributed generation.

CO3: To identify different advanced techniques employed for monitoring the smart grid.

CO4: To apply appropriate control and protection system for stable operation of Micro grid.

References:

1. Iniewski K.K, “Smart Grid Infrastructure and Networking”, McGraw Hill, First Edition, 2012
2. James Momoh, “Smart Grid: Fundamentals of Design and Analysis”, IEEE Computer Society Press, 2012.
3. Ekanayake J. Jenkins N., Liyanage K., Wu, J., Yokoyama A., “Smart Grid: Technology and Applications”, Wiley Publications, 2012.
4. Momoh J., “Smart Grid: Fundamentals of Design and Analysis”, John Wiley & Sons, 2012.
5. Flick T., Morehouse J., “Securing the Smart Grid: Next Generation Power Grid Security”, Syngress, First edition, 2010.

20EEP14	ENERGY MANAGEMENT AND AUDITING	L	T	P	C
		3	0	0	3

Course Objective:

- To study the concepts behind energy management and auditing, economic analysis and Load management on various electrical equipment
- To be familiar with different metering schemes, lighting systems and cogeneration.

Course Content:

Energy Cost and Load Management

Important Concepts in an Economic Analysis, Economic Models, Time Value of Money, Utility Rate Structures, Cost of Electricity, Loss Evaluation. Load Management, Demand Side Management Techniques, Utility Monitoring and Control System, HVAC and Energy Management - Economic Justification.

Energy Efficiency in Electrical Utilities

Electric Power Supply System, Power Factor Improvement and Its Benefits, Transformers Analysis, Distribution Losses in Industrial System, Energy Efficient Motors and Factors Affecting Motor Efficiency.

Energy Efficiency in Thermal Utilities

Boilers-Introduction, Classifications, Performance Evaluation of Boilers and Energy Conservation Opportunities in Boiler, Steam – Introduction, Properties of Steam, Efficient Steam Utilization, Furnace – Classifications, Fuel Economy Measures in Furnaces.

Lighting Systems and Cogeneration

Concept of Lighting Systems, Working Space, Light Sources, Luminaries, Intelligent Lighting Controls, Optimizing Lighting Energy, Power Factor and Effect of Harmonics, Lighting and Energy Standards, Cogeneration - Forms of Cogeneration, Feasibility of Cogeneration, Electrical Interconnection.

Course Outcomes:

CO1: Ability to understand the basics of energy management with respect to economic and social aspects.

CO2: Ability to apply the concepts of energy management in various electrical energy applications.

CO3: Ability to analyze the energy calculation and statistics for improving the efficiency in industries, commercial and domestic applications.

CO4: Ability to understand and illustrate the concept of lighting system, its standards and cogeneration.

References:

1. Barney L. Capehart, Wayne C. Turner, And William J. Kennedy, “Guide to Energy Management”,8th Edition, River Publishers, 2016
2. Bureau of Energy Efficiency, Ministry of Power, “Energy Efficiency in Electrical Utilities and Thermal Utilities”, Second Edition, 2016.
3. Amit K. Tyagi, “Handbook on Energy Audits and Management”, TERI, 2003.
4. IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 1996.
5. Reay D.A, “Industrial Energy Conservation”, First Edition, Pergamon Press, 1977.

20EEP35	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

Course Content:

System Types and Representation

Classification of Systems- Continuous, Discrete, Linear, Causal, Stable, Dynamic, Recursive, Time Variance; Classification of Signals - Continuous and Discrete, Energy and Power, Mathematical Representation of Signals, Spectral Density, Sampling Techniques, Quantization, Quantization Error, Nyquist Rate, Aliasing Effect, Digital Signal Representation

Discrete Time System Analysis

Z-Transform and Its Properties, Inverse Z-Transforms, Differential Equation – Solution using Z-Transform, Application to Discrete Systems, Stability Analysis, Frequency Response, Convolution – Introduction to Fourier Transform, Discrete Time Fourier Transform.

Discrete Fourier Transform & Computation

DFT Properties, Magnitude and Phase Representation, Computation of DFT Using FFT Algorithm, DIT and DIF, FFT using Radix 2, Butterfly Structure.

Digital Filters

FIR and IIR Filter Realization, Parallel and Cascade Forms, FIR Design- Windowing Techniques, Need and Choice of Windows, Linear Phase Characteristics, IIR Design- Analog Filter Design, Butterworth and Chebyshev Approximations, Digital Design using Impulse Invariant and Bilinear Transformation, Warping, Pre-Warping, Frequency Transformation.

Digital Signal Processors

Introduction, Architecture of DSP Processor for Motor Control, Features, Addressing, Formats, Functional Modes, Introduction to Commercial Processors.

Course Outcomes:

CO1: Ability to understand the basic concepts of signals, systems and multi rate signal processing.

CO2: Ability to understand Discrete Fourier Transform, FFT filtering techniques and multi rate signal processing.

CO3: Ability to analyze IIR and FIR filters for signal Processing applications.

CO4: Ability to apply digital signal processors and multi rate signal processing techniques for various DSP applications.

References:

1. Robert J. Schilling, Sandra L. Harris, “Introduction to Digital Signal Processing using MATLAB”, Cengage Learning, 2014.
2. Sen M. Kuo, Woonseng S. Gan, “Digital Signal Processors, Architecture, Implementations & Applications”, Pearson, 2013.
3. J.G. Proakis, D.G. Manolakis, “Digital Signal Processing Principles, Algorithms and Applications”, Pearson Education, New Delhi, 2009.
4. S.K. Mitra, “Digital Signal Processing – A Computer Based Approach”, Tata McGraw Hill, New Delhi, 2006.
5. B. Venkataramani, M. Bhaskar, “Digital Signal Processors, Architecture, Programming and Applications”, Tata McGraw Hill, New Delhi, 2003.

20EEP43	INTRODUCTION TO INDUSTRY 4.0	L	T	P	C
		3	0	0	3

Course Objectives:

- To impart knowledge on the concepts ,components of Industry 4.0, the architecture, business models and different layers of industrial IoT
- To familiar with the robotic advancements in Industry 4.0, augmented reality, mobile computing and cyber security.

Course Content

Introduction to Industry 4.0

Introduction, Origin, Main Concepts and Components, State of Art, Core Idea of Industry 4.0, Production System, Current State of Industry 4.0.

Roadmap for Industry 4.0

Internet of Things (IoT), Industrial Internet of Things (IIoT) - Business Model and Reference Architecture. Industrial IoT Layers, IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking.

Advances in Robotics in the Era of Industry 4.0

Human to Machine and Machine to Human interface, Recent Technological Components of Robots, Advanced Sensor Technologies, Internet of Robotic Things, Cloud Robotics and Cognitive Architecture for Cyber-Physical Robotics. Industrial Robotic Applications-Manufacturing, Maintenance and Assembly.

The Role of Augmented Reality in the Age of Industry 4.0

Introduction, AR Hardware and Software Technology, Industrial Applications of AR, Mobile Computing, Cyber Security.

Case Study

Industrial IoT- Application Domains: Chemical and Pharmaceutical Industry, Case Studies - Milk Processing, Packaging and Manufacturing Industries

Course Outcomes:

CO1: Ability to understand the concepts and components of Industry 4.0

CO2: Ability to analyze the architecture, business models and different layers of industrial IoT.

CO3:Ability to comprehend the robotic advancements in Industry 4.0 with the help of case studies.

CO4: Ability to demonstrate the concepts of augmented reality, mobile computing and cyber security.

References:

1. Sudip Misra, Chandana Roy and Anandarup Mukherjee, “Introduction to Industrial Internet of Things and Industry 4.0” , CRC Press, 2021.
2. Aleksandra Gąsior and Jerzy Duda, “Industry 4.0, A Global Perspective”, Routledge, 2021.
3. Carlos Toro, Humza Akhtar and Wei Wang, “Implementing Industry 4.0, The Model Factory as the Key Enabler for the Future of Manufacturing”, Springer, 2021.
4. Jesús Hamilton Ortiz, “Industry 4.0 Current Status and Future Trends”, Intech Open, 2020.
5. Akshi Kumar, Anand Nayyar, “A Roadmap to Industry 4.0: Smart Production, Sharp Business and Sustainable Development” , Springer, 2019.

20EEP51	INTRODUCTION TO NEURAL NETWORKS	L	T	P	C
		3	0	0	3

Course Content:

Introduction to Artificial Neural Networks (ANN)

Introduction to Neural Networks, Biological Neuron, Artificial Neuron Models, Architecture of ANN, Single Layer Network, Multilayer Neural Network, Classification of ANN, McCulloch-Pitts Neuron Model, Applications of ANN.

Essentials of Artificial Neural Networks

Activation Functions, Training Strategy of ANN (Supervised, Unsupervised, Reinforcement), Learning Rules, Amari's General Learning Rule, Hebb Learning Rule, Hebb Net, Delta Rule for Single Output Neuron.

Single Layer Feed Forward Networks

Introduction, Perceptron Architecture Perceptron Learning Algorithm, Perceptron Application, Adaline, Architecture, Training Algorithms, Applications.

Multi- Layer Feed Forward Networks

Back Propagation (BP) Network, Architecture, Derivation of Learning Rule for Back Propagation Procedure, Application of Back Propagation Algorithm, Self-organizing Maps (SOM), Introduction to SOM, Maxnet, Kohonen Self-Organizing Maps.

Associative Memories

Auto Associative Memory, Characteristic, Auto Associative Net, Algorithm, Application. Bidirectional Associative Memory (BAM) Architecture, Discrete BAM Training Algorithms: Continuous BAM, Discrete Hopfield Net, Hopfield Net Architecture, Algorithm, Applications.

Course Outcomes:

CO1: Ability to understand and compare the basic features, structure and working of a biological neuron with an artificial neuron.

CO2: Ability to describe the learning rules, activation functions and the topology of neural network architecture.

CO3: Ability to select suitable network architecture, tuning parameters of a feed forward network trained by backpropagation algorithm for solving pattern classification problems.

CO4: Ability to describe and select suitable network architecture of a competitive neural network for solving real life problems.

References:

1. Sathish Kumar, "Neural Networks - A Classroom Approach" Mc Graw Hill, 2017.
2. S. N. Sivanandam, M Paulraj "Introduction to Artificial Neural Networks", Vikas Publishing House, 2009.
3. Laurene Fausett, "Fundamentals of Neural Networks", Pearson Education, 2004.
4. Simon Haykin, "Neural Networks- A comprehensive foundation", Pearson, Education, 2003.

PROFESSIONAL ELECTIVE - V

20EEP03	RESTRUCTURED POWER SYSTEMS	L	T	P	C
		3	0	0	3

Course Objective:

- To introduce the restructuring of power industry , market modelsnd power sector in India
- To impart knowledge on fundamental concepts of congestion management.
- To analyze the concepts of locational marginal pricing and financial transmission rights.

Course Content:

Introduction

Deregulation of Power Industry, Restructuring Process, Issues Involved in Deregulation, Deregulation of Various Power Systems. Fundamentals of Economics: Consumer Behavior, Supplier Behavior, Market Equilibrium, Short and Long Run Costs, Various Costs of Production.

Transmission Congestion Management

Definition of Congestion, Reasons for Transfer Capability Limitation, Congestion Management – Importance, Features, Classification of Congestion Management Methods, Calculation of ATC, Non-Market Methods , Market Methods , Nodal Pricing , Capacity Alleviation Method.

Locational Marginal Prices and Financial Transmission Rights

Mathematical Preliminaries, Locational Marginal Pricing (LMP), LMP Calculation - Loss and Lossless DCOPF Model, ACOPF Model. Financial Transmission Rights(FTR), Risk Hedging Functionality, Simultaneous Feasibility Test and Revenue Adequacy, FTR-Issuance Process, Auction, Allocation, Treatment Of Revenue Shortfall.

Ancillary Service Management and Pricing of Transmission Network

Introduction of Ancillary Services , Classifications, Load Generation Balancing Services, Black Start Capability Service, Co-Optimization of Energy and Reserve Services, Transmission Pricing-Principles, Classification, Rolled in Transmission Pricing Methods, Pricing Paradigms- Marginal, Composite- Merits and Demerits.

Reforms in Indian Power Sector

Introduction, Framework of Indian Power Sector, Reform Initiatives, Availability Based Tariff, Electricity Act 2003, Open Access Issues, Power Exchange, Reforms in Near Future.

Course Outcomes:

CO1: To understand the concept of restructuring of power industry and various power sectors in India.

CO2: To understand the different congestion management methods

CO3: To apply suitable model to analyze the locational margin prices and financial 21 transmissior rights

CO4: To understand the significance ancillary services and pricing of transmission network

References:

1. Kankar Bhattacharya, Math H.J. Bollen, Jaap E. Daadler "Operation of Restructured Power Systems", Springer Science and Business Media, 2012.
2. Sally Hunt," Making Competition Work in Electricity", John Willey and Sons, 2002.
3. Steven Stoft," Power System Economics: Designing Markets for Electricity", Wiley, 2002.
4. Mohammad Shahidehpour, Alomoush M, "Restructured Electrical Power Systems: Operation, Trading and Volatility", CRC Press, 2001.
5. Loi Lei Lai, "Power System Restructuring and Deregulation: Trading, Performance and Information Technology", John Wiley & Sons Ltd., 2001

20EEP15	DESIGN OF PHOTOVOLTAIC SYSTEMS	L	T	P	C
		3	0	0	3

Course Objective:

- To impart knowledge on fundamentals of solar PV, types of power plants and battery sizing
- To expose the students to the design procedure of Solar PV system for given load and its controller

Course Content:

Introduction

Basic Terminologies of Solar PV, Solar Radiation, Measurements of Solar Radiation, Flat Plate and Concentrating Collectors, Applications. Fundamentals of Solar Photo Voltaic Conversion, Solar Cells, Solar PV Power Generation, Solar PV Applications.

Types of Solar Power Plant

Types of Solar PV System, Grid Connected Solar Power Plant, Grid Interactive Solar Power Plant, Net Metering Solar Power Plant, Off/On Grid Solar Connected Systems, Hybrid Solar Power Plant, Schemes of Solar Power Plant.

Battery Sizing

Battery function, Batteries for Photo Voltaic System, Battery Parameters and Selection, Battery Maintenance and Measurements, fault Detection and testing. Battery Installation for PV System, Charge Controller.

Photovoltaic Design

Solar Radiation Energy Measurements, Estimating Energy Requirement, Design Methodology for SPV System, Design of Off Grid Solar Power Plant, Case Studies of Off Grid Solar PV Power Plant, Design and Development of Solar Street Light and Solar Lantern.

Control Techniques

DC-DC Converters- Buck, Boost, Inverter- Fly Back, Full Bridge, Specification of Inverters and Charger. Control Techniques –PWM, Maximum Power Point Tracking.

Course Outcomes:

CO1: Ability to understand the fundamentals of solar photo voltaic power generation.
CO2: Ability to analyze the various types of solar power plants
CO3: Ability to identify the batteries used in solar PV design and analyze its sizing.
CO4: Ability to design solar PV system and choose appropriate controller.

References:

1. Chetan Singh Solanki, “Solar Photovoltaic Fundamentals, Technologies and Applications”, PHI Learning Private Limited, Second Edition, 2015.
2. Rik De Gunther, “Solar Power Your Home for Dummies”, John Wiley &Sons, 2010.
3. Michael Boxwell, “Solar Electricity Handbook”, Code Green Publishing, 2009.
4. Stuart R. Wenham, “Applied Photovoltaic”, Earthscan, 2007.
5. Martin A. Green, “Solar Cells: Operating Principles, Technology and System Applications”, Prentice-Hall, 1982.

20EEP31	MICROCONTROLLER BASED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

Course Content:

Introduction to PIC Microcontroller

Introduction, PIC16cxx Architecture, Pipelining, Program Memory Considerations, Register File Structure, Instruction Set, Addressing Modes, Simple Operations.

Interrupts and Timer

PIC Micro Controller Interrupts, External Interrupts, Interrupt Programming, Loop Time Subroutine, Timer Programming, Front Panel I/O Soft Keys, State Machines and Key Switches, Display of Constant and Variable Strings.

Peripherals and Interfacing

I2C Bus for Peripherals Chip Access, Bus Operation, Bus Subroutines, Serial EEPROM, Analog to Digital Converter, UART, Baud Rate Selection, Data Handling Circuit, Initialization, LCD And Keyboard Interfacing, ADC, DAC, Sensor Interfacing.

Introduction to ARM Processor

ARM Architecture, ARM Programmer's Model, ARM Development Tools, Memory Hierarchy, ARM Assembly Language Programming, Architectural Support for Operating Systems.

Arm Organization

3 and 5 Stage Pipeline, ARM Instruction Set and Execution, ARM Implementation, ARM Co-processor Interface, Architectural Support for High Level Languages, Embedded ARM Applications.

Course Outcomes:

CO1: Ability to Understand the features, instruction set and addressing modes of PIC microcontroller.

CO2: Ability to Understand the interrupts and timers of PIC microcontroller.

CO3: Ability to Illustrate the features of peripherals and its interfacing with PIC microcontroller.

CO4: Ability to Illustrate the features, architecture and assembly level programming of ARM processor.

References:

1. Sriram. V.Iyer, Pankaj Gupta, “Embedded Real Time Systems Programming”, Tata McGraw, Hill, First Edition 2017.
2. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey, “PIC Microcontroller and Embedded Systems using Assembly and C for PIC18”, Prentice Hall, First Edition, 2007.
3. John Iovine, “PIC Microcontroller Project Book”, McGraw, Hill Education, Second Edition, 2004.
4. Peatman, J.B., “Design with PIC Micro Controllers” Pearson Education, Third Edition, 2004.
5. Furber S., “ARM System on Chip Architecture” Addison Wesley Publication, 2000.

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20EEP41	VIRTUAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

Course Objectives:

To study the programming structures and tool sets architecture, data acquisition techniques, communication protocols of virtual instrumentation.

Course Content:

Introduction to Virtual Instrumentation

Concept & Architecture, Role of Hardware and Software in Virtual Instrumentation, Conventional Instruments versus Virtual Instruments, Graphical Programming and Data Flow Programming.

Programming Structures

Front Panel, Block Diagram, VIs, Sub VI. Looping - For Loop, While Loop, Shift Registers, Case and Sequence Structures, Formula Nodes, Arrays, Clusters, Charts and Graphs, Local and Global Variables, String and File I/O Functions.

Data Acquisition and I/O Functions

DAQ Architecture, Connecting Signals to DAQ Board, DAQ Assistant and I/O Functions in LabVIEW, Measurement and Automation Explorer.

Instrument Connectivity

Common Instrument Interfaces - RS 232C/ RS485, PCI. Bus Interfaces-USB, SCSI and PXI, Instrumentation Buses - Modbus and GPIB.

Applications of Virtual Instrumentation

Simulation of Systems using VI, Development of Control System, Fuzzy Logic Controller, Image Acquisition, Introduction to IMAQ and IMAQ Vision, Motion Control.

Course Outcomes

CO1:Ability to understand the architecture of virtual instrumentation.
CO2:Ability to explain the programming structures and tool sets of virtual instrumentation.
CO3: Ability to demonstrate various data acquisition techniques used in VI applications.
CO4: Ability to choose appropriate communication protocols for given VI application

References:

1. Riccardo de Asmundis, “LabVIEW-A Flexible Environment for Modeling and Daily Laboratory Use”, Intech Open, 2021.
2. Sanjay Gupta and Joseph John, “Virtual Instrumentation using LABVIEW”, McGraw Hill, 2017.
3. Rick Bitter, Taqi Mohiuddin and Matt Nawrocki, “LabVIEW Advanced Programming Techniques”, CRC Press, Second Edition, 2017.
4. Behzad Ehsani , “Data Acquisition Using LabVIEW”, Packt Publishing, 2016.
5. Robert H. Bishop, “Learning with LabVIEW”, Pearson Education, 2015.
6. Jovitha Jerome, "Virtual Instrumentation using LABVIEW ", PHI Learning, 2010.

20EEP53	ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

Course Content:

Introduction

History of EV, Basics of EV, Components in EV, Hybrid Electric Vehicles, Fuel Cell Vehicles, Recent EVs and HEVs, Efficiency Comparison, Pollution Comparison, Advantages of EV.

Vehicle Mechanics and Regenerative Braking

General Description of Vehicle Movement, Vehicle Resistance, Dynamic Equation, Tire–Ground Adhesion and Maximum Tractive Effort, Power Train Tractive Effort and Vehicle Speed, Vehicle Power Plant and Transmission Characteristics, EV Vehicle Performance, Tractive Effort in Normal Driving, Energy Consumption, Fundamentals of Regenerative Braking.

Electric Propulsion Systems and Design of Series and Parallel HEV

DC Motor Drives, Induction Motor Drives, PMBLDC Motors, SRM Drives, Series HEV: Operation Patterns, Control Strategies, Sizing of the Major Components – Parallel HEV: Control Strategies of Parallel Hybrid Drive Train, Design of Drive Train Parameters, Mild Hybrid Electric Drive Train Design.

Energy Storage System

Battery Basics, Types of Battery, Cell Discharge Operation, Cell Charge Operation, Construction, Alternative Batteries, Battery Parameters, Technical Characteristics, Practical Capacity, Battery Power, Ragone Plots, Targets and Properties of Batteries, Battery Modelling, Ultra Capacitors, Ultrahigh Speed Flywheels, Hybridization of Energy Storages.

Charging Station and Battery Management System(BMS)

EV and EV Charging Standards, Various Methods of Charging, Battery Swapping, V2G, G2V, V2B, V2H, Integration of EVs in Smart Grid, Introduction to BMS.

Course Outcomes

CO1: Ability to remember the basic concepts in Electric and hybrid electric vehicles.
CO2: Ability to understand the concept of vehicle dynamics, prime movers, energy storage device and various sensors Electric and hybrid electric vehicles.
CO3: Ability to apply control units concepts in Electric and hybrid electric vehicles to improve the vehicle efficiency.
CO4: Ability to interpret the concept of various EV charging and battery management system.

References:

1. Husain, I. “Electric and Hybrid Vehicles” Boca Raton, CRC Press, 2021.
2. Tariq Muneer and Irene Illescas García, “The Automobile In Electric Vehicles: Prospects and Challenges”, Elsevier, 2017.
3. Sheldon S. Williamson, “Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles”, Springer, 2013
4. Larminie, James, and John Lowry, “Electric Vehicle Technology Explained” John Wiley and Sons, 2012.
5. Emadi, A. (Ed.), Miller, J., Ehsani, M., “Vehicular Electric Power Systems” Boca Raton, CRC Press, 2003.

PROFESSIONAL ELECTIVE - VI

20EEP24	SPECIAL ELECTRICAL MACHINES AND CONTROLLERS	L	T	P	C
		3	0	0	3

Course Objectives

- To impart knowledge on Construction, principle of operation and performance of stepping motors, switched reluctance, permanent magnet motors and synchronous reluctance motors.

Course Content:

Stepper Motors

Constructional Features, Principle of Operation, Types, Torque Predictions, Linear Analysis, Characteristics, Drive Circuits, Closed Loop Control, Concept of Lead Angle, Applications.

Switched Reluctance Motors

Constructional Features, Principle of Operation, Torque Prediction, Characteristics Steady State Performance Prediction, Analytical Method, Power Controllers, Control of SRM Drive, Sensor Less Operation of SRM, Applications.

Permanent Magnet Brushless D.C. Motors

Fundamentals of Permanent Magnets, Types, Principle of Operation, Magnetic Circuit Analysis, EMF and Torque Equations, Power Converter Circuits and Their Controllers, Characteristics and Control, Applications.

Permanent Magnet Synchronous Motor

Constructional Features, Principle of Operation, EMF and Torque Equations, Sine Wave Motor with Practical Windings, Phasor Diagram, Power Controllers, Performance Characteristics, Digital Controllers, Applications.

SRM and Other Machines

Hysteresis Motor, Synchronous Reluctance Motor, Linear Induction Motor, Repulsion Motor - Constructional Features, Principle of Operation and Characteristics, Applications.

Course outcomes:

CO1: Ability to Understand the principle of operation and control of stepper motor and switched reluctance motor.

CO2: Ability to Comprehend the operation and characteristics of PMDC motor and its power converters.

CO3: Ability to Understand working of permanent magnet synchronous motor and its controllers.

CO4: Ability to Recall the operation of other special machines and their applications.

References:

1. Simmi P. Burman, “Special Electrical Machines”, S.K.Kataria & Sons, First Edition, 2013.
2. E.G. Janardanan, “Special Electrical machines”, PHI learning Private Limited, Delhi, First Edition, 2014.
3. K.Venkataratnam, “Special Electrical Machines”, Universities Press (India) Private Limited, First Edition, 2009.
4. R.Krishnan, “Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application”, CRC Press, New York, First Edition 2001.
5. T. Kenjo, “Stepping Motors and Their Microprocessor Controls”, Clarendon Press London, Second Edition,1995

20EEP33	WEARABLE ELECTRONICS	L	T	P	C
		3	0	0	3

Course Content:

Introduction

Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Recent Developments, Global and Indian Scenario, Types of Wearable Systems, Components of Wearable Systems, Physiological Parameters Commonly Monitored in Wearable Applications.

Smart Sensors and Vital Parameters

Vital Parameters - Significance, Bio-Potential Signal Recordings (ECG, EEG, EMG), Dry Electrodes - Design and Fabrication Methods, Smart Sensors- Textile Electrodes, Polymer Electrodes, Non-contact Electrodes, MEMS and Nano Electrode Arrays, Cuffless Blood Pressure Measurement, Photoplethysmography (PPG), Galvanic Skin Response (GSR), Body Temperature Measurements, Activity Monitoring for Energy Expenditure, Respiratory Parameters.

Wearable Computers

Flexible Electronics, Signal Processors, Signal Conditioning Circuits, Power Requirements, Wearable Systems Packaging, Batteries and Charging, Wireless Communication Technologies and Protocols, Receiver Systems, Mobile Applications Based Devices.

Wireless Body Area Networks

Introduction, Personal Area Networks (PAN), Application- Vital Physiological Parameter Monitoring, Design of Sensor and Sink Nodes, Communication and Routing Protocols, Security, Power and Energy Harvesting.

Electronic Textiles

Concepts and Development of Electronic Textile. Conductive Polymers and Fibers, Interfacing Circuits and Garments, Design of Heat Generating Circuit for Nichrome Fabric, Design of Communication Circuit for Copper Core Conductive Fabric.

Course Outcomes:

CO1: Ability to Understand the basic concepts of wearable electronics and its present scenario.

CO2: Ability to understand the monitoring of vital parameters and wearable sensors.

CO3: Ability to illustrate the features and interfacing of wearable networks.

CO4: Ability to illustrate the various sensing fabrics and applications.

References:

1. Elijah Hunter, “Wearable Technology”, First Edition, RicTamily Publishers, 2015.
2. Kate Hartman, “Wearable Electronics: Design, Prototype and Wear Your Own Interactive Garments”, First Edition, Maker Media, 2014.
3. Guang Zhong Yang, “Body Sensor Networks”, First Edition, Springer, 2014.
4. Micheal R Neuman, Edward Sazonov, “Wearable Sensors: Fundamentals, Implementation and Applications”, First Edition, Elsevier, 2014.
5. Xiaoming Tao, “Wearable Electronics and Photonic Wearable Electronics and Photonics, The Textile Institutes”, First Edition, CRC Press, Manchester, 2005.

20EEP22	FLEXIBLE AC TRANSMISSION SYSTEMS	L	T	P	C
		3	0	0	3

Course Objective

- To understand the various FACTS controllers and operation of FACTS systems to improve the power quality

Course Content:

Introduction

Reactive Power Control in Electrical Power Transmission Lines, Loads & 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)

Static Var Compensator (SVC) and Applications

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.

Thyristor Controlled Series Capacitor (TCSC) and Applications

Operation of 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.

Voltage Source Converter Based FACTS Controllers

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.

Co-ordination of FACTS Controllers

Controller Interactions, SVC–SVC Interaction, Co-Ordination of Multiple Controllers Using Linear Control Techniques.

Course outcomes:

CO1: Ability to Understand the technique of power flow control and types of power controllers for transmission lines.

CO2: Ability to Comprehend the operation and applications of static VAR compensator and TCSC controller.

CO3: Ability to Understand the transient stability and modelling of STATCOM for power system stability studies.

CO4: Ability to Interpret concept of coordination of FACTS controllers using various control techniques.

References:

1. K.R.Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Academic Science, New Delhi, 2017
2. Narain G.Hingorani, Laszlo Gyugyi “Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems”, Standard Publishers Distributors, 2011.
3. R.Mohan Mathur, Rajiv K.Varma, “Thyristor–Based Facts Controllers for Electrical Transmission Systems”, Wiley India Pvt Ltd, 2011
4. V.K.Sood, “HVDC and FACTS Controllers–Applications of Static Converters in Power System”, Kluwer Academic Publishers, 2004.
5. Yong Hua Song, A.T.John, “Flexible A.C. Transmission Systems (FACTS)”, Institution of Electrical and Electronic Engineers(IEEE), 1999

20EEP25	ADVANCED ELECTRICAL DRIVES	L	T	P	C
		3	0	0	3

Course Objectives

- To impart knowledge on the advanced industrial drives: operations, modelling, controls and its effects.

Course Content:

High Power Industrial Drives

Classification with Speed and Power Ratings, Evolution of Large Drive, Motors for Large Drives, Converters for Large Drives, Slip Power-Controlled Drives.

DC Motor Drive and its Operational Strategies

Dynamic model of machine with armature voltage control only and converters with continuous conduction only; Closed loop control using single (speed) and two loops (speed, current), Implementation using circulating current type three phase dual converter and four quadrant transistorized chopper.

Modelling and Control of DC Drives

State feedback control and sliding mode control of separately excited DC machine, Modelling and control of separately excited DC machine in field weakening region and discontinuous converter conduction mode

AC Drives and its Operational Strategies

Induction Motor Drive, Basic of Scalar and Vector Control, V/F Control, Sensor less Vector Control, Field Oriented Control, Direct Torque Control and Flux Observation, Variable Frequency Operation of Three Phase Symmetrical Induction Machine, Scalar Control Methods for Constant Power and Constant Torque Modes.

Compatibility of Motor and Drives

Effects of drives on motor - dv/dt, THD, Common Mode Voltage, Shaft Voltage and Bearing Current, Sound & Vibration

Course outcomes:

CO1: Ability to Understand the basic operation and features of large industrial drives.
CO2: Ability to Apply the dynamic model of DC machine for various operation modes of DC drives.
CO3: Ability to Identify and explain the various operational strategies of AC drives.
CO4: Ability to Analyse the effect of drives on the operation of electrical machines.

References:

1. Bimal K. Bose, “Power Electronics and Variable Frequency Drives: Technology and Applications”, Wiley-IEEE Press, Student Edition, 2010.
2. Malcolm Barnes, “Practical Variable Speed Drives and Power Electronics”, Newnes, Illustrated edition, 2003.
3. Clarence A. Phipps, “Variable Speed Drive Fundamentals” Prentice Hall, Third Edition, 1999.
4. David Finney,” Variable Frequency AC Motor Drive System”, The Institution of Engineering and Technology, 1988.
5. Mohan, N., Electric Drives: An Integrative Approach, MNPERE (2001).
6. Krishnan, R., Electric Motor & Drives: Modeling, Analysis & Control, PHI Pvt. Ltd. (2001)

20EEP21	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

Course Objective

- To provide knowledge about sources of renewable energy, the machines and converters used for its extraction
- To provide knowledge about the stand alone and grid connected renewable energy systems.

Course Content:

Introduction

Environmental Aspects of Electric Energy Conversion, Impacts of Renewable Energy Generation on Environment (Cost-GHG Emission), Qualitative Study of Different Renewable Energy Resources- Solar, Wind, Ocean, Biomass, Fuel Cell, Hydrogen Energy Systems.

Electrical Machines for Renewable Energy Conversion

Reference Theory Fundamentals, Principle of Operation and Analysis- Induction Generators(IG), Permanent Magnet Synchronous Generator (PMSG), Squirrel Cage Induction Generator(SCIG) and Doubly Fed Induction Generator (DFIG).

Power Converters

Line Commutated Converters (Inversion-Mode), Boost and Buck-Boost Converters, Selection of Inverter, Battery Sizing, Array Sizing, Three Phase AC Voltage Controllers, Uncontrolled Rectifiers, PWM Inverters, Grid Interactive Inverters-Matrix Converters.

Analysis of Wind and Solar Systems

Solar- Block Diagram of Solar Photo Voltaic System, Principle of Operation, Stand-Alone Operation of Fixed and Variable Speed Wind Energy Conversion Systems and Solar Systems, Grid Connection Issues, Grid Integrated PMSG, SCIG Based Wind Energy Conversion System (WECS), Grid Integrated Solar System.

Hybrid Renewable Energy Systems

Need for Hybrid Systems, Range and Type of Hybrid Systems, Case Studies of Wind and Solar Hybrid Systems.

Course outcomes:

CO1: Ability to Understand the basics of energy generation from different renewable sources and its impact on environment,

CO2: Ability to Identify different generators used in renewable energy conversion and understand their operation

CO3: Ability to Identify various power converters used in conditioning of renewable energy and understand their specifications

CO4: Ability to Analyse the issues and challenges in extracting energy from wind, solar and hybrid energy systems.

References:

1. Umakanta Sahoo, “Hybrid Renewable Energy Systems”, Wiley-Scrivener, First Edition, 2020.
2. Rashid.M.H, “Power Electronics Hand book”, Academic Press, Fourth Edition, 2018.
3. B. H. Khan, “Non-Conventional Energy Sources”, McGraw Hill Education India Private Limited; Third edition, 2017.
4. Ion Boldea, “Variable Speed Generators”, CRC Press, Second Edition, 2015.
5. Rai.G.D, “Non-Conventional Energy Sources”, Khanna Publishers, Sixth Edition, Reprint, 2009.

OPEN ELECTIVES OFFERED BY THE DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

20CSE01	BASICS OF PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to learn the basics of algorithmic problem solving, read and write simple Python programs and to develop Python programs with Python data structures namely lists, tuples, and dictionaries.

COURSE CONTENT:

Introduction

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion).

Python Basics

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments.

Control Structures and Strings

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays.

Lists and Tuples

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.

File Handling and Exceptions

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions.

COURSE OUTCOMES:

At the end of the course, the students will have the

CO1: Ability to develop algorithmic solutions to solve various computational problems

CO2: Ability to structure simple python programs for solving problems.

CO3: Ability to create applications written using simple Python programs.

REFERENCES:

1. Anita Goel and Ajay Mittal "Computer Fundamentals and Programming in C", Pearson Education, 2013(Unit 1)
2. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/) (Units 2,3,4 and 5)
3. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
4. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
5. John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
6. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.

20CSE02	INTRODUCTION TO AI	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The objective of the course is to learn the concepts of Artificial Intelligence and to understand the various characteristics of intelligent agents, the different search strategies in AI and represent knowledge for solving AI problems.

COURSE CONTENT:

Introduction

Introduction–Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents–Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.

Problem Solving Methods

Problem solving Methods – Search Strategies- Uninformed – Informed – Heuristics – Local Search Algorithms and Optimization Problems -Searching with Partial Observations – Constraint Satisfaction Problems.

Knowledge Representation

First Order Predicate Logic – Inference in FOL – Unification – Forward Chaining - Backward Chaining – Resolution.

Learning

Learning- Learning from Examples: Forms of Learning – Theory of Learning - Decision Trees - Explanation-Based Learning - Reinforcement Learning: Active - Passive.

AI Applications

Expert Systems: Architecture - DART - MYCIN- Robotics: Hardware – Robotic Perception – Planning - moving.

COURSE OUTCOMES:

At the end of the course, the students will have the

CO1: Ability to understand the basic concept of Artificial Intelligence.

CO2: Ability to apply appropriate search algorithms for any AI problem.

CO3: Ability to represent a problem using first order and predicate logic.

CO4: Ability to apply AI techniques in developing real world applications.

REFERENCES:

1. Stuart J. Russell, Peter Norvig, “Artificial Intelligence - A Modern Approach”, Third Edition, Pearson Publishers, 2015.
2. Elaine Rich, Kevin Knight, Shivashankar B. Nair, “Artificial Intelligence”, Third Edition, Tata McGraw-Hill Education, 2008.
3. Dr. S N Sivanandam, Dr. M Paulraj,” Introduction to Artificial Networks”,Vikas Publishing House, India-2014.

4. Steven Bird, Ewan Klein and Edward Loper, “Natural Language Processing with Python”, O’Reilly, 2009, https://www.nltk.org/book/.
5. Nils J. Nilsson, “Artificial Intelligence: A New Synthesis”, Morgan Kaufmaan Publishers Inc; Second Edition, 2003.
6. David L. Poole and Alan K. Mackworth, ―Artificial Intelligence: Foundations of Computational Agents‖, Cambridge University Press, 2010.

ONLINE RESOURCES:

1. NPTEL, “Artificial Intelligence”, http://nptel.ac.in/courses/106105079/2.
2. Udacity, “Introduction to Artificial Intelligence”.
3. https://www.coursera.org/learn/introduction-to-ai#syllabus.

20CSE03	FUNDAMENTALS OF DATA SCIENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will introduce the rapidly growing field of data science and equip the students with some of its basic principles and tools as well as its general applications.

COURSE CONTENT:

Introduction

What is Data Science? Big Data and Data Science – Datafication - Current landscape of perspectives - Skill sets needed; Matrices - Matrices to represent relations between data, and necessary linear algebraic operations on matrices - Intro to R/ Python.

Data preprocessing

Data cleaning - data integration - Data Reduction Data Transformation and Data Discretization-Evaluation of classification methods – Confusion matrix, Students T-tests and ROC curves - The Data Science Process.

Basic Machine Learning Algorithms

Association Rule mining - Linear Regression- Logistic Regression - Classifiers - k-Nearest Neighbors (k-NN), k-means -Decision tree - Naive Bayes. Feature Generation and Feature Selection algorithms - Filters; Wrappers; Decision Trees; Random Forests.

Clustering

Choosing distance metrics - Different clustering approaches - hierarchical agglomerative clustering, k-means (Lloyd's algorithm), - DBSCAN - Relative merits of each method - clustering tendency and quality.

Data Visualization

Basic principles, ideas and tools for data visualization.

COURSE OUTCOMES:

At the end of the course, the students will have the

CO1: Ability to describe what Data Science is and the skill sets needed to be a data scientist.

CO2: Ability to explain in basic terms what Statistical Inference means. Identify probability distributions commonly used as foundations for statistical modeling. Fit a model to data.

CO3: Ability to use R to carry out basic statistical modeling and analysis.

CO4: Ability to explain the significance of exploratory data analysis (EDA) in data science.

REFERENCES:

1. Cathy O'Neil and Rachel Schutt, “Doing Data Science, Straight Talk From The Frontline”, O'Reilly, 2014.
2. Jiawei Han, Micheline Kamber and Jian Pei, “Data Mining: Concepts and Techniques”, Third Edition. ISBN 0123814790, 2011.
3. Mohammed J. Zaki and Wagner Miera Jr, “Data Mining and Analysis: Fundamental Concepts and Algorithms”, Cambridge University Press, 2014.
4. Matt Harrison, “Learning the Pandas Library: Python Tools for Data Munging, Analysis, and Visualization, O'Reilly, 2016.
5. Joel Grus, “Data Science from Scratch: First Principles with Python”, O’Reilly Media, 2015.
6. Wes McKinney, “Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython”, O'Reilly Media, 2012.

20CSE04	BASICS OF INTERNET PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to learn the basics of HTML5, CSS3 and JavaScript essential for website development. Also, to learn the basics of PHP and XML essential for the development of dynamic websites.

COURSE CONTENT:

Introduction to World Wide Web and HTML5

Web Basics – Multitier Application Architecture – Client-Side Scripting versus Server-Side Scripting – **HTML5:** Introduction – Editing HTML5 – Headings – Linking – Images – Special Characters – Horizontal Rules – List - Tables – Forms – Form Input Types

Cascaded Style Sheets

Introduction – Inline styles – Embedded styles – linking external styles – Conflicting styles – Absolute and Relative Positional Elements – Backgrounds – Box Model – Text flow – linear gradient – radial gradient

Client-Side Programming: JavaScript

Displaying a line of Text – User input with prompt dialogs – Arithmetic – Control Statements – if, if- else, while – for – switch – do…while – break and Continue – logical operators – Function Definitions – Scope Rules – Global functions – Declaring and Allocating Arrays - Example Arrays - Modelling a Document: DOM Nodes and Trees – Traversing and Modifying DOM Tree - load Event – Event mousemove and the event Object – Form processing with Events.

Server-Side Programming: PHP

Introduction – Converting between data types – Operators – Arrays – String Comparison – Form Processing and Business Logic – Reading from a database – Using Cookies and Session

XML

XML Basics – Structuring Data – XML Namespaces – W3C XML Schema Documents - Ajax web Application – Ajax example using XMLHttpRequest Object.

COURSE OUTCOMES:

At the end of the course, the students will have the

CO1: Ability to design and develop a static website with latest W3C standards

CO2: Ability to design and develop an interactive website with client-side programming

CO3: Ability to design and develop a dynamic web page / web application with database access and session management.

REFERENCES:

1. Deitel and Deitel and Nieto, “Internet and World Wide Web - How to Program”, Prentice Hall, 5th Edition, 2012.
2. Jeffrey C. Jackson, Web Technologies A Computer Science Perspective, 1st edition, Pearson Education, 2011
3. Chris Bates, Web Programming: Building Internet Applications, 3rd Edition, Wiley India Pvt. Limited, 2007
4. Robert W. Sebesta, Programming the World Wide Web, 7th Edition, Pearson, 2013
5. Eric Freeman, Elisabeth Robson, Head First HTML5 Programming, Building Web Apps with JavaScript, 1st Edition, O'Reilly Media, Incorporated, 2011
6. Jason Hunter, William Crawford, Java Servlet Programming, 2nd Edition, O'Reilly Media, 2010

20CSE05	INTRODUCTION TO SOFT COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course focuses on the various soft computing frame works and familiarize with the design of neural networks, fuzzy logic and fuzzy systems and also to learn the mathematical background for optimized genetic programming.

COURSE CONTENT:

Introduction

Introduction to Soft computing - Basic tools of Soft Computing - Soft Computing vs Hard Computing -Artificial Neural Networks -Classification of ANNs.

Artificial Neural Networks

Back propagation Neural Networks – Associative memory neural networks - Bi-directional Associative Memory -Adaptive Resonance Theory Neural Networks.

Fuzzy Systems

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets – Classical Relations and Fuzzy Relations -Membership Functions -Defuzzification – Fuzzy Arithmetic.

Genetic Algorithms

Basic Concepts- Working Principles -Encoding- Fitness Function – Reproduction - Inheritance Operators – Cross Over – Inversion and Deletion -Mutation Operator – Bit-wise Operators -Convergence of Genetic Algorithm.

Optimization Techniques

Multi objective Evolutionary Algorithms (MOEA) - Particle swarm optimization (PSO)- Ant Colony Optimization - Fire fly Optimization.

COURSE OUTCOMES:

At the end of the course, the students will have the

CO1: Ability to apply the various soft computing concepts for solving real time problems.

CO2: Ability to apply the fuzzy rules and reasoning to develop decision making and expert system.

CO3: Ability to improve solution by optimization techniques.

REFERENCES:

1. S.Rajasekaran and G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications", Prentice-Hall of India Pvt. Ltd., 2006.
2. George J. Klir, Ute St. Clair, Bo Yuan, “Fuzzy Set Theory: Foundations and Applications” Prentice Hall, 1997.
3. David E. Goldberg, “Genetic Algorithm in Search Optimization and Machine Learning” Pearson Education India, 2013.
4. James A. Freeman, David M. Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Education India, 1991.
5. Simon Haykin, “Neural Networks Comprehensive Foundation” Second Edition, Pearson Education, 2005.

OPEN ELECTIVES OFFERED BY THE DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

20ECE01	ELECTRONIC MEASUREMENTS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn the fundamentals of electrical and electronic instruments, measurement techniques, and storage and display devices.

COURSE CONTENT:

Introduction

Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement — Standards and calibration

Electrical and Electronic Instruments

Principle and types of analog and digital voltmeters, ammeters, multimeters – Single and three phase wattmeters and energy meters – Magnetic measurements – Determination of B-H curve and measurements of iron loss.

Comparative Methods of Measurements

D.C & A.C potentiometers, D.C & A.C bridges, transformer ratio bridges, self-balancing bridges. Interference & screening – Multiple earth and earth loops - Electrostatic and electromagnetic interference – Grounding techniques.

Storage and display Devices

Magnetic disk and tape –digital plotters and printers, CRT display, digital CRO, OLED,LED display systems, LCD –USB Data Loggers.

Transducers and Data Acquisition Systems

Classification of transducers – Selection of transducers – Resistive, capacitive & inductive transducers – Piezoelectric, Hall effect, optical and digital transducers – Elements of data acquisition system – A/D, D/A converters – Smart sensors.

COURSE OUTCOMES:

At the end of the course, the students will have the

CO1: Ability to find electrical parameters using appropriate Electronics Instruments.

CO2: Ability to interpret the characteristics and operation of Electrical and Electronic Instruments.

CO3: Ability to apply storage and display devices.

CO4: Ability to select appropriate sensors in various applications.

REFERENCES:

1. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2004.
2. J. B. Gupta, 'A Course in Electronic and Electrical Measurements', S. K. Kataria & Sons, Delhi, 2003.
3. J Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., 2007.
4. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw Hill, II Edition 2004.
5. D.V.S. Moorthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt Ltd, 2007.

20ECE02	MICROCONTROLLERS AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn the primary concept of microcontrollers, hardware usage for programming intelligence and get familiarized with the architecture, instruction set and applications of microcontroller.

COURSE CONTENT:

8051 Microcontroller

Architecture of 8051 – Register set - I/O Pins, Ports and Circuits - Instruction set - Addressing modes - Assembly language programs for arithmetic and Logical operations.

Interfacing 8051 Microcontroller

Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - Stepper Motor Interfacing –ADC – DAC.

Application of 8051 Microcontroller

Temperature Controller using ADC – Square and Triangular waveform generation using DAC – Water level controller – Traffic Light Controller.

PIC Microcontroller

CPU Architecture – Register – I/O pins, Ports -Instruction set – addressing modes - Interrupts

Interfacing PIC Microcontroller

PIC: Timers- I2C Interfacing –UART- A/D Converter –Pulse Width Modulation.

COURSE OUTCOMES:

At the end of the course, the students will have the

CO1: Ability to interpret the architecture of 8051 and PIC microcontrollers.

CO2: Ability to develop Assembly Language Programs (ALP) for arithmetic and Logical operations using microcontrollers.

CO3: Ability to build 8051 microcontroller-based systems using peripheral interfaces.

CO4: Ability to build PIC microcontroller-based systems using peripheral interfaces.

REFERENCES:

1. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Second Edition, Pearson Education, 2011
2. Subrata Ghoshal, “8051 Microcontrollers: Internals, Instructions, Programming &Interfacing”, Second Edition, Pearson education, 2014.
3. John. B. Peatman, “Design with PIC Microcontroller”, Prentice Hall, 2011.
4. Gene .H.Miller, “Micro Computer Engineering”, Pearson Education, 2013.
5. Subrata Ghoshal, “8051 Microcontrollers: Internals, Instructions, Programming &Interfacing”, Second Edition, Pearson education, 2014.

20ECE03	INTRODUCTION TO EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn the architecture of embedded systems, design and analysis of embedded computing, basic concepts of real time operating system, programming concepts for embedded systems, system design techniques of embedded hardware and its applications.

COURSE CONTENT:

Architecture of Embedded Systems

Categories of Embedded Systems – Specifications of Embedded systems – Recent trends in Embedded Systems – Detailed Hardware and Software Design – ARM Processor – CPU: programming input and output - supervisor mode, exceptions and traps – Co-processors – Memory system mechanisms – CPU performance – CPU power consumption.

Embedded Computing Platform Design

The CPU Bus-Memory devices and systems – Designing with computing platforms – Host and target machines – consumer electronics architecture – platform-level performance analysis - Components for embedded programs – Models of programs – Assembly, linking and loading – compilation techniques – Program level performance analysis

Processes and Operating Systems

Introduction – Multiple tasks and multiple processes – Multi rate systems – Preemptive real-time operating systems – Priority based scheduling – Inter process communication mechanisms –Semaphores and Shared Data – Message Queues – Mailboxes and Pipes – Interrupt Routines in RTOS Environment – Evaluating operating system performance – power optimization strategies for processes.

Hardware/Software Integration & Programming

Cross-Compilers – Cross-Assemblers – Linker/Locator – Debugger – Emulator – Simulators – Introduction to Integrated Development Environment (IDE) – Getting Embedded Software into Target System: In-Circuit Emulators –Serial Port Programming and Interrupts Programming.

Embedded System Applications

Applications of Embedded systems – Case study of Embedded systems like automatic chocolate vending machine, Adaptive Cruise Control Systems in a Car, Digital camera, Smart card and ATM.

COURSE OUTCOMES:

At the end of the course, the students will have the

CO1: Ability to understand the architecture of embedded systems.

CO2: Ability to understand the concepts of multiple processes and operating systems.

CO3: Ability to choose appropriate tools for developing real time embedded systems.

CO4: Ability to apply suitable hardware and software architectures to implement embedded system applications.

REFERENCES:

1. Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design", Third Edition, Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.
2. Jonathan W. Valvano, "Embedded Microcomputer Systems Real Time Interfacing", Third Edition Cengage Learning, 2012.
3. Raj Kamal, "Embedded Systems Architecture Programming and Design", Pearson, 2011.
4. K.V.K.K.Prasad "Embedded /Real-Time Systems: Concepts, Design and Programming" Dream tech, Wiley 2012.
5. Daniel 5.W Lewis, "Fundamentals of Embedded Software" Pearson Education, 2013.

20ECE04	NANO ELECTRONICS AND SENSORS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn the overview of nano electronics, basic components of electronic systems, memory devices, sensors and actuators.

COURSE CONTENT:

Overview of Nano-Electronics

Nano-scale electronics; Foundation of nano-electronics – low dimension transport, quantum confinement, Coulomb blockade and quantum dot; Ballistic transport and Quantum interferences; Landauer formula, quantization of conductance, example of Quantum point contact.

Two-Terminal Junction Transistors

Basic CMOS process flow; MOS scaling theory; Issues in scaling MOS transistors; Requirements for non-classical MOS transistor; PMOS versus NMOS; Design and construction of MOS capacitor; Integration issues of high-k MOS – interface states, bulk charge, band offset, stability, reliability; MOS transistor and capacitor characteristics.

Gate Transistors

Metal gate transistors – motivation, basics and requirements; quantum transport in nano MOSFET; Ultrathin body silicon on insulator (SOI) – double gate transistors; Vertical transistors – FinFET and surround gate FET; compound semiconductor MOSFET – Hetero-structures MOSFET.

Characteristics of Sensors and Actuators

Basics: types and working principles of sensors and actuators; Characteristic features: Range, Resolution, Sensitivity, Error, Repeatability, Linearity and Accuracy, Impedance, Nonlinearities, Static and Coulomb Friction, Eccentricity, Backlash, Saturation, Dead-band, System Response, First Order System Response, Under-damped Second Order System Response, Frequency Response.

Memory Devices and Sensors

Nano ferroelectrics – Ferroelectric random-access memory –Fe-RAM circuit design – ferroelectric thin film properties and integration – calorimetric -sensors – electrochemical cells – surface and bulk acoustic devices – gas sensitive FETs – resistive semiconductor gas sensors –electronic noses – identification of hazardous solvents and gases – semiconductor sensor array.

COURSE OUTCOMES:

At the end of the course, the students will have the

CO1: Ability to understand the concepts of Nano electronics

CO2: Ability to interpret the characteristics and operation of Gate transistors.

CO3: Ability to interpret the characteristics of sensors and actuators.

CO4: Ability to understand the operation of memory devices and sensors.

REFERENCES:

1. W. Ranier, 'Nano Electronics and Information Technology', Wiley, 2003.
2. K.E. Drexler, 'Nano systems', Wiley, 1992.
3. M.C. Petty, 'Introduction to Molecular Electronics', 1995.
4. Handbook of Nanoscience, Engineering and Technology", Kluwer publishers, 2002.
5. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties &Applications", Imperial College Press, 2004.

20ECE05	PRINCIPLES OF VLSI SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn the principles of MOS transistors, realization of combinational and sequential logic circuits using MOS transistors, arithmetic building blocks and implementation strategies using FPGA.

COURSE CONTENT:

MOS Transistor Principle

NMOS and PMOS transistor operations, MOS DC Equations, Electrical properties of CMOS circuits and device modeling, scaling principles CMOS inverter, Second Order Effects, Stick diagram.

Combinational Logic Circuits

MOSFETs as switches, Basic Logic Gates in CMOS, Examples of Combinational Logic Design, RC Delay Model, Linear Delay Model, Elmore's constant, Pass transistor Logic, Transmission gates, static and dynamic CMOS design.

Sequential Logic Circuits

Static and Dynamic Latches and Registers, Timing issues, Memory architecture and memory control circuits.

Arithmetic Building Blocks

Data path circuits, Architectures for ripple carry adders, carry look ahead adders, High speed adders, Multipliers, speed and area tradeoff

Implementation Strategies

Full custom and Semi-custom design, Standard cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures, Xilinx FPGA.

COURSE OUTCOMES:

At the end of the course, the students will have the

- **CO1:** Ability to interpret the characteristics and operation of MOS transistors.
- **CO2:** Ability to interpret the operation of VLSI architecture using FPGA.
- **CO3:** Ability to build CMOS based arithmetic and logic circuits.
- **CO4:** Ability to build CMOS based sequential circuits.

REFERENCES:

1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, “Digital Integrated Circuits: A Design Perspective”, Second Edition, Prentice Hall of India, 2013.
2. M.J. Smith, “Application Specific Integrated Circuits”, Addisson Wesley, 2001.
3. A.Pucknell, Kamran Eshraghian, “BASIC VLSI Design”, Third Edition, Prentice Hall of India, 2009.
4. Weste and Harris: CMOS VLSI DESIGN: A Circuits and Systems Perspective (Fourth edition) Pearson Education, 2010.
5. N.Weste, K.Eshraghian, “Principles of CMOS VLSI Design”, Second Edition, Addison Wesley 2009.

OPEN ELECTIVES OFFERED BY THE DEPARTMENT OF MECHANICAL ENGINEERING

20MEE01	AUTOMOTIVE FUNDAMENTALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

To provide knowledge on IC Engines, braking, transmission, suspension, starting systems along with insights into new combustion techniques used for various fuels and alternative sources.

COURSE CONTENT

VEHICLE STRUCTURE, ENGINE

Types of automobiles, vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics, IC engines –components function and materials.

ENGINE AUXILIARY SYSTEMS

Electronically controlled gasoline injection system for SI engines and diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system)

TRANSMISSION SYSTEMS

Clutch: Types diaphragm clutch, single and multi-plate clutch, centrifugal clutch and construction, Gear box: Types - gear selector and shifting mechanism, transfer box, propeller shaft, slip joints, universal joints, Differential and rear axle.

BRAKES AND SUSPENSION SYSTEMS

Braking system: Types of brakes, Mechanical, and Air brakes, Disc & Drum brakes, Engine brakes, anti-lock braking system (ABS).Suspension system: Types of Suspension Systems-front and rear suspension.

ALTERNATIVE ENERGY SOURCES AND EMISSION CONTROL

Use of Natural Gas, Liquefied Petroleum Gas, and Hydrogen in Automobiles. Electric and Hybrid Vehicles, Fuel Cell. Engine emission, Engine emission control system, Emission norms (Euro and BS).

COURSE OUTCOMES

At the end of the course the students will have the ability

CO1: To identify the fundamental components of automobile structures, engine auxiliary systems, along with brakes and suspension system

CO2: To classify the clutches, gear boxes, braking and suspension systems based on different types of vehicles.

CO3: To examine the various injection systems, ignition systems and gear shifting mechanism along with alternative energy sources and engine emission characteristics.

REFERENCES

1. Kirpal Singh, “Automobile Engineering”, Standard Publishers, Vol-I & II. Thirteenth Edition. New Delhi, 2014.
2. R. K. Rajput, “A Text book of Automobile Engineering”, Lakshmi publication, Second Edition. 2014
3. Heniz Heisler, “Vehicle and Engine Technology, SAE, Second Edition. 2009.
4. Julian Happian Smith, “An Introduction to Modern Vehicle Design”, Butterworth-Heinemann, New Delhi, 2002.
5. Gupta R B, “Automobile Engineering", Satya Prakashan, 2015.
6. C.R. Ferguson, A. T. Kirkpatrick, Internal Combustion Engines, 2nd Edition, John Wiley & Sons, 2016.

20MEE02	COMPUTER AIDED DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

To provide an overview of how computers are being used in engineering component designs and make the students understand different CAD standards used in Industries

COURSE CONTENT

FUNDAMENTALS OF COMPUTER GRAPHICS

Product cycle- Design process- sequential and concurrent engineering- Computer aided design – CAD system architecture- Computer graphics – co-ordinate systems- 2D and 3D transformations homogeneous coordinates - Line drawing -Clipping- viewing transformation

GEOMETRIC MODELING

Geometry and topology -representation of curves- Hermite curve- Bezier curve- B-spline curves-rational curves-Techniques for surface modeling – surface patch- Coons and bicubic patches. Solid modeling techniques- CSG

ASSEMBLY OF PARTS

Assembly modelling – interferences of positions and orientation – tolerance analysis- mass property calculations – mechanism simulation and interference checking.

CAD STANDARDS

Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images- Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc. Communication standards.

COURSE OUTCOMES

At the end of the course the students will have the ability

CO1: To identify the fundamental components of computer graphics such as product cycle, CAD system and architecture, computer graphics, homogeneous coordinates, geometry, topology along with assembly of parts and CAD standards

CO2: To classify the types of Coordinate systems, representation of different curves, surface modeling techniques and the various standards used in computer graphics such as GKS, open, IGES, STEP, and CALS.

CO3: To examine the assembly modeling with interferences of position and orientation, tolerance analysis and communication standards.

REFERENCES

1. Ibrahim Zeid “Mastering CAD CAM” Tata McGraw-Hill Publishing Co.2007
2. Chris McMahon and Jimmie Browne “CAD/CAM Principles", "Practice and Manufacturing management “ Second Edition, Pearson Education, 1999.
3. William M Neumann and Robert F.Sproul “Principles of Computer Graphics”, McGraw Hill Book Co. Singapore, 1989.
4. Donald Hearn and M. Pauline Baker “Computer Graphics”’. Prentice Hall, Inc, 1992.
5. Foley, Wan Dam, Feiner and Hughes - "Computer graphics principles & practice" Pearson Education - 2003.

20MEE03	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

To providing an overview of power plants and detailing the role of Engineers in their operation and maintenance of renewable power sources.

COURSE CONTENT

LAYOUT OF POWER PLANTS

Layout of Steam, Hydel, Diesel, Nuclear and Gas Turbine Power Plants - Combined Power Cycles – Comparison and Selection

NUCLEAR AND HYDRO POWER PLANTS

Nuclear Energy – Fission, Fusion Reaction, Types of Reactors, Waste Disposal and safety. Hydroelectric power plants – runoff storage and pumped storage type.

DIESEL AND GAS POWER PLANTS

Types of Diesel Plants, Components, Selection of Engine Type, Applications, environmental hazards- Gas Turbine Power Plant – Fuels - Gas Turbine Material – Regeneration and Intercooling.

SOLAR, TIDAL, WIND POWER PLANTS AND ECONOMIC ISSUES OF POWER PLANTS

Tidal - Solar thermal central receiver system – wind power plants -Cost of Electric Energy – Fixed and operating Costs – Energy Rates – Types of Tariffs.

COURSE OUTCOMES

At the end of the course the students will have the ability

CO1: To identify the fundamental components of power plant layouts along with the selection procedure.

CO2: To classify the types of power plant layouts, reactors based on the type of fuel energy utilized.

CO3: To examine the various components and systems of different power plants such as nuclear, hydro, diesel, gas. Solar, tidal, wind and to determine the economical issues associated with them.

REFERENCE

1. EI- Wakil M. M, “Power Plant Technology”, McGraw-Hill, Second Edition, 2014.
2. Arora S. C and Domkundwar S, “A course in Power Plant Engineering”, Dhanpatrai, Third Edition, 2012.
3. Nag P.K, “Power Plant Engineering”, Tata McGraw-Hill, 2014.
4. G. D. Rai, “Introduction to Power Plant Technology”, Khanna Publishers, Third Edition, 2014.
5. T. Morse Frederick, “Power Plant Engineering”, Prentice Hall of India, Third Edition, 2014.
6. Culp A. W., “Principles of Energy Conversion”, McGraw Hill, Second Edition, 201

20MEE04	INTRODUCTION TO ROBOTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

To impart knowledge about automation, various sensors and their applications in robots. Along with Robot Programming methods & Languages used by robots.

COURSE CONTENT

INTRODUCTION

Automation and robotics –History of robotics - Definition of a Robot - Basic Concepts - Robot configurations - Types of Robot drives - Basic robot motions - Point to point control - Continuous path control.

COMPONENTS AND OPERATIONS

Basic control system concepts - control system analysis - robot actuation and fed back, Manipulators Coordinate transformation - Brief Robot dynamics. Types of Robot and effectors - Grippers - Tools as end effectors - Robot/End - effort interface.

SENSING AND MACHINE VISION

Range sensing - Proximity sensing - Touch sensing - Force and Torque sensing. Introduction to Machine vision - Sensing and digitizing - Image processing and analysis.

ROBOT PROGRAMMING

Methods - languages - Capabilities and limitation - Artificial intelligence - Knowledge representation - Search techniques - AI and Robotics.

INDUSTRIAL APPLICATIONS

Application of robots in machining - Welding - Assembly - Material handling - Loading and unloading - CIM - Hostile and remote environments

COURSE OUTCOMES

At the end of the course the students will have the ability

CO1 : To identify the basic control system concepts, manipulator coordinate transformation, robot dynamics, range sensing, Artificial intelligence and industrial applications of robot such as in Welding, Assembly, Material handling, Loading and unloading,

CO2: To classify the types of robots, end effectors, grippers, sensing techniques and robot programming methods,

CO3: To examine the languages, Capabilities, limitations and Search techniques of robot

REFERENCES

1. S.R. Deb, “Robotics Technology and flexible automation”, Tata McGraw-Hill Education., 2010
2. Mikell P Groover& Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, “Industrial Robotics, Technology programming and Applications”, McGraw Hill, 2012
3. Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin,”Robotics Engineering an Integrated Approach”, PHI Learning, 2011.
4. K.S. Fu., R.C.Gonalez, C.S.G.Lee, “Robotics Control Sensing ", Vision and Intelligence, McGraw Hill International Edition, 2000.
5. Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education, 2008.

20MEE05	3D PRINTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

To understand the various RPT processes adopted to produce parts and to impart knowledge on three dimensional printing, reverse engineering, current technologies and their influence in manufacturing.

COURSE CONTENT

FUNDAMENTALS OF RPT

Development of RP systems, Rapid Tooling, Rapid Manufacturing- Principle –Fundamental – File format – Other translators – medical applications of RP- Materials for Rapid Prototyping Systems

LIQUID BASED RAPID PROTOTYPING SYSTEMS

Liquid based system – Stereolitho graphy Apparatus (SLA), details of SL process, products, Advantages, Limitations, Applications and Uses.

SOLID BASED RAPID PROTOTYPING SYSTEMS

Solid based system - Fused Deposition Modeling, principle, process, products, advantages, applications and uses - Laminated Object Manufacturing

POWDER BASED RAPID PROTOTYPING SYSTEMS

Selective Laser Sintering – principles of SLS process, principle of sinter bonding process, Laser sintering materials, products, advantages, limitations, applications and uses.

REVERSE ENGINEERING AND NEW TECHNOLOGIES

Reverse Engineering - Introduction, measuring device- contact type and non-contact type, CAD model creation, medical data processing - types of medical imaging, software for making medical models, medical materials, and other applications.

COURSE OUTCOMES

At the end of the course the students will have the ability

CO1: To identify the development of RP systems such as liquid, solid and powder based systems, Rapid Tooling, Rapid Manufacturing principle and Fundamentals, File format, translators and medical applications of RP, Materials for Rapid Prototyping Systems along with the concept of reverse engineering.

CO2: To classify the advantages, disadvantages and limitations of liquid, solid and powder based rapid prototyping systems along with the types of measuring devices utilized in reverse engineering.

CO3: To examine the Stereo lithography Apparatus (SLA), Fused Deposition Modeling, Selective Laser Sintering, Laminated Object Manufacturing based on principles, process and products,

CO4: To analyze the concept of reverse engineering, medical data processing and software for making medical models, medical materials, and other applications.

REFERENCES

1. Douglas Bryden ,“CAD and Rapid Prototyping for Product Design”, Laurence King, 2014.
2. Kalani Kirk Hausman ,Richard Horne,”3D Printing For Dummies”,Wiley Publications, 2014.
3. Chee Kai Chua, Kah Fai Leong, Chu Sing Lim “Rapid Prototyping: Principles and Applications” World Scientific Publication Pvt Ltd, 2011.
4. Chua C. K, Leong K. F and Lim C. S, “Rapid Prototyping: Principles and Applications”, World Scientific, second edition, 2010.
5. Ian Gibson, “Advanced Manufacturing Technology for Medical applications: Reverse Engineering, Software conversion and Rapid Prototyping”, Wiley, 2006.

OPEN ELECTIVES OFFERED BY THE DEPARTMENT OF INFORMATION TECHNOLOGY

20ITE01	BIG DATA ANALYTICS AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

This course will enable the students to understand the basics of big data analytics, Hadoop, and gain knowledge about the different data analytics techniques and its applications.

COURSE CONTENT

Introduction to Big Data

Introduction – distributed computing – Need of distributed computing for Big Data– Evolution of data management–Understanding the data – Defining big data – characteristics of Big Data – Big Data and its importance– Big Data analytics–Traditional and advanced analytics. Big Data Types - Structured data - Unstructured data - Semi structured data.

Introduction to Hadoop

Big Data – Apache Hadoop & Hadoop Ecosystem – Moving Data in and out of Hadoop – Understanding inputs and outputs of Map Reduce - Data Serialization.

Introduction to MongoDB

What is MongoDB? – Why Mongo DB? – Terms used in RDBMS and MongoDB – Data Types in MongoDB – MongoDB Query Language.

Big Data Trends

Data Curators – CDOs are stepping up – Dark data in the cloud – Streaming the IoT for machine learning - Edge Computing – Open Source – chatbots will get smarter – Container Revolution - Commoditization of visualization.

Big Data Applications

Big Data in Health care – Big Data contributions to Education - Big Data contributions to Insurance Services - Big Data Contributions to Industrial and Natural Resources - Big Data Contributions to Transportation - Big Data Contributions to Banking Zones and Fraud Detection.

COURSE OUTCOMES

- **CO1:** Understand the fundamental concepts of Big Data
- **CO2:** Demonstrate the deployment of Hadoop and Map reduce in a Big Data Environment
- **CO3:** Understand the usage of Mongo DB in data analytics.
- **CO4:** Compare the various data platforms with IoT and Cloud based on evaluation parameters.
- **CO5:** Understand the application of big data analytics in real-time scenarios

REFERENCES

1. Seema Acharya, Subhashini Chellappan, “Big Data and Analytics”, 2nd Edition, Wiley India Pvt Ltd, 2021.

2. Chris Eaton, Dirk deroos, “Understanding Big data”, McGraw Hill, 2012.

3. Judith Hurwitz, Alan Nugent et al.,” Big Data for Dummies”, John Wiley & Sons, Inc, 2013

4. Vignesh Prajapati, “Big Data Analytics with R and Haoop”, Packet Publishing, 2013.

5. Tom Plunkett, Brian Macdonald et al, “Oracle Big Data Handbook”, Oracle Press, 2014.

20ITE02	CLOUD COMPUTING FUNDAMENTALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

The course will enable the students to understand the basic concepts, Cloud Models, architecture of cloud computing and techniques of virtualization and also get familiarized with the cloud platforms.

COURSE CONTENT

Cloud Computing and Cloud Services

Introduction to Cloud Computing - History of Cloud computing - Types of Clouds - Characteristics of Cloud Computing - Cloud Architecture - Cloud Storage - Cloud Services - Benefits from Cloud Computing - Pros and Cons of Cloud Computing - Applications of Cloud Computing. Web based applications - Advantages of cloud development - Disadvantages of cloud development - Types of Cloud Service Development: Software as a Service - Platform as a Service - On demand Computing - Discovering Cloud services development services and tools.

Virtualization Technology and Services

Introduction - Virtualization Defined - Virtualization benefits - Server Virtualization - Virtualization for x86Architecture - Hypervisor Management Software - Virtual Infrastructure Requirements. Exploring Online Calendar Applications: Google Calendar - Yahoo Calendar - Windows Live Calendar - Apple MobileMe calendar - Exploring Online Scheduling Applications - Exploring Online Planning.

Collaborating with Cloud

Evaluating Web mail services - Evaluating Instant Messaging Services - Evaluating Web Conferencing Tools – Collaborating via social networks and group ware - Collaborating on budgets.

Web Services

Introduction - Amazon Web Services - Google App Engine – Microsoft Azure – Cloud computing economics - AJAX and Mashups.

Security in Cloud Computing

Cloud Computing software security Fundamentals : Cloud Security Services, Cloud Security Design Principles - Security Challenges Concerns, Risk Issues, and Legal Aspects - Security Requirements for the Architecture.

COURSE OUTCOMES

CO1: Apply cloud computing techniques to solve large scale scientific problems.

CO2: Implement virtualization for applications, desktops, servers, and network platforms.

CO3: Develop a cloud application with a user interface and understand data components.

CO4: Apply the various cloud platforms to develop and deployment for web application.

CO5: Understand the security aspects and architecture that are considering to protect cloud systems

REFERENCES

1. Rajkumar Buyya, Christian Vacchiola, S Thamarai Selvi, "Mastering Cloud Computing", First Edition ,McGraw Hill Publications, 2013.
2. Michael Miller, "Cloud Computing: Web-Based Applications that Change the way you Work and collaborate Online', Pearson publications Aug 2008.
3. Kai Hwang, Geoffrey C.Fox, Jack J.Dongarra, "Distributed and Cloud Computing: From Parallel Processing to the Internet of Things", First Edition Morgan Kaufmann Publisher, an imprint Elsevier 2012.
4. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", Publisher: CRC Press, September 2013.
5. Graham Speake, Vic (J.R.) Winkler, "Securing the Cloud: Cloud Computer Security Techniques and Tactics", Elsevier, USA, 2011.

20ITE03	FUNDAMENTALS OF INTERNET OF THINGS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

This Course will enable the students to understand the basic concepts of Internet of Things, Elements involved in Internet of Things, Physical Devices of IoT,Data Analytics in IoT and Explore the various real-time applications which can be automated using Internet of Things.

COURSE CONTENT

Fundamentals of IoT

Introduction - Definition and Characteristics of IoT - Physical design - IoT Protocols - Logical design - IoT communication models, IoT Communication APIs - Enabling technologies - Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates - Domain specific IoTs - IoT Architectural view - IoT and M2M- difference between IoT and M2M - IoT systems management – Needs - NETCONF, YANG - IoT design methodology

Elements of IoT

Sensors and actuators - Communication modules – Zigbee - LoRa - RFID - Wi-Fi - Power sources-IoT platforms - Cloud Computing in IoT - Cloud Connectivity - Big Data Analytics-Data Visualization.

IoT Physical Devices and Endpoints

Basic Building Blocks of IoT Device - Raspberry Pi – About the Board – Linux on Raspberry Pi - Raspberry Pi interfaces – Introduction Django framework – Designing a Web RESTful API - Other IoT devices – Introduction to Arduino.

Data Analytics for IoT

Introduction – Apache Hadoop – Using Hadoop MapReduce for Batch data analysis – Apache Spark – Apache Storm – using Apache Storm for Real time data analytics.

Challenges in IoT and Case Studies

Security Concerns and Challenges - Real time applications of IoT – Home automation Cities – Environment – Energy – Agriculture – Industry – Health and Lifestyle.

COURSE OUTCOMES

CO1: Understand the fundamental concepts of Internet of Things.

CO2: Demonstrate the integration IoT elements with various technologies.

CO3: Understand the building blocks of Internet of Things and characteristics

CO4: Understand the relationship between IoT and Data analytics.

CO5: Understand the application of IoT in real-time scenarios.

REFERENCES

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things-A hands-on approach", Universities Press, 2015.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things: Key applications and Protocols”, Wiley Publications 2nd Edition, 2013.
3. Raj Kamal, “Internet of Things – Architecture and Design Principles”, Mc Graw Hill Education Pvt. Ltd., 2017.
4. Internet of Things and Data Analytics, HwaiyuGeng, P.E, Wiley Publications, 2017.
5. Adrian McEwen, “Designing the Internet of Things”, Wiley Publishers, 2013.

20ITE04	INTRODUCTION TO DATABASE MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

The course will enable the students to learn the basic concepts of DBMS, ER Diagrams, Relational model, transaction processing, and Familiarized with the various queries that can be used for data retrieval.

COURSE CONTENT

Introduction to DBMS

Overview - Purpose of Database System -– Views of data – Data Models – Database Languages — Database System Architecture – Database users and Administrator - Data Models – Introduction to relational databases

Relational Model

Entity-Relationship Diagram-Design Issues- Weak Entity Sets- and Extended E-R features - Structure of relational Databases- Views- Modifications of the Database – Keys.

SQL Fundamentals

Concept of DDL- DML- TCL - DCL: Basic Structure- Set Operations- Aggregate Functions- Null Values- Domain Constraints- Referential Integrity Constraints- CODD's Rule - Functional Dependency- Different Anomalies in designing a Database - Normalization.

Data Storage, Querying and Transaction Management

RAID – Indexing – Query optimization and Processing – transaction Concept – ACID Properties – Serializability – Transactions as SQL statements.

Database Applications

Proprietary DBMS vs Open-Source DBMS –NoSQL – Databases for Social Networks – Introduction to Multimedia Databases.

COURSE OUTCOMES

CO1: Describe the most common designs for core database system components

CO2: Apply the modeling concepts and notation of the relational data model

CO3: Create a relational database schema in SQL that incorporates key, entity integrity and referential integrity constraints.

CO4: Understand the various transaction processing, transaction models, storage management techniques and indexing techniques.

CO5: Understand the various types of databases that are used in social networks.

REFERENCES

1. Abraham Silberschatz, Henry F. Korth and S. Sudharshan, “Database System Concepts”, Sixth Edition, McGraw Hill Education India Pvt. Ltd., 2016.
2. Atul Kahate, “Introduction to Database Management Systems”, Pearson Education, New Delhi, 2006.
3. Alexis Leon and Mathews Leon, “Database Management Systems”, Vikas Publishing House Private Limited, New Delhi, 2003.
4. Raghu Ramakrishnan, “Database Management Systems”,Mc Graw-Hill, third Edition,2014.
5. Bipin C Desai, “An Introduction to Database Systems”, Galgotia Publications Pvt Limited, Revised edition 2012.

20ITE05	WEB INTERFACE DESIGN AND DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

The course will enable the students to understand the basic concepts of web designing, CSS, Java script, JQuery and familiarized with designing web pages.

COURSE CONTENT

HTML5

Introduction, New Elements, Canvas, SVG, Drag/Drop, Geolocation, Video, Audio, Input Types, Form Elements, Attributes, Semantic, Web Storage, App Cache, Web Workers, SSE.

Cascading Style Sheets

Introduction, Syntax, Id & Class, Backgrounds, Text, Fonts, Links, Lists, Tables, Box Model, Border, Outline, Margin, Padding, Grouping/Nesting, Dimension, Display, Positioning, Floating, Align, Pseudo-class, Pseudo-element, Navigation Bar.

Radial Gradients of Cascading Style Sheets

Image Gallery, Image Opacity, Image Sprites, Media Types, Animations, Attribute Selectors, CSS3 Introduction, Gradients, Text Effects, Fonts, 2D Transforms, 3D Transforms, Transitions, Animations, Multiple Columns.

JavaScript

Introduction, Comment, Variable, Global Variable, Data Types, Operators, If Statement, Switch, Loop: for and while, Function, Objects, Array, Browser Object Model, Validation.

JQuery

Introduction, Selectors, Events, CSS Classes, Dimensions.

COURSE OUTCOMES

- **CO1:** Create and validate HTML/XHTML documents
- **CO2:** Use Cascading Style Sheets as a presentation technology.
- **CO3:** Understand the radial gradients of CSS.
- **CO4:** Design and implement a simple web page using JavaScript and JQuery.
- **CO5:** Construct a website to include Client-side programming with JavaScript.

REFERENCES

1. Harvey Deitel, Abbey Deitel, Internet and World Wide Web: How to Program 5th Edition, Pearson Education 2012.
2. DJ Editorial Services, "HTML5 Black Book", 2nd Edition, Dream tech Press 2016.
3. Thomas A.Powell, HTML & CSS: The Complete Reference, 5th Edition, Tata McGraw-Hill 2010.
4. Thomas A.Powell and Fritz Schneider, JavaScript: The Complete Reference, 3rd Edition, Tata McGraw-Hill, 2013.
5. Thomas A.Powell, Web Design: The Complete Reference, 2nd Edition, Tata McGraw-Hill, 200

20ITE06	INTRODUCTION TO DATA STRUCTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

The course will enable the student to learn basic and advanced concepts related to linear data structures such as lists, stack, queue and non-linear data structures like trees and graphs. It also provides an outline of various sorting, searching and storage techniques.

COURSE CONTENT

Preliminaries of Data Structures

Basic Terminology- Algorithms: Complexity, Time-Space tradeoff – Algorithmic Notations – Complexity of Algorithms

Arrays and Linked Lists

Linear Arrays – Traversing Linear Arrays – Inserting and Deleting – Linked Lists -Traversal - Search- Insertion, Deletion – Two-way Lists

Stacks, Queues and Recursion

Stacks: Array Representation, Linked Representation – Arithmetic Expressions – Applications: Recursion, Tower of Hanoi – Queues – Linked Representation of Queues – Priority Queues

Trees and Graphs

Tree Terminology - Binary Trees: Representation – Binary Search Trees: Search, Insertion, Deletion – AVL Search Trees: Insertion, Deletion – Heap – Heapsort – Graph Terminology – Graph Representations: Adjacency Matrix, Path Matrix –Shortest Paths (Dijkstra's Algorithm)- Topological Sort – Minimum Spanning Trees (Prim's Algorithm and Kruskal's Algorithm)

Sorting and Searching

Sorting – Insertion Sort – Selection Sort – Radix Sort – Searching and Data Modification - Hashing

COURSE OUTCOMES

- **CO1:** Apply appropriate data structures and abstract data types (ADT) such as lists, stacks, queues, trees and graphs in problem solving.
- **CO2:** Analyze the performance of different implementations of data structures.
- **CO3:** Determine appropriate ADTs and data structures for various sorting and searching algorithms.
- **CO4:** Determine time and space requirements of common sorting and searching algorithms.
- **CO5:** Describe a simple hash function.

REFERENCES

1. Seymour Lipschutz, “Data Structures with C”, McGraw Hill, 1st Edition, 2017.
2. John Hubbard, “Data Structures with C++”, McGraw Hill, 1st Edition, 2017.
3. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, Pearson Education, 2nd Edition, 2014.
4. Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum, “Data Structures using C and C++”, Pearson, 2nd Edition, 2015.
5. Venkatesan R and Lovelyn Rose S, “Data Structures”, Wiley, 2nd Edition, 2019.

20ITE07	PRINCIPLES OF SOFTWARE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

The course will enable the students with the understanding of software engineering processes such as requirement modeling, design, testing etc. and experiential learning opportunities to apply that knowledge to solve real-world problems.

COURSE CONTENT

Software Process and Agile Development

Introduction to Software Engineering – Process Model: Perspective process models- Specialized process models- The unified process - Personal and Team Process Models- Agile Process- Other Agile Process Models.

Requirements Modeling

Functional and non-functional requirements – User Requirements – System requirements - Interface specification - The software requirements document - Requirements engineering processes

Design Concepts

Architectural design: Architectural design decisions - System organization - Modular decomposition styles - Control styles - Reference architectures.

Testing

Software Testing Fundamentals - System testing - Component testing - Test case design - Test automation.

Project management

Management activities - Project planning - Project scheduling - Risk management.

COURSE OUTCOMES

CO1: Understand the various software process models.

CO2: Apply the requirement specifications and appropriate software design methodology for a given scenario.

CO3: Understand the various architectural styles of software.

CO4: Compare and contrast various testing measures.

CO5: Acquire the knowledge of managing, modern and future software projects.

REFERENCES

1. Ian Sommerville, “Software Engineering”, Pearson Education Asia, 10th Edition, 2017.
2. Roger S Pressman, Bruce R Maxim, “Software Engineering - A Practitioner’s Approach”, McGraw-Hill Education, 8th Edition, 2019.
3. Rajib Mall, “Fundamentals of Software Engineering”, PHI Learning, 4th Edition, 2014
4. Pankaj Jalote, “Software Engineering: A Precise Approach”, Wiley India, 2010.
5. Shari Lawrence Pfleeger, “Software Engineering Theory and Practice”, Pearson Education, 4th Edition, New Delhi, 2009.