P. A. COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution, Affiliated to Anna University, Chennai)
An ISO 9001:2015 Certified Institution - Accredited by NBA and NAAC with 'A' Grade
Pollachi – 642 002

B. E. ELECTRICAL AND ELECTRONICS ENGINEERING

CURRICULA AND SYLLABI

(I to VIII Semester)

REGULATIONS

2019

Vision and Mission of the Institute and Department

Vision of the Institute

To progress to become a center of excellence in Engineering and Technology through creative and innovative practices in teaching-learning process and promoting research and development to produce globally competitive and employable professionals who are psychologically strong and emotionally balanced with social perception and professional ethics.

Mission of the Institute

To offer academic programmes, in the emerging areas of Engineering and Technology, provide training and research facilities and opportunities to promote student and faculty research in collaboration with Industry and Government for sustainable growth.

Vision of the Department

The department of Electrical and Electronics Engineering serves the state and the nation by creating high quality engineers and also continuously pursuing quality research, preserving technical knowledge to make them competent.

Mission of the Department

The department of Electrical and Electronics Engineering fortifies the Mission by enriching the student's technical knowledge and learn to apply it, enhance their technical skills and transfer student into good engineer by contributing research for growth of society.

Program Educational Objectives (PEO)

The objectives of the programme are to provide the following to the students:

PEO 1: To provide strong foundation in basic science, mathematics and electrical engineering necessary to formulate, solve and analyze electrical and electronics problems.

PEO 2: To prepare successful career in industry and motivation for higher education.

PEO 3: To provide awareness among the students for lifelong learning and to inculcate professional ethics.

Program Specific Outcomes (PSO):

The following outcomes of the programme are provided to the students:

PSO 1: Ability to understand, model, analyze and design of electrical science and apply them to electrical and electronics engineering problems.

PSO 2: Ability to review, prepare and present technological developments.

PSO 3: Ability to exhibit a commitment to professional and ethical practices, and prepare themselves for lifelong learning.

Program Outcomes (POs):

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/Development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

SEMESTER I

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
		Induction Programme	0	0	0	0
THEORY						
1	19CAHS001	Communicative English	3	0	0	3
2	19CABS001	Engineering Mathematics-I	3	1	0	4
3	19CABS003	Engineering Physics	3	0	0	3
4	19CAES003	Programming for problem solving	3	0	0	3
PRACTICAL						
5	19CAES005	Workshop Practice	0	0	4	2
6	19CABS004	Physics Laboratory	0	0	3	1.5
7	19CAES006	Programming in C Laboratory	0	0	3	1.5
		Total	**12**	**1**	**10**	**18**

SEMESTER II

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	19CABS006	Engineering Chemistry	3	0	0	3
2	19CABS007	Engineering Mathematics-II	3	1	0	4
3	19EEES203	Basics of Civil and Mechanical Engineering	3	0	0	3
4	19CAES007	Engineering Graphics	2	0	4	4
5	19CAPC001	Electric Circuit Analysis	3	1	0	4
PRACTICAL						
6	19CABS005	Chemistry Laboratory	0	0	3	1.5
7	19EEPC207	Electrical Appliances Laboratory	0	0	3	1.5
		Total	**14**	**2**	**10**	**21**

SEMESTER III

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	19CABS008	Transforms and Partial Differential Equations	3	0	0	3
2	19EEPC302	Electromagnetic Theory	3	1	0	4
3	19EEPC303	Electronic Devices and Circuits	3	0	0	3
4	19EEPC304	DC Machines and Transformers	3	0	0	3
5	19EEPC305	Linear Integrated Circuits and Applications	3	0	0	3
6	19CAHS002	Environmental Science and Engineering	3	0	0	3
PRACTICAL						
7	19EEPC307	Electric Circuits and Electronic Devices Laboratory	0	0	3	1.5
8	19EEPC308	DC Machines and Transformers Laboratory	0	0	3	1.5
		Total	**18**	**1**	**6**	**22**

SEMESTER IV

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	19CABS009	Numerical Methods	3	0	0	3
2	19EEPC402	Networks and Synthesis	3	0	0	3
3	19EEPC403	Digital Logic Circuits	3	0	0	3
4	19EEPC404	Synchronous and Induction Machines	3	0	0	3
5	19EEES405	Object Oriented Programming with C++	3	0	0	3
6	19EEES406	Power Plant Engineering	3	0	0	3
PRACTICAL						
7	19EEPC407	Analog Circuits and Digital IC Laboratory	0	0	3	1.5
8	19EEPC408	Synchronous and Induction Machines Laboratory	0	0	3	1.5
9	19EEES409	Object Oriented Programming Using C++ Laboratory	0	0	3	1.5
		Total	**18**	**0**	**9**	**22.5**

SEMESTER V

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	19EEPC501	Transmission and Distribution	3	0	0	3
2	19EEPC502	Microprocessors and Microcontrollers	3	0	0	3
3	19EEPC503	Control Systems	3	1	0	4
4	19EEPC504	Electrical Machine Design	3	0	0	3
5	19EEPC505	Measurements and Instrumentation	3	0	0	3
6		Open Elective I	3	0	0	3
PRACTICAL						
7	19EEPC506	Microprocessors and Microcontrollers Laboratory	0	0	3	1.5
8	19EEPC507	Measurements and Control Systems Laboratory	0	0	3	1.5
		Total	**18**	**1**	**6**	**22**

SEMESTER VI

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	19EEHS601	Technology Management	3	0	0	3
2	19EEPC602	Power System Analysis	3	0	0	3
3	19EEPC603	Power Electronics	3	0	0	3
4		Open Elective II	3	0	0	3
5	19EEPE6XX	Professional Elective I	3	0	0	3
6	19EEPE6XX	Professional Elective II	3	0	0	3
PRACTICAL						
7	19EEPC604	Power Electronics and Drives Laboratory	0	0	3	1.5
8	19CAHS003	Communication Skills Laboratory	0	0	2	1
		Total	**18**	**0**	**5**	**20.5**

SEMESTER VII

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	19EEPC701	Renewable Energy Systems	3	0	0	3
2		Open Elective III	3	0	0	3
3	19EEPE7XX	Professional Elective III	3	0	0	3
4	19EEPE7XX	Professional Elective IV	3	0	0	3
5	19EEPE7XX	Professional Elective V	3	0	0	3
6	19EEMC702	Constitution of India	3	0	0	0
PRACTICAL						
7	19EEPC703	Power System & Renewable Energy Laboratory	0	0	4	2
8	19EEEE704	Mini Project	0	0	4	2
		Total	**18**	**0**	**8**	**19**

SEMESTER VIII

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	19CAHS004	Professional Ethics in Engineering	3	0	0	3
2		Open Elective IV	3	0	0	3
3	19EEPE8XX	Professional Elective VI	3	0	0	3
PRACTICAL						
4	19EEEE802	Project Work	0	0	16	8
		Total	**9**	**0**	**16**	**17**

Total Credits: 18+21+22+22.5+22+20.5+19+17=162

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT (HS)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19CAHS001	Communicative English	3	0	0	3
2	19CAHS002	Environmental Science and Engineering	3	0	0	3
3	19EEHS601	Technology Management	3	0	0	3
4	19CAHS003	Communication Skills Laboratory	0	0	2	1
5	19CAHS004	Professional Ethics in Engineering	3	0	0	3

BASIC SCIENCES (BS)

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19CABS001	Engineering Mathematics-I	3	1	0	4
2	19CABS003	Engineering Physics	3	0	0	3
3	19CABS004	Physics Laboratory	0	0	3	1.5
4	19CABS005	Chemistry Laboratory	0	0	3	1.5
5	19CABS006	Engineering Chemistry	3	0	0	3
6	19CABS007	Engineering Mathematics-II	3	1	0	4
7	19CABS008	Transforms and Partial Differential Equations	3	0	0	3
8	19CABS009	Numerical Methods	3	0	0	3

ENGINEERING SCIENCES (ES)

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19CAES003	Programming in C	3	0	0	3
2	19CAES005	Workshop Practice	0	0	4	2
3	19CAES006	Programming in C Laboratory	0	0	3	1.5
4	19EEES203	Basics of Civil and Mechanical Engineering	3	0	0	3
5	19CAES007	Engineering Graphics	2	0	4	4
6	19EEES405	Object Oriented Programming with C++	3	0	0	3
7	19EEES406	Power Plant Engineering	3	0	0	3
8	19EEES409	Object Oriented Programming Using C++ Laboratory	0	0	3	1.5

PROFESSIONAL CORES (PC)

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19CAPC001	Electric Circuit Analysis	3	1	0	4
2	19EEPC207	Electrical Appliances Laboratory	0	0	3	1.5
3	19EEPC302	Electromagnetic Theory	3	1	0	4
4	19EEPC303	Electronic Devices and Circuits	3	0	0	3
5	19EEPC304	DC Machines and Transformers	3	0	0	3
6	19EEPC305	Linear Integrated Circuits and Applications	3	0	0	3
7	19EEPC307	Electric Circuits and Electronic Devices Laboratory	0	0	3	1.5
8	19EEPC308	DC Machines and Transformers Laboratory	0	0	3	1.5
9	19EEPC402	Networks and Synthesis	3	0	0	3
10	19EEPC403	Digital Logic Circuits	3	0	0	3
11	19EEPC404	Synchronous and Induction Machines	3	0	0	3
12	19EEPC407	Analog Circuits and Digital IC Laboratory	0	0	3	1.5
13	19EEPC408	Synchronous and Induction Machines Laboratory	0	0	3	1.5
14	19EEPC501	Transmission and Distribution	3	0	0	3
15	19EEPC502	Microprocessors and Microcontrollers	3	0	0	3
16	19EEPC503	Control Systems	3	1	0	4
17	19EEPC504	Electrical Machine Design	3	0	0	3
18	19EEPC505	Measurements and Instrumentation	3	0	0	3
19	19EEPC506	Microprocessors and Microcontrollers Laboratory	0	0	3	1.5
20	19EEPC507	Measurements and Control Systems Laboratory	0	0	3	1.5
21	19EEPC602	Power System Analysis	3	0	0	3
22	19EEPC603	Power Electronics	3	0	0	3
23	19EEPC604	Power Electronics and Drives Laboratory	0	0	3	1.5
24	19EEPC701	Renewable Energy Systems	3	0	0	3
25	19EEPC703	Power System & Renewable Energy Laboratory	0	0	4	2

PROFESSIONAL ELECTIVES (PE) – I (SEMESTER VI)

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19EEPE601	Principles of Virtual Instrumentation	3	0	0	3
2	19EEPE602	Neural and Fuzzy Systems	3	0	0	3
3	19EEPE603	Power System Economics	3	0	0	3
4	19EEPE604	Power Quality Engineering	3	0	0	3
5	19EEPE605	Automotive Electronics for Electrical Engineering	3	0	0	3

PROFESSIONAL ELECTIVES (PE) – II (SEMESTER VI)

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19EEPE606	HVDC Transmission System	3	0	0	3
2	19EEPE607	FACTS Controllers	3	0	0	3
3	19EEPE608	Energy Auditing and Management	3	0	0	3
4	19EEPE609	Digital Signal Processing	3	0	0	3
5	19EEPE610	Computer System Architecture	3	0	0	3

PROFESSIONAL ELECTIVES (PE) – III (SEMESTER VII)

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19EEPE701	Power System Stability	3	0	0	3
2	19EEPE702	Power Plant Instrumentation	3	0	0	3
3	19EEPE703	Logic and Distributed Control Systems	3	0	0	3
4	19EEPE704	Restructured Power System	3	0	0	3
5	19EEPE705	Special Machines and Controllers	3	0	0	3

PROFESSIONAL ELECTIVES (PE) – IV (SEMESTER VII)

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19EEPE706	Principles of Embedded Systems	3	0	0	3
2	19EEPE707	MEMS and Applications	3	0	0	3
3	19EEPE708	Biomedical Instrumentation	3	0	0	3
4	19EEPE709	Industrial Drives and Control	3	0	0	3
5	19EEPE710	Energy Storage Technology	3	0	0	3

PROFESSIONAL ELECTIVES (PE) – V (SEMESTER VII)

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19EEPE711	Solid State Relays	3	0	0	3
2	19EEPE712	Computer Aided Design of Electrical Apparatus	3	0	0	3
3	19EEPE713	Smart Grid Technology	3	0	0	3
4	19EEPE714	Modern Control Theory	3	0	0	3
5	19EEPE715	Power System Transients	3	0	0	3

PROFESSIONAL ELECTIVES (PE) – VI(SEMESTER VIII)

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19EEPE801	Optimization Techniques	3	0	0	3
2	19EEPE802	Distributed Generation and Micro Grid	3	0	0	3
3	19EEPE803	Power System Dynamics	3	0	0	3
4	19EEPE804	Microcontroller Based System Design	3	0	0	3
5	19EEPE805	Power System Operation, Control and Protection	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EE)

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	19EEEE704	Mini Project	0	0	4	2
2.	19EEEE802	Project Work	0	0	16	8

OPEN ELECTIVES (OE)

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	19CAOE01	Geographical Information System	3	0	0	3
2.	19CAOE02	Green Buildings	3	0	0	3
3.	19CAOE03	Planning of Smart Cities	3	0	0	3
4.	19CAOE04	Vastu Science for Building Construction	3	0	0	3
5.	19CAOE05	Disaster Management and Mitigation	3	0	0	3
6.	19CAOE06	Open Source Technologies	3	0	0	3
7.	19CAOE07	Ethical Hacking	3	0	0	3
8.	19CAOE08	Internet of Things	3	0	0	3

9.	19CAOE09	Software Testing	3	0	0	3
10.	19CAOE10	User Interface Design	3	0	0	3
11.	19CAOE11	Automotive Electronics	3	0	0	3
12.	19CAOE12	Hardware Descriptive Language	3	0	0	3
13.	19CAOE13	Embedded System Design using ARM Processor	3	0	0	3
14.	19CAOE14	Bioinspired Computing Technologies	3	0	0	3
15.	19CAOE15	Vehicular Communication and Networking Technology	3	0	0	3
16.	19CAOE16	Energy Efficient Lighting System	3	0	0	3
17.	19CAOE17	Sensors and Transducers	3	0	0	3
18.	19CAOE18	Electrical Safety	3	0	0	3
19.	19CAOE19	Electric Vehicles	3	0	0	3
20.	19CAOE20	SCADA System and Application Management	3	0	0	3
21.	19CAOE21	Testing of Materials	3	0	0	3
22.	19CAOE22	Robotics	3	0	0	3
23.	19CAOE23	Industrial Engineering	3	0	0	3
24.	19CAOE24	Marketing Management	3	0	0	3
25.	19CAOE25	Energy Conservation and Management	3	0	0	3

MANDATORY COURSE (MC) (NO – CREDIT)

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19EEMC702	Constitution of India	3	0	0	0

VALUE ADDED COURSES (VA)

Sl.No.	SUBJECT CODE	COURSE TITLE	CREDITS			
			L	T	P	C
1	19EEVAX01	Yoga and Youth Empowerment	1	0	0	1
2	19EEVAX02	Electrical Wiring, Winding and Earthing, Repairing of Household Appliances	1	0	0	1
3	19EEVAX03	IOT applications	1	0	0	1
4	19EEVAX04	JAVA programming	1	0	0	1
5	19EEVAX05	PCB Design and Fabrication	1	0	0	1
6	19EEVAX06	Home Automation	1	0	0	1
7	19EEVAX07	Simulation Tools for Electrical Engineers	1	0	0	1
8	19EEVAX08	PLC Automation	1	0	0	1
9	19EEVAX09	Study of Weather Monitoring System	1	0	0	1
10	19EEVAX10	Online Course (NPTEL)	1	0	0	1

SUMMARY OF CREDIT DISTRIBUTION

S. No.	Course Work Subject Area	Credits Per Semester								Total Credits	% of credit	Credit Range	
		I	II	III	IV	V	VI	VII	VIII			PA	AICTE
1	HS	3	-	3	-	-	4	-	3	**13**	8.02	**13**	12
2	BS	8.5	8.5	3	3	-	-	-	-	**23**	14.20	**23**	26
3	ES	6.5	7	-	7.5	-	-	-	-	**21**	12.96	**21**	20
4	PC	-	5.5	16	12	19	7.5	5	-	**65**	40.13	**65**	53
5	PE	-	-	-	-	-	6	9	3	**18**	11.11	**18**	18
6	OE	-	-	-	-	3	3	3	3	**12**	7.41	**12**	18
7	EE	-	-	-	-	-	-	2	8	**10**	6.17	**10**	11
8	MC	0	-	-	-	-	-	0	-	**0**	-	**0**	-
	Total	**18**	**21**	**22**	**22.5**	**22**	**20.5**	**19**	**17**	**162**	100	**162**	158

BS – Basic Sciences ; HS – Humanities and Social Sciences including Management ;

ES – Engineering Sciences ; PC – Professional Cores; PE – Professional Electives ;

OE – Open Electives; EE– Employability Enhancement Courses ;

MC – Mandatory Courses; VA-Value Added Courses

INDUCTION PROGRAMME **SEMESTER I**

Number of Days **21 Days**

Activities:

- Physical activity
- Creative Arts
- Universal Human Values
- Literary
- Proficiency Modules
- Lectures by Eminent People
- Visits to local Areas
- Familiarization to Dept./Branch & Innovations

19CAHS001 COMMUNICATIVE ENGLISH SEMESTER I

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To make learners acquire listening skills with correct pronunciation, stress and Intonation.
- To emphasize the development of speaking skills amongst the learners of Engineering.
- To inculcate the habit of reading for effective and efficient communication.
- To equip the learners with writing skills needed for academic as well as work place contexts.
- To enable learners to fine-tune their linguistic skills with appropriate grammatical usage.

UNIT-I: LISTENING 9

Listening Comprehension, Pronunciation, Intonation, Stress, Pause, Rhythm, Listening to Short & Long Conversations/Monologues- Note -Taking.

UNIT-II: SPEAKING 9

Self Introduction, Making Oral & Formal Presentation, Communication at Work Place, Mock Interviews, Role Play Activities, Group Discussions, Debates, Delivering Welcome Address, Proposing Vote of Thanks, Introducing the Chief Guest at a function.

UNIT-III: READING 9

Reading Comprehension, Speed Reading, Interpreting Visual Materials (Signs, Post Cards, Pictures, and Labels Etc), Reading for Specific Information, Reading to identify Stylistic Features (Syntax, Lexis and Sentence Structures), Cloze Test.

UNIT-IV: WRITING 9

Phrase, Clause and Sentence Structures, Punctuation, Discourse Markers, Coherence, Precision in Writing, Graph & Process Description, Definition, Writing E-mail, Paraphrasing, Note-making, Job Application with Resume, Writing Review of a Book/Movie, Creative Writing.

UNIT-V: GRAMMAR AND VOCABULARY 9

Word Formation with Prefix and Suffix, Synonyms and Antonyms, Tenses, Parts of Speech, Common Errors in English (Subject-Verb Agreement, Noun-Pronoun Agreement, Prepositions, Articles, Conditional statements, Redundancies, Clichés etc), Voices.

Contact periods:

Lecture:45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Board of Editors, Using English, Orient Black Swan, 2015.
2. Practical English Usage, Michael Swan, OUP 1995.
3. Cambridge BEC Vantage Practice Tests, Self-study Edition, CUP, 2002.
4. Exercises in Spoken English. Parts 1-II, EFLC, Hyderabad, OUP, 2014.
5. Indlish. Jyothi Sanyal, Viva Books, 2006.
6. Communicative English. J. Anbazhagan Vijay, Global Publishers, Chennai 2018.

WEB REFERENCES:

1. www.cambridgeenglish.org/exams/
2. www.examenglish.com/BEC/BEC_Vantage.html
3. www.splendid-speaking.com/exams/bec_ speaking.html

COURSE OUTCOMES:

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

CO1: Listen and comprehend the contexts delivered in English

CO2: Speak clearly, confidently, comprehensively and communicate with one or many listeners using appropriate communicative strategies

CO3: Read different genres of texts adopting various reading strategies

CO4: Write effectively and persuasively to enhance students' employability

CO5: Communicate cohesively, coherently and flawlessly avoiding grammatical errors and using a wide vocabulary range in speaking and writing contexts

19CABS001 ENGINEERING MATHEMATICS-I SEMESTER I

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To be familiarize with differentiation of single variable and its applications.
- To acquire knowledge of differentiation for more than one variable and its applications.
- To obtain the knowledge of definite and improper integration.
- To acquire the knowledge of multiple integration and related applications.
- To gain methods to solve differential equations with constant and variable coefficients.

UNIT-I: DIFFERENTIAL CALCULUS 9+3

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable.

UNIT -II: FUNCTIONS OF SEVERAL VARIABLES 9+3

Partial differentiation - Homogeneous functions and Euler‘s theorem - Total derivative - Change of variables - Jacobians - 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-III: INTEGRAL CALCULUS 9+3

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

UNIT-IV: MULTIPLE INTEGRALS 9+3

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

UNIT-V: DIFFERENTIAL EQUATIONS 9+3

Higher order linear differential equations with constant coefficients - Method of variation of parameters - Homogenous equation of Euler‘s and Legendre‘s type - System of simultaneous linear differential equations with constant coefficients - Method of undetermined coefficients.

Contact periods:

Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods

REFERENCES:

1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publisher, 43rd Edition, 2010.
2. James Stewart., "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.
3. Anton H, Bivens I and Davis S., "Calculus", Wiley, 10th Edition, 2016.
4. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 3rd Edition, 2007.
5. Narayanan, S. and Manicavachagom Pillai, T. K., “Calculus" Volume I and II, S.Viswanathan Publishers Pvt. Ltd., Chennai, 2007.

6. Srimantha Pal and Bhunia, S.C., "Engineering Mathematics" Oxford University Press, 2015.

COURSE OUTCOMES:

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

CO1: Understand the limit definition and rules of differentiation to differentiate functions.

CO2: Apply differentiation to solve maxima and minima problems.

CO3: Evaluate integrals using techniques of integration, such as substitution, partial fraction and integration by parts.

CO4: Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.

CO5: Apply various techniques in solving differential equations.

19CABS003 **ENGINEERING PHYSICS** **SEMESTER I**

L T P C

3 0 0 3

COURSE OBJECTIVES:

- To acquire knowledge on Wave optics phenomenon, Huygens' principle and Interference of light.
- To understand the basic principles in lasers, characteristics, types of lasers and its applications.
- To accustom the student about origin of quantum physics, Schrodinger's equation and its applications.
- To know about free electron theory, density of states in metals, Intrinsic and Extrinsic properties.
- To acquaint the student with the concepts of Fiber optic principles and its applications.

UNIT-I: WAVE OPTICS **9**

Huygens" Principle - superposition of waves and interference of light - Air wedge - Theory - Applications - Testing of flat surfaces - Thickness of a thin sheet of paper - Michelson interferometer - Theory - Applications - Determination of wavelength of monochromatic light.

UNIT-II: LASER OPTICS **9**

Einstein's theory of matter - radiation interaction and A and B coefficients - amplification of light by population inversion - different types of lasers - gas laser - $C0_2$ - solid state laser - Neodymium Nd -YAG laser - dye laser - properties of laser beams - monochromaticity - coherence - directionality and brightness - Applications of lasers in cutting, welding and materials processing.

UNIT-III: INTRODUCTION TO QUANTUM MECHANICS **9**

Limitations of classical Physics - Introduction to Quantum theory - Dual nature of matter and radiation - Properties of matter waves - de Broglie wavelength in terms of voltage, energy, and temperature - Heisenberg's Uncertainty principle - verification - physical significance of wave function - Schrodinger's Time independent and Time dependent wave equations - Particle in a one dimensional potential well.

UNIT-IV: INTRODUCTION TO SOLIDS AND SEMICONDUCTORS **9**

Quantum theory - Fermi distribution function - effect of temperature - density of energy states in metals - Semiconductors - Properties - elemental and compound semiconductors - Intrinsic and extrinsic semiconductors - properties - Carrier concentration in intrinsic Semiconductor - variation of Fermi level with temperature - extrinsic semiconductors - Carrier concentration in P type and N type semiconductors - variation of Fermi level with temperature and impurity concentration.

UNIT-V: FIBER OPTICS **9**

Introduction - Basic Principles involved in fiber optics - Total internal reflection - Structure of optical fiber - Propagation of light through optical fiber - Derivation for Numerical Aperture and acceptance angle - fractional index change - Classification of optical fiber based on materials, refractive index profile and Modes - Fiber optical communication links - Fiber optic sensors - Temperature and displacement.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Avadhanulu M. N. and Kshirsagar P. G, "A Textbook of Engineering Physics", S.Chand and Company Ltd, New Delhi, 2010.
2. Hecht E, "Optics", McGraw Hill Education, 2012.
3. Griffiths D.J, "Quantum mechanics", Pearson Education, 2014.
4. Neamen, D.A. "Semiconductor Physics and Devices, Times Mirror High Education Group Chicago, 1997.
5. Pain H.J, "The physics of vibrations and waves", Wiley, 2006.
6. Svelto O, "Principles of Lasers", Springer Science & Business Media, 2010.

COURSE OUTCOMES:

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

CO1: Understand waves and optics phenomena and their applications

CO2: Analyze the construction and working of gas lasers and solid-state lasers

CO3: Be familiar with the dual nature of matter using de-Broglie matter waves, Heisenberg's Uncertainty principle, Schrodinger's time independent and dependent wave equations

CO4: Know about the properties of conducting and semiconducting materials anddevices

CO5: Gain knowledge about fiber optics and classify fibers based on index profiles and modes

19CAES003 PROGRAMMING FOR PROBLEM SOLVING SEMESTER I

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To develop C Programs using basic programming constructs
- To develop C programs using arrays and strings
- To develop applications in C using functions and pointers.
- To develop program in C using structures and union.
- To perform file handling operations in C and learn dynamically allocated memory techniques.

UNIT-I: BASICS OF C PROGRAMMING 11

Generation and Organization of Computers - Number System - Binary - Decimal - Conversion - Problems. Need for logical analysis and thinking - Algorithm - Pseudo code - Flow Chart. Introduction to programming paradigms: Structure of C program - Data Types - Constants - Enumeration Constants - Keywords - Operators and Expressions - Input / Output statements.

UNIT-II: ARRAYS AND STRINGS 9

Decision making statements - Switch statement - Looping statements - Arrays - Initialization - Declaration - One dimensional and Two dimensional arrays - String: String operations - String Arrays - Simple programs: Sorting - Searching - Matrix operations.

UNIT-III: FUNCTIONS AND POINTERS 9

Introduction to functions: Function prototype, function definition, function declaration, function call, Built-in functions (string functions, math functions) - Recursion - Pointers - Pointer operators - Pointer arithmetic - Arrays and pointers - Array of pointers - Parameter passing: Pass by value, Pass by reference.

UNIT-IV: STRUCTURES AND UNION 9

Structure - Nested structures - Pointer and Structures - Array of structures - Example Program using structures and pointers - Self referential structures - Union - Programs using structures and Unions -Enumeration types - Bit fields -typedefs - Dynamic memory allocation - Storage classes.

UNIT-V: FILE PROCESSING 7

Files: File opening modes - Types of file processing: Sequential access, Random access - Preprocessor directives - Command line arguments.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
2. ReemaTheraja "Fundamentals of Computing and Programming in C", Second Edition, Oxford University Press, 2016
3. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 15th revised edition, 2016.
4. Dawn Griffiths, David Griffiths, "Head First C", O'Reilly Publishers, 2012.
5. Paul J. Deitel and Harvey Deitel, "C How to Program", 7th ed., Pearson Education, 2013.

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to:

CO1: Develop simple applications in C using basic constructs
CO2: Design and implement applications using arrays and strings
CO3: Develop and implement applications in C using functions and pointers.
CO4: Develop applications in C using structures and union.
CO5: Design applications using sequential and random-access file processing.

19CAES005 WORKSHOP PRACTICE SEMESTER I

L T P C
0 0 4 2

COURSE OBJECTIVES:

- To provide exposure to the students with hands on various basic engineering practices in Civil, Mechanical and Electrical Engineering.
- To make various basic prototypes in the carpentry trade such as Lap joint, Lap Tee joint, Dove tail joint, Mortise & Tenon and Cross-Lap joint.
- To make various Welding joints and sand mould preparation for various patterns
- To prepare electrical wirings.
- To fabricate various parts like tray, frustum of cone and square box in sheet metal

LIST OF EXPERIMENTS

1. Introduction to use of tools and equipments in Carpentry, Welding, Foundry and Sheet Metal
2. Safety aspects in Carpentry, Welding and Foundry
3. Half lap Joint and Dove tail Joint in Carpentry
4. Welding of Lap joint, Butt joint and T-joint
5. Preparation of Sand mould for cube, conical bush, pipes and V pulley
6. Fabrication of parts like tray, frustum of cone and square box in sheet metal
7. Electrical wiring - simple house wiring
8. Plumbing
9. CNC Machines demonstration and lecture on working principle.
10. Additive manufacturing demonstration and lecture on working principle.

Contact periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 60 Periods

COURSE OUTCOMES:

Upon on completion of this course, the student will be able to

CO1: Use a variety of the tools and equipment used in sheet metal, welding, foundries, and carpentry.

CO2: Fabricate basic carpentry prototypes such as the lap joint, lap tee joint, dovetail joint, mortise and Tenon, and cross-lap joint.

CO3: Prepare various Welding joints and sand moulds for various patterns.

CO4: Carry out basic home electrical works and appliances and pipe connections including plumbing woks

CO5: Sheet metal fabrication of various parts such as tray, frustum of cone, and square box

19CABS004 PHYSICS LABORATORY SEMESTER I

L T P C
0 0 3 1.5

COURSE OBJECTIVES:

- To understand the physical and thermal properties of matter.
- To calibrate the electrical devices, Laser diffraction and parameters of optical fibers.
- To determine the compressibility of liquids and viscosity of liquids.
- To analyze the band gap energy of semiconductors and thickness of paper.
- To determine the spectral wavelength and dispersive power of prism.

LIST OF EXPERIMENTS

1. Young's Modulus - Cantilever Bending - Koenig's Method
2. Torsional pendulum - Determination of Rigidity Modulus & Moment of Inertia
3. Young's Modulus - Non Uniform bending Method
4. Lee's Disc method - Thermal conductivity of a bad conductor
5. Ammeter and Voltmeter Calibration - Low Range
6. a) Laser - Particle size Determination
   b) Optical fiber - Determination of NA & Acceptance angle
7. Ultrasonic Interferometer - Velocity of sound & Compressibility of liquids
8. Poiseuille's method - Determination of Coefficient of viscosity of a liquid
9. Determination of Bandgap Energy of Semiconductor
10. Air Wedge - Determination thickness of a paper
11. Spectrometer - Diffraction Grating - Normal Incidence Method
12. Spectrometer - Determination of Dispersive power of a prism

Contact periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

CO1: Determine the physical and thermal properties of matter

CO2: Calibrate electrical measuring instruments and thereby effectively using it for electronic application and understanding the principle of Laser diffraction and propagation through optical fibers and determine its parameters

CO3: Understand the ultrasonic wave propagation in liquids and determine the viscosity of liquids for engineering applications

CO4: Determine the band gap energy of semiconductor materials and thickness of paper

CO5: Identify the spectral wavelength and determine the dispersive power of prism

19CAES006 PROGRAMMING IN C LABORATORY SEMESTER I

L T P C
0 0 3 1.5

COURSE OBJECTIVES:

- To develop programs in C using basic constructs.
- To develop applications in C using strings, pointers, functions, structures.
- To develop applications in C using file processing.

LIST OF EXPERIMENTS:

1. Programs using I/O statements and expressions.
2. Programs using decision-making constructs.
3. Write a program to find whether the given year is leap year or Not? (Hint: not every centurion year is a leap. For example 1700, 1800 and 1900 is not a leap year)
4. Design a calculator to perform the operations, namely, addition, subtraction, multiplication, division and square of a number.
5. Check whether a given number is Armstrong number or not?
6. Given a set of numbers like <10, 36, 54, 89, 12, 27>, find sum of weights based on the following conditions:
   i. 5 if it is a perfect cube.
   ii. 4 if it is a multiple of 4 and divisible by 6.
   iii. 3 if it is a prime number.

   Sort the numbers based on the weight in the increasing order as shown below
   <10,its weight>,<36,its weight><89,its weight>
7. Populate an array with height of persons and find how many persons are above the average height.
8. Populate a two dimensional array with height and weight of persons and compute the Body Mass Index of the individuals.
9. Given a string ―a$bcd./fg‖ find its reverse without changing the position of special characters.
   (Example input:a@gh%;j and output:j@hg%;a)
10. Convert the given decimal number into binary, octal and hexadecimal numbers using user defined functions.
11. From a given paragraph perform the following using built-in functions:
    a. Find the total number of words.
    b. Capitalize the first word of each sentence.
    c. Replace a given word with another word.
12. Solve towers of Hanoi using recursion.
13. Sort the list of numbers using pass by reference.
14. Generate salary slip of employees using structures and pointers.
15. Compute internal marks of students for five different subjects using structures and functions.
16. Insert, update, delete and append telephone details of an individual or a company into a telephone directory using random access file.
17. Count the number of account holders whose balance is less than the minimum balance using sequential access file.
18. **Mini project**
    Create a - Railway reservation system‖ with the following modules

- Booking
- Availability checking
- Cancellation
- Prepare chart

Contact periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
CO1: Develop C programs for simple applications making use of basic constructs, arrays and strings.
CO2: Develop C programs involving functions, recursion, pointers, and structures.
CO3: Design applications using sequential and random access file processing.

19CABS006 ENGINEERING CHEMISTRY SEMESTER II

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the principles of electrochemical reactions, electrode potential and applications of EMF measurements.
- To accustom the student about the principles and generation of energy in different types of batteries.
- To obtain the knowledge on concepts of electrochemical reactions, redox reactions in corrosion of materials and methods for corrosion prevention and protection of materials.
- To acquaint the student with the concepts of important photophysical and photochemical processes and elemental analysis using spectroscopy.
- To develop the advanced engineering materials by using silicon wafer techniques.

UNIT-I: ELECTROCHEMICAL CELLS 9

Galvanic cells - redox reactions - electrodes metal and metal ion, hydrogen electrode and calomel electrode - electrode potentials-standard oxidation and reduction potentials - Nernst equation and problems - EMF series and significance - Application of EMF measurements - pH measurement using glass electrode and fluoride measurement by ISE.

UNIT-II: BATTERIES 9

Batteries - components, characteristics - voltage, current, current capacity, power density, energy density, cycle life, shelf life and self discharge. Types of batteries - Primary - Zn/MnO_2, Zn/HgO, Zn/Ag_2O, $Li/SOCl_2$, construction, function and performance comparison - Secondary lead acid, nickel cadmium and lithium ion battery - construction, function and performance comparison.

UNIT-III: CORROSION 9

Corrosion - spontaneity - chemical corrosion - mechanism, nature of oxides – Pilling - Bedworth rule - electrochemical corrosion - mechanism-galvanic series and importance - prevention methods - design of materials, cathodic protection techniques(sacrificial anode and impressed current cathode), inhibitors - Protective coatings - inorganic coating - electroplating - surface preparation and plating method applied to Cr and Ni and galvanizing - organic coating - paints - constituents and functions.

UNIT-IV: SPECTROSCOPIC TECHNIQUES AND APPLICATIONS 9

Beer-Lambert's law - UV Visible spectroscopy and IR spectroscopy – principles - instrumentation (block diagram only) - Flame photometry-principles - instrumentation (block diagram only) - estimation of sodium by flame photometry - atomic absorption spectroscopy - principles instrumentation(block diagram only)-estimation of Ni by atomic absorption spectroscopy.

UNIT-V: SILICON WAFER TECHNOLOGY 9

Silicon for IC chips - single crystal - preparation by czechralsky and float zone processes - wafer preparation, P-N junction formation - ion implantation, diffusion and epitaxial growth techniques - insulator layer by oxidation - printing of circuits by photolithography - masking and electron beam methods - etching by chemical and electrochemical methods.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Jain P.C. and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publications Pvt. Ltd, New Delhi, 16" Edition, 2017.
2. Dara S.S, Umarae, "Text book of Engineering Chemistry", S. Chand Publications, 2004.
3. Agarwal, C.V, "Chemistry of Engineering Materials", 9" Edition, B.S. Publications, 2006.
4. Kuriakose J.C, and Rajaram J, "Chemistry in Engineering and Technology", vol.1 & I, Tata McGraw Hill Publishing company Pvt. Ltd, New Delhi, 2001.
5. Sharma Y.R,"Elementary Organic Spectroscopy", S. Chand Publications, 2013.
6. Tyagi M.S., "Introduction to semiconductor materials and devices", Wiley India 2012.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to

CO1: Understand the principles of electrochemical cells, EMF measurements and electrode potentials which makes them to apply in experimental instrumentation techniques.

CO2: Know the knowledge about different types of batteries with their functions which is useful for various engineering fields.

CO3: Be familiar with corrosion of the instruments and equipments they use in their field and also to learn the mechanisms and the preventive measures by various techniques.

CO4: Know about the different types of spectroscopic techniques and applications.

CO5: Gain the knowledge about the silicon chips and their fabrication methods and to apply in preparation of electrical and electronics instruments.

19CABS007 ENGINEERING MATHEMATICS-II SEMESTER II

L T P C

3 1 0 4

COURSE OBJECTIVES:

- To obtain the knowledge of Eigen values and diagonalization of a matrix.
- To gain the knowledge of vector differentiation, integration and related applications.
- To be known about analytic functions with properties, construction of analytic function and the knowledge of conformal transformation.
- To obtain the knowledge of Cauchy's integral theorem, calculus of residues and complex integration around unit circle and semicircle.
- To be familiar with techniques of Laplace and Inverse Laplace transformation.

UNIT-I: MATRICES 9+3

Eigen values and Eigenvectors of a real matrix - Characteristic equation - Properties of Eigen values and Eigenvectors - Cayley-Hamilton theorem - Diagonalization of matrices -Reduction of a quadratic form to canonical form by orthogonal transformation -Nature of quadratic forms

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UNIT-II: VECTOR CALCULUS 9+3

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

UNIT-III: ANALYTIC FUNCTIONS 9+3

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

UNIT-IV: COMPLEX INTEGRATION 9+3

Line integral - Cauchy's integral theorem - Cauchy's integral formula - Taylor's and Laurent's series - Singularities - Residues - Residue theorem - Application of residue theorem for evaluation of real integrals - Use of circular contour and semicircular contour.

UNIT-V: LAPLACE TRANSFORMS 9+3

Existence conditions - Transforms of elementary functions - Transform of unit step function and unit impulse function - Basic properties - Shifting theorems - Transforms of derivatives and integrals - Initial and final value theorems - Inverse transforms - Convolution theorem - Transform of periodic functions - Application to solution of linear second order ordinary differential equations with constant coefficients.

Contact periods:

Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods

REFERENCES:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, 2015.
2. Erwinkreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons, 2016.
3. Bali N.P , Manish Goyal v and Watkins C., "Advanced Engineering Mathematics", Firewall

Media, New Delhi, 7th Edition, 2009.
4. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi , 3rd Edition, 2007.
5. O'Neil, P.V. "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.
6. Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.

COURSE OUTCOMES:

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

CO1: Understand the concept of Eigen values and eigenvectors, diagonalization of a matrix, symmetric matrices, positive definite matrices and similar matrices

CO2: Acquire knowledge in Gradient, divergence and curl of a vector point function and related identities

CO3: Understand the properties and formation of analytic function, mappings of standard functions and bilinear transformation

CO4: Understand calculus of residues to evaluate contour integration

CO5: Understand Laplace transform and inverse transform of simple functions, various related theorems and application to differential equations with constant coefficients.

19EEES203 BASIC CIVIL AND MECHANICAL ENGINEERING **SEMESTER II**

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To impart basic knowledge on Civil and Mechanical Engineering.
- To familiarize the materials and measurements used in Civil Engineering.
- To provide the exposure on the fundamental elements of civil engineering structures.
- To enable the students to distinguish the components and working principle of power Plant units, IC engines.
- To enable the students to working principle of R & AC system.

UNIT-I : OVERVIEW OF CIVIL AND MECHANICAL ENGINEERING 9

Overview of Civil engineering – Surveying - Different classification of surveying - measurements of distances-determination of land areas - Building floor area, carpet area and floor space index. Overview of Mechanical Engineering - Specialized sub disciplines in Mechanical Engineering - Production, Automobile, Energy Engineering.

UNIT-II: BUILDING MATERIALS AND CONSTRUCTION 9

Classification and Characteristics of building stones, bricks, sand, cement, concrete, steel and timber. Foundation - types of foundation - Bearing capacity and settlement - Requirement of good foundations. Brickmasonry - stonemasonry-plastering and pointing.

UNIT-III: CIVIL ENGINEERING STRUCTURES 9

Components of building - beams - columns - lintels – roofing - flooring - Types of Bridges and Dams - water supply - sources and quality of water - Rain water harvesting - introduction to high way and rail way.

UNIT-IV: POWER PLANTS AND INTERNAL COMBUSTION ENGINES 9

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

UNIT-V: REFRIGERATION AND AIR CONDITIONING SYSTEM 9

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system - Layout of typical domestic refrigerator - Window and Split type room Air conditioner.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 00 Periods Total: 45 Periods

REFERENCES:

1. Ramamrutham S., "Basic Civil Engineering", Dhanpat Rai Publishing Co.(P) Ltd. 2013
2. Bhavikaati S.S,"Basic Civil Engineering and Engineering Mechanics", New Age International Publishers, New Delhi, 2011.
3. Kilbert C., "Sustainable Construction: Green building design and delivery", John wiley & sons, 2005.
4. Jagadish K.S, Venkataraman Reddy B.V. and K.S. Nanjunda Rao "Alternative Building

Materials and Technologies" New Age International (P) Ltd. Publishers, New Delhi.
5. Nagpal G.R, "Power Plant Engineering" Khanna Publishers, New Delhi, 2002.
6. Jain R.K ,"Production Technology" Khanna Publishers, New Delhi, 2004
7. Shanmugam.G ,"Basic Mechanical Engineering" McGraw Hill Education (India) Pvt. Ltd, New Delhi, 4" Edition, 2013.

COURSE OUTCOMES:

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

CO1: Appreciate the Civil and Mechanical Engineering components.

CO2: Explain the usage of construction material and proper selection of construction materials.

CO3: To identify various structures sources of water, rain water harvesting, modes of transport and sewage disposal methods.

CO4: Identify the components used in power plant cycle and demonstrate working principles of petrol and diesel engine.

CO5: Elaborate the components of refrigeration and Air conditioning cycle.

19CAES007 ENGINEERING GRAPHICS SEMESTER II

L	T	P	C
2	0	4	4

COURSE OBJECTIVES:

- To know the geometrical construction in plane geometry used in engineering practice.
- To know how to draw orthographic projection from a pictorial view and to practice the projection of points, line and planes in first quadrant and projection of solids on different principle planes.
- To know about the section of solids and development of the same.
- To know how to draw Pictorial view of solids from the orthographic view.
- To demonstrate and familiarise of CAD packages.

UNIT-I: GEOMETRICAL CONSTRUCTIONS 6+12

Dimensioning - Lettering - Types of Lines - Scaling conventions - Dividing a given straight line in to any number of equal parts - Bisecting a given angle - Drawing a regular polygon given one side - Special methods of constructing a pentagon and hexagon.

UNIT-II: ORTHOGRAPHIC PROJECTIONS 6+12

Introduction to Orthographic projections - Projection of points - Projection of straight lines with traces – conversion of pictorial views to orthographic views - Projection of solids

UNIT-III: SECTION OF SOLIDS AND DEVELOPMENT 6+12

Sectioning of solids - Development of surfaces

UNIT-IV: PICTORIAL VIEW 6+12

Isometric Projections – Conversion of orthographic views to Pictorial views (simple objects)

UNIT-V: COMPUTER AIDED DRAFTING 6+12

Introduction to computer aided drafting package to make 2-D Drawing. Object Construction - page layout - Layer and Line type - Creating, Editing and selecting the Geometric Objects - Mechanics - Viewing, Annotating, Hatching and Dimensioning the drawing - Creating Blocks and Attributes, Drafting - Create 2D drawing. A Number of chosen problems will be solved to illustrate the concepts clearly. (Demonstration purpose only, not be included in examinations)

Contact periods:

Lecture: 30 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 90 Periods

REFERENCES:

1. N.S Parthasarathy and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
2. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50th Edition, 2010.
3. Natrajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2009.
4. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2008.
5. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill

Publishing Company Limited, New Delhi, 2008.
6. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.

COURSE OUTCOMES:

Upon on completion of the course, the student will be able to

CO1: Represent solids as per international standards.

CO2: Generate and interpret multiple views through development, interpretation and sectional views

CO3: Generate and interpret orthographic views.

CO4: Generate and interpret pictorial views.

CO5: Towards the end of the course it is expected that the students would be matured to visualize the engineering components.

19CAPC001 ELECTRIC CIRCUIT ANALYSIS SEMESTER II

L T P C
3 1 0 4

COURSE OBJECTIVES:

- To introduce electric circuits and its analysis
- To impart knowledge on solving circuits using network theorems
- To introduce the phenomenon of resonance in coupled circuits.
- To educate on obtaining the transient response of circuits.
- To introduce phasor diagrams and analysis of three phase circuits

UNIT-I: BASIC CIRCUITS ANALYSIS 9+3

Ohm's Law - Kirchoff's laws - DC and AC Circuits - Resistors in series and parallel circuits - Mesh current and node voltage method of analysis for D.C and A.C. circuits - Phasor diagram - Power, Power Factor and Energy

UNIT-II: NETWORK REDUCTION AND NETWORK THEOREMS FOR DC AND AC CIRCUITS 9+3

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

UNIT-III: RESONANCE AND COUPLED CIRCUITS 9+3

Series and paralled resonance - their frequency response - Quality factor and Bandwidth - Self and mutual inductance - Coefficient of coupling - Tuned circuits - Single tuned circuits.

UNIT-IV: TRANSIENT RESPONSE FOR DC CIRCUITS 9+3

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

UNIT-V: THREE PHASE CIRCUITS 9+3

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

Contact periods:

Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods

REFERENCES:

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis",Tata Mc Graw Hill publishers, New Delhi (2013).
2. Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum's series, Tata Mc Graw-Hill, New Delhi (2010).
3. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", Tata Mc Graw Hill (2015).
4. Chakrabati A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, Seventh - Revised edition (2018)
5. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Second Edition, Mc Graw Hill (2013).

COURSE OUTCOMES:

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

CO1: Analyse electrical circuits

CO2: Apply circuit theorems

CO3: Analyse resonance circuits

CO4: Analyse transient response

CO5: Analyse three phase circuits

19CABS005 CHEMISTRY LABORATORY SEMESTER II

L T P C
0 0 3 1.5

COURSE OBJECTIVES:

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric analysis.
- To provide exposure to the students with hands on experience on the determination of chemical substances present in solution by conductometric and potentiometric experiments.
- To quantify the Copper content by Iodometric method.
- To expose the students to test the Saponification value of an oil.
- To equip the students with the principles of rate constant of a chemical reaction.

LIST OF EXPERIMENTS:

1. Estimation of hardness by EDTA method.
2. Estimation of chloride by Argentometric method.
3. Conductometric titration of mixture of acids and strong base.
4. Estimation of iron content of the given solution using Potentiometer.
5. Determination of Saponification value of oil.
6. Estimation of Iron by Spectrophotometry.
7. Estimation of HCl by pH titration.
8. Determination of the rate constant of reaction.
9. Estimation of Dissolved Oxygen by Iodometry.
10. Conductometric titration of strong acid and strong base.
11. Conductometric precipitation titration using $BaCl_2$ and Na_2SO_4.
12. Estimation of copper content of the given solution by Iodometry.

Contact periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:

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

CO1: Outfit with hands-on knowledge in the quantitative chemical analysis of water quality related parameters

CO2: Apply the EMF and conductometric measurements in quantitative analysis of substances

CO3: Equip with the methods and techniques involved in the Saponification process

CO4: Comprehend the rate constant of a chemical reaction with respect to time

CO5: Quantify the metal ion concentration of the given sample

19EEPC207 ELECTRICAL APPLIANCES LABORATORY SEMESTER II

L T P C
0 0 3 1.5

COURSE OBJECTIVES:

- To gain the knowledge of electrical measuring equipments
- To assemble and test different electrical appliances
- To learn inverter connection and battery charging

LIST OF EXPERIMENTS:

1. Measurement of energy using single phase energy meter
2. Determination of winding resistance and insulation resistance
3. Assembling and testing of Mixer and Wet Grinder
4. Assembling and testing of ceiling fan
5. Inverter connection for domestic wiring
6. Assembling of 15 watts LED circuit
7. Battery charging through solar panel
8. Assembling and testing of Induction Heater
9. Assembling and testing of Microwave oven
10. Measurement of earth resistance
11. Study of UPS and SMPS
12. Study of protective devices

Contact periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:

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

CO1: Apply the electrical measuring equipments

CO2: Assemble and test domestic electrical appliances

CO3: Apply battery charging with solar panel

CO4: Design UPS and SMPS

CO5: Employ protective devices in electrical circuits

19CABS008 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS **SEMESTER III**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z-transform techniques for discrete time systems.

UNIT-I: PARTIAL DIFFERENTIAL EQUATIONS **9**

Formation of partial differential equations – Singular integrals – Solutions of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT-II: FOURIER SERIES **9**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

UNIT-III: APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **9**

Classification of PDE – Method of separation of variables – Fourier series solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.

UNIT-IV: FOURIER TRANSFORMS **9**

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

UNIT-V: Z – TRANSFORMS AND DIFFERENCE EQUATIONS **9**

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

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45**Periods**

REFERENCES:

1. Grewal B. S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi, 2014.
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. Andrews L. C and Shivamoggi B., "Integral Transforms for Engineers", SPIE Press, 1999
4. Bali N. P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.
5. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.
6. James G.,"Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.

COURSE OUTCOMES:

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

CO1: Understand how to solve the given standard partial differential equations.

CO2: Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.

CO3: Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.

CO4: Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.

CO5: Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

19EEPC302 ELECTROMAGNETIC THEORY SEMESTER III

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To understand the concepts of electrostatics, electrical potential, energy density and their applications.
- To understand the concepts magnetostatics, magnetic flux density, scalar and vector potential and its applications.
- To acquire knowledge about faraday's laws, induced emf and their applications.
- To acquire knowledge about the relation between the fields under time varying situations.
- To understand the principles of propagation of uniform plane waves and Poynting vector.

UNIT-I: ELECTROSTATICS – I 9+3

Sources and effects of electromagnetic fields – Coordinate Systems – Vector fields – Gradient, divergence, curl – Theorems and applications – Coulomb's Law – Electric field intensity – Field due to discrete and continuous charges – Gauss's law and applications.

UNIT-II: ELECTROSTATICS – II 9+3

Electric potential – Electric field and equipotential plots, uniform and non-uniform field, Utilization factor – Electric field in free space, conductors, dielectrics – Dielectric polarization – Dielectric strength – Electric field in multiple dielectrics – Boundary conditions, poisson's and laplace's equations, capacitance, energy density, applications.

UNIT-III: MAGNETOSTATICS 9+3

Lorentz force, magnetic field intensity (H) – Biot–savart's law – Ampere's circuit law – H due to straight conductors, circular loop, infinite sheet of current, magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization, magnetic field in multiple media – Boundary conditions, scalar and vector potential, poisson's Equation, magnetic force, torque, inductance, energy density, applications.

UNIT-IV: ELECTRODYNAMIC FIELDS 9+3

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

UNIT-V: ELECTROMAGNETIC WAVES 9+3

Electromagnetic wave generation and equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors – Skin depth – Poynting vector – Plane wave reflection and refraction.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 15**Periods** **Practical:** 0 **Periods** **Total:** 60**Periods**

REFERENCES:

1. John D. Kraus and Daniel A. Fleisch," Electromagnetics with Applications", McGrawHill International Edition, 2014
2. William H.Hayt,"Engineering Electromagnetics", McGraw Hill Book Co., 2015
3. Ashutosh Pramanik,"Electromagnetism", Prentice Hall of India Pvt. Ltd, 2013
4. Dr.Dhananjayan.P,"Engineering Electromagnetics", Lakshmi Publications, 2015

5. Mathew N.D Sadiku, "Elements of Electromagnetic", Oxford university press, 4th Edition, 2015
6. Joseph Edminister, "Electromagnetics", 2nd Edition, Tata McGraw Hill Book Co., 2016

COURSE OUTCOMES:

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

CO1: Analyze field potentials due to static charges.
CO2: Analyze field potentials due to static magnetic fields the ability to solve the problems based on boundary conditions in electric field.
CO3: Understand how materials affect electric and magnetic fields.
CO4: Apply the Maxwell's equation relating to the electric and magnetic fields.
CO5: Understand principles of wave motion in Electromagnetic fields.

19EEPC303 ELECTRONIC DEVICES AND CIRCUITS SEMESTER III

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the structure of basic electronic devices.
- To familiarize the operation and applications of transistor like BJT and FET.
- To explore the characteristics of amplifier gain and frequency response.
- To explore the characteristics of multistage and differential amplifier.
- To learn the required functionality of positive and negative feedback systems.

UNIT-I: DIODES, SPECIAL DIODES AND APPLICATIONS 9

PN diode – Operation – Voltage-current characteristics –Transition and diffusion capacitance –Reverse recovery time –Diode models – Applications –Half-wave and Full-wave rectifiers and filters – Power supply regulators – Avalanche and Zener breakdown – Zener diodes – Applications –Varactor and optical diodes.

UNIT-II: BI-POLAR JUNCTION TRANSISTORS AND THYRISTOR 9

BJT, JFET, MOSFET – Structure, operation, characteristics – UJT, Thyristors and IGBT – Structure, operation and characteristics – Photo-transistors and opto couplers – New semiconductor material – Silicon carbide – Gallium Arsenide.

UNIT-III: AMPLIFIERS 9

Biasing: base, emitter and voltage divider – DC operating point – BJT small signal model - Analysis of CE, CB, CC amplifiers – Gain and frequency response –MOSFET small signal model– Analysis of CS and source follower – Gain and frequency response – High frequency equivalent model .

UNIT-IV: MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER 9

Cascade amplifier – Differential amplifier – Common mode and difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers –Types (Qualitative analysis).

UNIT-V: FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Feedback amplifier – Concepts of positive and negative feedback – Feedback topologies – positive feedback –Condition for oscillations, phase shift – Wien bridge, hartley, colpitts and crystal oscillators.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Thomas L. Floyd,"Electronic Devices", 10th Edition, Pearson Inc.,2018.
2. Robert Boylestad,"Electronic Devices and Circuit Theory" ,11th Edition, Pearson ,2013.
3. Jacob Millman, Christos C Halkias and Satyabrata JIT, "Electron Devices and Circuits", 4th Edition, Tata McGraw Hill, 2015.
4. David A. Bell ,"Electronic Devices and Circuits", 5th Edition, Prentice Hall of India, 2008.
5. Allen Mottershead, "Electronic Devices and Circuits, An Introduction", Eastern Economy Edition, Prentice-Hall of India, 2009.
6. Adel S. Sedra and Kenneth C. Smith, "Microelectronic Circuits", 6th Edition, Oxford University Press, 2009.

COURSE OUTCOMES:

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

CO1: Understand the construction and working of semiconductor devices.
CO2: Analyze the characteristics of the various electronic devices.
CO3: Analyze the parameters of amplifier circuit and frequency response.
CO4: Design of multistage amplifier and tuned amplifier.
CO5: Employ the acquired knowledge in design and analysis of oscillators.

19EEPC304 DC MACHINES AND TRANSFORMERS SEMESTER III

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the concepts of electro mechanical energy conversion.
- To acquire the knowledge of working principle of DC generators.
- To acquire the knowledge of working principle of DC motors.
- To acquire the knowledge of construction details of transfromers.
- To grasp the knowledge of testing of DC machines and transformers.

UNIT-I: PRINCIPLES OF ELECTROMECHANICAL ENERGY CONVERSION 9

Energy in magnetic system – Field energy and co energy – Force and torque equations – Eddy current and hysteresis losses – Singly and multiply excited magnetic field systems – MMF of distributed AC windings – Winding Inductances – Rotating magnetic field and MMF waves – Magnetic saturation and leakage fluxes.

UNIT-II: DC GENERATORS 9

Constructional details and principle of operation – Armature winding – EMF equation – Types of DC generators – Armature reaction – Effects of armature reaction – Demagnetizing & cross magnetizing ampere-turns – Compensating windings – Interpoles – Commutation – Characteristics of DC generators – Losses and efficiency – Parallel operation of DC generators – Applications of DC generators.

UNIT-III: DC MOTORS 9

Constructional details and principle of operation – Back emf – Types of DC motors – Torque equation – Losses and efficiency – Power flow diagram – Electrical and mechanical characteristics of different types of DC motors – DC motor Starters – Speed control methods – Types of Electric braking – Applications of DC motors.

UNIT-IV: TRANSFORMERS 9

Principle of operation – Types and constructional features of single phase and three phase transformers – EMF equation – Phasor diagram – Transformers on load – Equivalent circuit – Voltage regulation and efficiency – All day efficiency – Three phase transformer connections – Scott connection – Parallel operation of three phase transformers – Inrush current – Auto transformers – Tap changing transformer.

UNIT-V: TESTING OF DC MACHINES AND TRANSFORMERS 9

DC machines: Brake test, field test, retardation test – Swinburne's test – Hopkinson's test. Transformers: Open circuit and Short circuit tests – Phasing, identification and polarity of transformer winding – Sumpner's test.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Fitzgerald A. E, Kingsley C and Umans.S., "Electric Machinery", Mc Graw Hill, 2017.
2. Bimbra P. S., "Electrical Machinery", 7/e, Khanna Publishers, 2011.
3. Nagrath J. and Kothari D. P., "Theory of Electric Machines", Tata Mc Graw Hill, 2010.
4. Jacek F. Gieras., "Electrical Machines: Fundamentals of Electromechanical Energy Conversion", CRC press, 2016.

5. Abhijith Chakrabarti and Sudipta Debnath., "Electrical Machines", Mc Graw Hill Education, NewDelhi, 2015.
6. Deshpande M. V., "Electrical Machines", Prentice Hall India, New Delhi, 2011.

COURSE OUTCOMES:

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

CO1: Illustrate the working principles of electrical machines using the concepts of electromechanical energy conversion principles and derive expressions for generated voltage and torque developed in all electrical machines.

CO2: Explain the working principles of DC generator, types, determination of their no load / load characteristics, losses and efficiency.

CO3: Explain the working principles of DC motors, the various losses taking place in DC motor, starting methods and speed control of motors.

CO4: Illustrate the constructional details, the principle of operation, prediction of performance, the methods of testing single phase transformers and three phase transformers.

CO5: Illustrate the prediction of performance, the methods of testing the DC machines and transformers.

19EEPC305 LINEAR INTEGRATED CIRCUITS AND APPLICATIONS **SEMESTER III**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn and understand the fabrication of ICs.
- To acquire knowledge about th OPAMP characteristics.
- To identify of suitable solutions to real time applications.
- To apply the use of special ICs to specific applications.
- To apply of circuits for interfacing and generation of waveforms.

UNIT-I: IC FABRICATION **9**

IC classification – Fundamental of monolithic IC technology: epitaxial growth, masking and etching, diffusion of impurities – Realization of monolithic ICs and packaging – Fabrication of diodes, capacitance, resistance and FETs.

UNIT-II: OPERATIONAL AMPLIFIERS CHARACTERISTICS **9**

Functional block diagram – Ideal op-amp – Open loop and closed loop operation – CMRR – Input bias and offset currents – Input and output offset voltages – Compensation techniques – Frequency response of op-amp – Transfer characteristics – Slew rate – Bandwidth – Open loop and closed loop configuration– Inverting and non inverting amplifiers.

UNIT-III: APPLICATIONS OF OPERATIONAL AMPLIFIERS **9**

Instrumentation amplifier – Differential amplifier – Summer – Integrator and differentiator – Active filters – Voltage to frequency converters – Sample and hold circuits – Comparators – Zero crossing detectors – Square and triangular waveform generator – Clippers & clampers.

UNIT-IV: SPECIAL ICs **9**

555 timer – Functional block diagram – Astable and monostable operation of 555 timer – Applications – Frequency counters – IC 566 VCO and IC 565 PLL – A/D converters – D/A converters.

UNIT-V: APPLICATION ICs **9**

Positive and negative voltage regulators (IC723) – Adjustable voltage regulators (LM117/LM317) – Dual tracking regulators (78xx & 79xx Series) – Programmable supply – LM 380 power amplifier – ICL 8038 function generator IC.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Roy Choudhry D. and Shail Jain, "Linear Integrated Circuits", New Age international, New Delhi, 5th Edition, 2014.
2. David A.Bel, "Op-amp & Linear ICs" Oxford, 2013.
3. Ramakant A.Gayakwad, "OPAMPs and Linear Integrated Circuits", Prentice Hall of India Pvt. Ltd. New Delhi, 4th Edition, 2010.
4. Jacob Millman, Christos C.Halkias, "Integrated Electronics – Analog and Digital circuits", Mc Graw Hill India, 2ndEdition, 2017.

COURSE OUTCOMES:

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

CO1: Explain various processing steps involved in fabrication of ICs.

CO2: Summarize the DC/AC characteristics and compensation techniques of an operational amplifier.

CO3: Understand the working and design of various linear applications using op-amp.

CO4: Use of special purpose op-amp circuits to specific applications.

CO5: Understand the working and design of analog circuits such as voltage regulator and dual tracking regulators.

19CAHS002 ENVIRONMENTAL SCIENCE AND ENGINEERING SEMESTER III

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand what constitutes the environment.
- To conserve the natural resources.
- To learn and understand the role of a human being in maintaining a clean and useful environment for the future generations.
- To acquire knowledge about ecological balance and preservation of biodiversity.
- To get an idea about the role of government and non-government organization in environment management.

UNIT-I: ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

Definition, scope and importance of environment – Need for public awareness – Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – Biogeographical classification of India – Value of biodiversity: Consumptive use, Productive use, Social, Ethical, Aesthetic and Option values – Biodiversity at global, National and local levels – India as a mega – Diversity nation – Hot-spots of biodiversity – Threats to biodiversity: Habitat loss, Poaching of wildlife, Man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, Insects, Birds; Field study of simple ecosystems – Pond, River, Hill slopes, etc.

UNIT-II: ENVIRONMENTAL POLLUTION 8

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Solid waste management: Causes, Effects and Control measures of municipal solid wastes – Role of an individual in prevention of pollution –Pollution case studies –Disaster management: Floods, Earthquake, Cyclone and Landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT-III: NATURAL RESOURCES 10

Forest resources: Use and over – Exploitation, Deforestation, Case studies –Timber extraction, mining, Dams and their effects on forests and tribal people – Water resources: Use and over – Utilization of surface and ground water, Floods, Drought, Conflicts over water, dams – Benefits and problems – Mineral resources: Use and exploitation, Environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, Changes caused by agriculture and overgrazing, Effects of modern agriculture, Fertilizer–pesticide problems, Water logging, Salinity, Case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, Use of alternate energy sources. Case studies – Land resources: Land as a resource, Land degradation, Man induced landslides, Soil erosion and desertification – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – River / Forest / Grassland / Hill / Mountain.

UNIT-IV: SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, Watershed management – Resettlement and rehabilitation of people; Its problems and concerns, Case studies – Role of non-governmental organization –Environmental ethics: Issues and possible solutions – Climate change, Global warming, Acid rain, Ozone layer depletion, Nuclear accidents and holocaust, Case studies. – wasteland reclamation – Consumerism and waste products – Environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act– Forest conservation act – Enforcement machinery involved in environmental legislation – Central and state pollution control boards – Public awareness.

UNIT-V: HUMAN POPULATION AND THE ENVIRONMENT 6

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 – Case studies.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M. Masters, "Introduction to Environmental Engineering and Science", 2nd Edition, Pearson Education, 2004.
3. Dharmendra S. Sengar, "Environmental law", Prentice hall of India Pvt. Ltd., New Delhi, 2007.
4. Erach Bharucha, "Textbook of Environmental Studies", Universities Press (I) Pvt. Ltd., Hyderabad, 2015.
5. Rajagopalan R., "Environmental Studies-From Crisis to Cure", Oxford University Press, 2005.
6. Tyler. G Miller and Scott E. Spoolman, Environmental Science, Cengage Learning India PVT, LTD, Delhi, 2014.

COURSE OUTCOMES:

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

CO1: Understand how to conserve the natural resources.

CO2: Understand what constitutes the environment and how to conserve biodiversity.

CO3: Create awareness about environmental pollution and disaster management.

CO4: Gain adequate knowledge about the social issues of the environment and the role of government and non government organization in environment management.

CO5: Understand about human population and the environment and the role of information technology in environment and human health.

19EEPC307 ELECTRIC CIRCUITS AND ELECTRONIC DEVICES LABORATORY **SEMESTER III**

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To observe and understand the basic laws circuit theory and analyze the performance characteristics of semiconductor devices.

LIST OF EXPERIMENTS

1. Verification of Ohm's Law and Kirchhoff's laws
2. Verification of Thevenin's and Norton's theorems
3. Verification of superposition and maximum power transfer theorems
4. Measurement of three phase power by two wattmeter method
5. Semiconductor diode characteristics
6. Zener diode characteristics
7. Transistor characteristics – Common emitter mode
8. Transistor characteristics – Common base mode
9. Transistor characteristics – Common collector mode
10. Characteristics of UJT
11. Characteristics of FET

Contact periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:

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

CO1: Verify the basic laws of circuit theory and various network theorems.
CO2: Infer the characteristics of basic semiconductor devices.
CO3: Measure the real and reactive power in three phase network.
CO4: Determine the characteristics of transistor BJT.
CO5: Determine the characteristics of UJT and FET.

19EEPC308 DC MACHINES AND TRANSFORMERS LABORATORY SEMESTER III

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To give hands on training for evaluating the performance and characteristics of DC Machines and Transformers.

LIST OF EXPERIMENTS

1. Open circuit characteristics and load test on DC shunt generator
2. Open circuit characteristics and load test on DC compound generator
3. Load test on DC shunt motor
4. Load test on DC series motor
5. Load test on DC compound motor
6. Load test on single phase transformer
7. OC and SC tests on single phase transformer
8. Separation of losses in transformer
9. Swinburne's test and Speed control of DC shunt motor
10. Hopkinson's Test
11. Sumpner's test
12. Study of starters and three phase transformers connections

Contact periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:

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

CO1: Analyze the electrical / mechanical / performance characteristics of DC Machines.
CO2: Identify suitable DC motor speed control method for applications.
CO3: Analyze the performance characteristics of transformer.
CO4: Develop the transformer model and analyze the performance.
CO5: Ability to acquire knowledge on separation of losses.

19CABS009 **NUMERICAL METHODS** **SEMESTER IV**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals in real life situations.
- To acquaint the student with understanding of numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To understand the knowledge of various techniques and methods of solving various types of partial differential equations.

UNIT-I: SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS **9**

Solution of algebraic and transcendental equations – Fixed point iteration method – Newton Raphson method – Solution of linear system of equations – Gauss elimination method – Pivoting – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel – Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT-II: INTERPOLATION AND APPROXIMATION **9**

Interpolation with unequal intervals – Lagrange's interpolation – Newton's divided difference interpolation – Cubic Splines – Difference operators and relations – Interpolation with equal intervals – Newton's forward and backward difference formulae.

UNIT-III: NUMERICAL DIFFERENTIATION AND INTEGRATION **9**

Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's Method – Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

UNIT-IV: INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS **9**

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

UNIT-V: BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS **9**

Finite difference methods for solving second order two-point linear boundary value problems – Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0**Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Burden R.L and Faires J.D., "Numerical Analysis", 9th Edition, Cengage Learning,2016.
2. Grewal B.Sand GrewalJ.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.

3. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, New Delhi, 2007.
4. Gerald C. F and Wheatley P. O., "Applied Numerical Analysis", Pearson Education, Asia, 6th Edition, New Delhi, 2006.
5. Mathews J.H.,"Numerical Methods for Mathematics, Science and Engineering", 2nd Edition, Prentice Hall, 1992.
6. Sankara Rao. K, "Numerical Methods for Scientist and Engineers", Prentice Hall of India Pvt. Ltd., 3rd Edition, New Delhi, 2007.

COURSE OUTCOMES:

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

CO1: Understand the basic concepts and techniques of solving algebraic and transcendental Equations.

CO2: Appreciate the numerical techniques of interpolation and error approximations in various intervals in real life situations.

CO3: Apply the numerical techniques of differentiation and integration for engineering problems.

CO4: Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.

CO5: Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

19EEPC402 **NETWORKS AND SYNTHESIS** **SEMESTER IV**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To acquire knowledge about network topology.
- To analysis the two port network.
- To apply state variable approach for electrci circuits.
- To realize the one port network.
- To classify the filters and attenuators for electric circuits.

UNIT-I: NETWORK TOPOLOGY **9**

Basic definitions of a network graph – Oriented graph – Sub graph – Planar graph – Path and Circuit – Tree and its properties – Cut sets – Incidence matrix – Circuit matrix – Cut set matrix – Fundamental circuit of Tie set matrix – Fundamental cut set matrix. Network analysis using graph theory: Formation of network equations – Network equilibrium equations on the basis of loop analysis – Network equilibrium equations on the basis of node analysis – Application to DC networks.

UNIT-II: NETWORK FUNCTIONS AND TWO PORT NETWORKS **9**

Concept of complex frequency – Network functions – Driving point and transfer functions and their properties – Poles and Zeros and their significance – Time domain behaviour from pole-zero plot – Two port networks – Z, Y, ABCD and h parameters – Condition for reciprocity and symmetry – Parameter conversion – Interconnection of two port networks – Analysis of typical two port networks – Input and Output impedances of terminated two port networks – Image impedances.

UNIT-III: STATE VARIABLE ANALYSIS **9**

State, State variables and State space – State space models – Continuous time models – State space models applicable for electric circuits – Classification of circuits in state variable analysis – State variable analysis of circuits with controlled sources – Formation of state equations using network graph theory – Zero state response of the state vector – Complete response of state vector.

UNIT-IV: ELEMENTS OF REALIZABILITY AND SYNTHESIS OF ONE – PORT NETWORKS **9**

Hurwitz polynomials – Positive real functions – Frequency response of reactive one ports – Synthesis of reactive one ports by Foster method and Cauer method – Synthesis of RL and RC networks by Foster method and Cauer method.

UNIT-V: FILTERS AND ATTENUATORS **9**

Classification of filters – Filter networks – Equations of filter networks – Classification of pass band and stop band – Characteristic impedance in pass and stop bands – Constant K low pass, high pass, band pass and band elimination filters – Limitations of constant K filters – M derived filters – Composite filter. Attenuators: T type, π type, Lattice, Bridged T and L type attenuators.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Ravish R. Singh, "Network Analysis and Synthesis", TMH, New Delhi, 1st Edition, 2013.
2. Sudhakar A and Shyammohan S.P., "Circuits and Networks: Analysis and Synthesis", TMH, New Delhi,5th Edition, 2017.
3. Roy D. Choudhury, "Networks and Systems", New Age Publications, New Delhi, 4th Edition, 2010.
4. Franklin F. Kuo, "Network Analysis and Synthesis", Wiley India Pvt. Ltd., New Delhi, 2nd Edition, 2012.
5. Joseph A. Edminister and Mahmood Nahvi, "Electric Circuits", Schaum's Series, TMH, New Delhi, 5th Edition, 2017.
6. Chakrabarti A., "Circuit Theory: Analysis and Synthesis", Dhanpat Rai & Co. Pvt. Ltd, 7th Edition, New Delhi, 2018.

COURSE OUTCOMES:

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

CO1: Understand graph theory concepts and solve circuit theory problems.

CO2: Apply the concept of complex frequency in studying network functions and analyse two port network parameters using various models.

CO3: Formulate mathematical models for linear systems and circuits and also determine the solution using state variable approach.

CO4: Identify the given function for positive realness and synthesize reactive one port RC and RL network using Foster and Cauer methods.

CO5: Design constant K, M derived filters and Attenuators.

19EEPC403 DIGITAL LOGIC CIRCUITS SEMESTER IV

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study various number systems, simplify the logical expressions using Boolean functions.
- To study and implementation of combinational circuits.
- To design various synchronous and asynchronous circuits.
- To introduce memory elements registers and PLD.
- To introduce digital simulation for development of application oriented logic circuits.

UNIT-I: BOOLEAN ALGEBRA AND LOGIC GATES 9

Binary systems, boolean algebra and logic gates – Boolean functions – Canonical and standard Forms – Digital logic gates – Digital logic families(RTL,DTL,TTL,ECL,CMOS) – K-Map representations – Minimization using K-Map methods – NAND and NOR Implementation

UNIT-II: COMBINATIONAL LOGIC CIRCUITS 9

Combinational circuits – Analysis and design procedure –Adders – Subtractors – Code converters – Magnitude comparator – Decoders – Encoders – Multiplexers – De-Multiplexers..

UNIT-III: SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS 9

Sequential circuits – Latches – Flip flops – Analysis of synchronous sequential circuits – Moore and Melay models – State reduction and assignment – Design procedure – Modulo counters – Asynchronous circuits – Analysis procedure -– Race free state assignment – Hazards & error in digital circuits.

UNIT-IV: REGISTERS, COUNTERS AND MEMORY 9

Registers, shift registers, ripple counters, synchronous counters, random access memory – Error detection and correction – Programmable Read Only Memory (PROM) – Programmable Logic Array (PLA) – Programmable Array Logic (PAL) – Design examples

UNIT-V: HARDWARE DESCRIPTION LANGUAGE 9

Introduction to verilog: structure of verilog module, operators, data types, styles of description-data flow description, implement logic gates, half adder and full adder using verilog data flow description. Behavioral description: structure, variable assignment statement, sequential statements, loop statements, verilog behavioral description of multiplexers (2:1,4:1,8:1) and de-multiplexers – Encoders (8 to 3), decoders (2 to 4) – Flipflops.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Morris Mano M., "Digital Design", Pearson Education, New Delhi, 6th Edition, 2018.
2. Charles H. Roth,"Fundamentals of Logic Design",7th Edition, Jaico Publishing House, 2013.
3. Nazeih M. Botros, "HDL Programming VHDL and Verilog", Dreamtech press, 2009 reprint.
4. Ronald J. Tocci, Neal S. Widmer and Gregory L. Moss, "Digital Systems – Principles and

Applications", Pearson, 10th Edition, 2009.
5. Floyd and Floyd Thomas L., "Digital fundamentals", Pearson Education, New Delhi 11th Edition, 2014.

COURSE OUTCOMES:

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

CO1: Understand the fundamental of digital electronics and logic families.
CO2: Outline the formal procedures for the analysis and design of combinational circuits.
CO3: Analyze the design capability in synchronous and asynchronous sequential circuits.
CO4: Understand various memory devices and registers.
CO5: Acquire knowledge on the fundamental concepts and programming techniques used in HDL.

19EEPC404 SYNCHRONOUS AND INDUCTION MACHINES SEMESTER IV

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the basic construction and performance of salient and non–salient type synchronous generators.
- To acquire knowledge of operation and performance of synchronous motor.
- To understand the basic principle of operation and performance of induction machines.
- To learn the concepts of starting and speed control of three-phase induction motors.
- To learn the operation and performance of single phase induction motors and special machines.

UNIT-I: SYNCHRONOUS GENERATOR 9

Constructional details – Types of rotors – Winding factors – EMF equation – Synchronous reactance – Armature reaction – Phasor 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.

UNIT-II: SYNCHRONOUS MOTOR 9

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

UNIT-III: THREE PHASE INDUCTION MACHINE 9

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

UNIT-IV: STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR 9

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

UNIT-V: SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES 9

Constructional details of single phase induction motor – Double field revolving theory and operation – Equivalent circuit – No load and blocked rotor test – Performance analysis – Starting methods of single-phase induction motors – Capacitor-start capacitor run induction motor – Shaded pole induction motor – Linear induction motor – Repulsion motor – Hysteresis motor – AC series motor – Servo motors – Stepper motors – Introduction to magnetic levitation systems.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Janardanan E.G., "Special electrical machines", PHI learning Pvt Ltd., Delhi, 2014.
2. Fitzgerald A. E, Charles Kingsly C, Stephen D and Umans,"Electric Machinery", Tata McGraw Hill, 6th Edition, 2013.
3. Kothari D. P and Nagrath I. J.,"Electric Machines", Tata McGraw Hill, 5th Edition, 2017.
4. Bimbhra P.S., "Electrical Machinery", Khanna Publishers, New Delhi, 7th Edition, 2011.
5. Sen S. K., "Electric Machinery", Khanna Publishers, New Delhi, 2008.
6. Langsdorf A. S., "Theory of A.C Machinery", Tata McGraw Hill, 2001.

COURSE OUTCOMES:

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

CO1: Illustrate the constructional details and the performance of salient and non salient type synchronous generators.

CO2: Illustrate the constructional details and the performance of synchronous motor.

CO3: Illustrate the constructional details and the performance of three phase induction motor.

CO4: Executing the speed control and starting methods for various induction motor.

CO5: Familiarize special electrical machines and their applications

19EEES405 OBJECT ORIENTED PROGRAMMING WITH C++ SEMESTER IV

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of object oriented programming paradigms.
- To learn the classes and objects.
- To know concepts of reusability using inheritance.
- To acquire knowledge of pointers and standard templates in C++.
- To understand file and string handling operations.

UNIT-I: INTRODUCTION **9**

Object oriented programming paradigm – Advantages – Object oriented languages – I/O in C++. declaration – Control structures and decision making – If else, goto, break, continue, switch case statements. loops in C++: for, while, do – Functions in C++ – Inline functions – Function overloading.

UNIT-II: CLASSES AND OBJECTS **9**

Declaring objects – Defining member functions – Static member variables and functions – Array of objects – Friend functions – Overloading member functions – Bit fields and classes – Constructor and destructor with static members – Memory models – New and delete operators – Dynamic object – Binding, polymorphism and virtual functions.

UNIT-III: INHERITANCE **9**

Overloading unary, binary operators – Overloading friend functions – Type conversion – Inheritance: Types of inheritance – Single, Multilevel, Multiple, Hierarchal, Hybrid, Multi path inheritance – Virtual base classes – Abstract classes. exceptions – Exception hierarchies and handlers.

UNIT-IV: POINTERS AND TEMPLATES **9**

Declaration – Pointer to class, object – This pointer – Pointers to derived classes and base classes. template overview – Customizing a templated method – Standard template library containers.

UNIT-V: FILE HANDLING **9**

File stream classes – File modes – Sequential read / write operations – Binary and ASCII files – Random access operation – String: Declaring and initializing string objects – String attributes – Standard streams – Miscellaneous functions.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Herbert Schildt, "The Complete Reference in C++", 4th Edition, Tata McGraw Hill, 2003,
2. Deitel H.M and Deitel P.J., "C++ How to Program", 7th Edition, Prentice Hall, 2010.
3. Robert Lafore, "Object Oriented Programming in C++", 2002, Pearson education.
4. Horstmann, "Computing Concepts with C++ Essentials", 3rd Edition, John Wiley, 2003.
5. Bjarne Stroustrup, "The C++ Programming language", 3rd Edition, Pearson Education, 2012.

COURSE OUTCOMES:

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

CO1: Write simple and effective C++ programs.
CO2: Use polymorphism in C++ classes and objects.
CO3: Apply inheritance and explore reusability of code.
CO4: Use pointers and templates in C++ programs.
CO5: Handle file operations efficiently.

19EEES406 POWER PLANT ENGINEERING SEMESTER IV

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To providing an overview of thermal power plants and detailing the role of mechanical engineers in their operation and maintenance.
- To understand construction and operation of diesel, gas turbine and combined cycle power plants.
- To understand construction and operation of nuclear power plants.
- To learn about power from wind and solar.
- To know about the energy, economic and environmental issues of power plants.

UNIT-I: COAL BASED THERMAL POWER PLANTS 9

Rankine cycle – Improvisations, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam &heat rate, subsystems of thermal power plants – Fuel and ash handling, draught system, feed water treatment. Binary cycles and cogeneration systems.

UNIT-II: DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS 9

Otto, diesel, dual & braytoncycle – Analysis &optimisation. Components of diesel and gas turbine power plants. Combined cycle power plants. Integrated gasifier based combined cycle systems.

UNIT-III: NUCLEAR POWER PLANTS 9

Basics of nuclear engineering, layout and subsystems of nuclear power plants, working of nuclear Reactors : Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium-Uranium reactor (CANDU), breeder, gas cooled and liquid metal cooled reactors. safety measures for nuclear power plants.

UNIT-IV: POWER FROM RENEWABLE ENERGY 9

Hydro electric power plants – Classification, typical layout and associated components including turbines, principle, construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar thermal, Geo thermal, Biogas and Fuel cell power systems.

UNIT-V: ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS 9

Power tariff types, load distribution parameters, load curve, comparison of site selection criteria, relative merits & demerits, capital &operating cost of different power plants. Pollution control technologies including waste disposal options for coal and nuclear power plants.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Nag P. K., "Power Plant Engineering", 4th Edition, Tata McGraw – Hill Publishing Company Ltd., 2014.
2. El -Wakil M. M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
3. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.

4. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Standard Handbook of Power Plant Engineering", 2nd Edition,McGraw – Hill Professional, 2012.

COURSE OUTCOMES:

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

CO1: Understand the layout, construction and working of the components inside a thermal power plant.

CO2: Acquire knowledge about the layout, construction and working of the components inside a diesel, das and combined cycle power plants.

CO3: Gain the basic knowledgeof construction and working of the components inside nuclear power plants.

CO4: Explore the construction and working of the components inside renewableenergy power plants.

CO5: Analysis and solve energy and economic related issues in power sector.

19EEPC407 ANALOG CIRCUITS AND DIGITAL IC LABORATORY SEMESTER IV

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To design and development of various electronic circuits for real time applications.

LIST OF EXPERIMENTS

1. Design of Rectifier with Filters
2. Clipper and Clamper circuits
3. Design of Oscillator circuits using BJT
4. Design of Transistor amplifiers using BJT
5. Applications of Operational Amplifier-Inverting & Non-Inverting Amplifier
6. Design of Logic Circuits-AND, OR, NAND, NOR, NOT, EX-OR
7. Design of Arithmetic Circuits-Adder, Subtractor
8. Registers
9. Design of Counters
10. Encoder and Decoder
11. Multiplexer and Demultiplexer

Contact periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:

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

CO1: Acquire knowledge about internal circuitry and logic for digital circuits.
CO2: Fabricate electronic circuit depends on applications.
CO3: Test various waveform generation circuits using opamps, comparators and IC's.
CO4: Design and test various combinational logic circuits.
CO5: Design and test various sequential logic circuits.

19EEPC408 SYNCHRONOUS AND INDUCTION MACHINES SEMESTER IV LABORATORY

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To give hands on training for evaluating the performance and characteristics of various types of rotating AC machines.

LIST OF EXPERIMENTS

1. Regulation of alternator by EMF and MMF methods
2. Regulation of alternator by ZPF method
3. Load test on three phase alternator
4. Regulation of salient pole alternator by slip test
5. V and Inverted V curves of three phase synchronous motor
6. Load test on three phase squirrel cage induction motor
7. Load test on three phase slip ring induction motor
8. No load and blocked rotor tests on three phase induction motor (Determination of equivalent circuit parameters)
9. Separation of no load losses of three phase induction motor
10. Load test on single phase induction motor
11. No load and blocked rotor test on single phase induction motor
12. Study of different types of starting of induction motors

Contact periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:

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

CO1: Understand and analyze alternator regulation methods.
CO2: Analyze the characteristics of V and inverted V curves.
CO3: Suggest suitable test for performance analysis of induction machines.
CO4: Understand the importance of induction machines.
CO5: Acquire knowledge on separation of losses.

19EEES409 OBJECT ORIENTED PROGRAMMING USING C++ LABORATORY **SEMESTER IV**

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To understand the principles of object oriented programming and to transform the physical problem domain into a hierarchy of objects, use OOP technique to solve simple engineering problems and to acquire skill sets to become a proficient C++ programmer with development of solution for complex problems in the real world.

LIST OF EXPERIMENTS

1. Write a C++ program to understand classes and objects
2. Implement arrays and structures in C++
3. Write a C++ program to implement inline functions
4. Demonstrate various types of inheritance
5. Implement operator overloading and function overloading
6. Implement virtual functions in C++
7. Write a C++ program to understand pointers
8. Demonstrate the usage of templates
9. Implement exception handling in C++
10. Write a C++ program to illustrate file operations
11. Write a C++ program to illustrate streams
12. Mini project

Contact periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:

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

CO1: Design an object oriented program using classes and objects.

CO2: Apply inheritance to reuse the C++ code.

CO3: Apply polymorphism to extend the code and reduce the complexity of the program.

CO4: Implement exception handling in projects using generic types.

CO5: Implement files and streams in C++ programs.

19EEPC501 TRANSMISSION AND DISTRIBUTION SEMESTER V

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the structure of electric power system and to develop expressions for the computation of transmission line parameters.
- To obtain the equivalent circuits for the transmission lines based on distance and to determine voltage regulation and efficiency.
- To understand the mechanical design of transmission lines and to analyze the voltage distribution in insulator strings to improve the efficiency.
- To study the types, construction of cabilitys and methods to improve the efficiency.
- To study about distribution systems, types of substations, methods of grounding, EHVAC, HVDC and FACTS.

UNIT-I: TRANSMISSION LINE PARAMETERS 9

Structure of power system – Parameters of single and three phase transmission lines with single and double circuits – Resistance, inductance and capacitance of solid, stranded and bundled conductors, symmetrical and unsymmetrical spacing and transposition – Application of self and mutual GMD; skin and proximity effects – Typical configurations, conductor types and electrical parameters of EHV lines.

UNIT-II: MODELLING AND PERFORMANCE OF TRANSMISSION LINES 9

Performance of transmission lines – Short line, medium line and long line – Equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance – Transmission efficiency and voltage regulation, real and reactive power flow in lines – Power circle diagrams – Formation of corona – Critical voltages – Effect on line performance.

UNIT-III: MECHANICAL DESIGN OF LINES 9

Mechanical design of OH lines – Line supports –Types of towers – Stress and sag calculation – Effects of wind and ice loading. Insulators: Types, voltage distribution in insulator string, improvement of string efficiency, testing of insulators.

UNIT-IV: UNDER GROUND CABLES 9

Underground cables – Types of cables – Construction of single core and 3 core cables – Insulation resistance – Potential gradient – Capacitance of single core and 3 core cables – Grading of cables – Power factor and heating of cables – DC cables.

UNIT-V: DISTRIBUTION SYSTEMS 9

Distribution systems – General aspects – Kelvin's law – AC and DC distributions – Techniques of voltage control and power factor improvement – Distribution loss –Types of substations – Methods of grounding – Trends in transmission and distribution: EHVAC, HVDC and FACTS (Qualitative treatment only).

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Chakrabarti, Soni Ml, Gupta P. V and Bhatnagar U.S.,"A Text Book On Power System Engineering", Dhanpat Rai Publishing Company, 2008.
2. Wadwa C. L.,"Electrical Power Systems", 7th Edition, New Age International, 2017.

3. Kothari D. P.and Nagrath I. J., "Power System Engineering", 3rd Edition, Tata McGraw Hill, Third Reprint 2019.
4. Mehta V. K. and Rohit Mehta.,"Principles of Power Systems", S.Chand and Co., 4th Revised Edition, 2006.
5. Luces M. Fualkenberry and Walter Coffer, "Electrical Power Distribution and Transmission", Pearson Education,1stEdition 1996.
6. Singh S. N., "Electric Power Generation, Transmission and Distribution", Prentice Hall of India Pvt.Ltd, New Delhi, 2008.
7. "Tamil Nadu Electricity Board Handbook", 2003.

COURSE OUTCOMES:

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

CO1: The importance and the functioning of transmission line parameters.

CO2: Grasp the knowledge on the performance of transmission lines.

CO3: Acquire knowledge on mechanical design of transmission lines along with the concepts of lines and insulators.

CO4: Grasp the knowledge on underground cables.

CO5: Clench the knowledge the function of different components used in distribution levels of power system and modeling of these components.

19EEPC502	MICROPROCESSORS AND MICROCONTROLLERS	SEMESTER V

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn the architecture of microprocessor.
- To learn the assembly language programming of microprocessor and microcontroller.
- To know the architecture of microcontroller.
- To understand the use of interfacing techniques.
- To develop the microprocessor and microcontroller based applications.

UNIT-I: 8085 PROCESSOR **9**

Hardware architecture, pinouts – Functional building blocks of processor – Memory organization – I/O ports and data transfer concepts – Timing diagram – Interrupts.

UNIT-II: PROGRAMMING OF 8085 PROCESSOR **9**

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

UNIT-III: 8051 MICRO CONTROLLER **9**

Hardware architecture, pinouts – Functional building blocks of processor – Memory organization – I/O ports and data transfer concepts – Timing diagram – Interrupts – Data transfer, manipulation, control algorithms & I/O instructions, comparison to programming concepts with 8085.

UNIT-IV: PERIPHERAL INTERFACING **9**

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

UNIT-V: MICRO CONTROLLER PROGRAMMING & APPLICATIONS **9**

Simple programming exercises – Key board and display interface – Control of servo motor – Stepper motor control – Application to automation systems.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Sunil Mathur & Jeebananda Panda, "Microprocessor and Microcontrollers", PHI Learning Pvt. Ltd, 2016.
2. RAM B., "Computer Fundamentals Architecture and Organization", New age International Pvt. Ltd., 5th Edition, 2017.
3. Gaonkar R. S., 'Microprocessor Architecture Programming and Application", with 8085, Wiley Eastern Ltd., New Delhi, 2013
4. Muhammad Ali Mazidi, Janice Gilli Mazidi and Kinely R.D.,"The 8051 Micro Controller and Embedded Systems", PHI Pearson Education, 5th Indian reprint, 2003
5. Deshmhmukh L. M., "Microcontrollers (Theory and applications)", Tata McGraw-Hill Publishing Co. Ltd, New Delhi, 2008
6. Douglas V. Hall, "Microprocessor and Interfacing", McGraw Hill Edu,2016.

COURSE OUTCOMES:

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

CO1: Acquire knowledge in addressing modes & instruction set of 8085.

CO2: Need & use of Interrupt structure 8085 & 8051.

CO3: Create interface between digital system and input/output devices.

CO4: Illustrate the architecture of processors and employ the interfacing with various devices.

CO5: Develop the microprocessor and microcontroller based applications.

19EEPC503 **CONTROL SYSTEMS** **SEMESTER V**

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

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

UNIT-I: CONTROL SYSTEM MODELING **9+3**

Basic elements of control system – Open loop and closed loop systems – Transfer function models of linear time-invariant systems – Modelling of electric systems, mechanical systems – Block diagram reduction techniques – Signal flow graph.

UNIT-II: TIME DOMAIN ANALYSIS **9+3**

Standard test signals – Time response of first and second order systems for standard test inputs – Application of initial and final value theorem. Design specifications for second-order systems based on the time response – Error coefficients – Generalized error series – Steady state error – Root locus construction – Effects of P, PI, PID modes of feedback control.

UNIT-III: FREQUENCY DOMAIN ANALYSIS **9+3**

Relationship between time and frequency response, bode plots, polar plots, nyquist plot – Gain and phase margin. Closed-loop frequency response.

UNIT-IV: STABILITY ANALYSIS AND COMPENSATORS **9+3**

Stability – Routh-Hurwitz criterion – Nyquist stability criterion – Relative stability. Series, Parallel, Series-Parallel compensators – Design of lead, lag, and lead lag compensators.

UNIT-V: STATE VARIABLE MODEL **9+3**

Concepts of state variables – State space model – Decomposition of transfer function – Canonical state model – Transfer function from state model – Solution of state equations – State transition matrix – Concept of controllability and observability.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 15**Periods** **Practical:** 0 **Periods** **Total:** 60**Periods**

REFERENCES:

1. Nagarath I. J. and Gopal M., "Control Systems Engineering", New Age International Publishers, 2017.
2. Benjamin C. Kuo, "Automatic Control Systems", Wiley, 2014.
3. Katsuhiko Ogata, "Modern Control Engineering", Pearson, 2015.
4. Richard C. Dorf and Bishop R. H., "Modern Control Systems", Pearson Education,2009.
5. John J. D, Azzo Constantine H, Houpis Sttuart and Sheldon N., "Linear Control System Analysis and Design with MATLAB", CRC Taylor & Francis Reprint 2009.
6. Rames C. Panda and Thyagarajan T., "An Introduction to Process Modelling Identification and Control of Engineers", Narosa Publishing House, 2017.

COURSE OUTCOMES:

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

CO1: Apply the fundamental concepts of control systems and develop the mathematical model of the physical systems.

CO2: Analyze the response of the open and closed loop systems.

CO3: Examine the stability of the open loop and closed loop systems.

CO4: Design suitable compensators for the system.

CO5: Develop and analyze the state space models of system.

19EEPC504 ELECTRICAL MACHINE DESIGN SEMESTER V

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study mmf calculation and thermal rating of various types of electrical machines.
- To design armature and field systems for D.C. machines.
- To design core, yoke, windings and cooling systems of transformers.
- To design stator and rotor of induction machines.
- To design stator and rotor of synchronous machines and study their thermal behaviour.

UNIT-I: INTRODUCTION TO ELECTRICAL MACHINE DESIGN 9

Major considerations in electrical machine design – Electrical engineering materials – Space factor – Choice of specific electrical and magnetic loadings – Concept of magnetic circuit – MMF calculation for various types of electrical machines – Thermal considerations – Heat flow – Temperature rise and insulating materials – Rating of machines – Standard specifications.

UNIT-II: DESIGN OF DC MACHINES 9

Output equations – Main dimensions – Choice of specific electric and magnetic loading – Magnetic circuits calculations – Carter's coefficient – Net length of iron – Selection of number of poles – Design of armature, commutator, air gap, field poles, field coil and brushes.

UNIT III : DESIGN OF TRANSFORMERS 9

Output equations – Main dimensions – kVA output for single and three phase transformers – Window space factor – Design of core, yoke and winding – Overall dimensions – Operating characteristics – No load current – Temperature rise in transformers – Design of tank and cooling tubes of transformers.

UNIT-IV: DESIGN OF INDUCTION MOTORS 9

Output equation of induction motor – Main dimensions – Design of stator – Choice of average flux density – Length of air gap – Rules for selecting rotor slots of squirrel cage machines – Design of rotor bars, slots and end rings – Design of wound rotor – Magnetizing current – Short circuit current – Operating characteristics – Losses and efficiency.

UNIT-V: DESIGN OF SYNCHRONOUS MACHINES 9

Output equations – Choice of electrical and magnetic loading – Design of salient pole machines – Short circuit ratio – Shape of pole face – Armature design – Estimation of air gap length – Design of rotor and damper winding – Determination of full load field mmf – Design of field winding – Design of turbo alternators – Rotor design.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Sawhney A. K., "A Course in Electrical Machine Design", Dhanpat Rai & Sons, New Delhi, 2016.
2. Deshpande M.V.,"Design and Testing of Electrical Machines", PHI learning Pvt Lt, 2011.
3. Sen S. K., "Principles of Electrical Machine Designs with Computer Programmes",Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2009.

4. Rajini V and Nagarajan V. S., “Electrical Machine Design”, Pearson, 2018.
5. Shanmugasundaram A, Gangadharan G and Palani R.,“Electrical Machine Design DataBook”, New Age International Pvt. Ltd., Reprint 2007.
6. Vishnumurthy K. M.,“Computer aided design of electrical machines”, B SPublications, 2008.
7. Agarwal R. K.,“ Principles of Electrical Machine Design”, Esskay Publications, Delhi, 2002.

COURSE OUTCOMES:

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

CO1: Acquire the knowledge about the electrical apparatus for design of electrical machines.
CO2: Model the field and armature design of DC machines analysis.
CO3: Analysis the design of various types of transformer.
CO4: Model the stator and rotor of induction motor.
CO5: Design the field and armature system of AC machines.

19EEPC505 MEASUREMENTS AND INSTRUMENTATION SEMESTER V

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn the basic functional elements of instrumentation.
- To learn the fundamentals of electrical and electronic instruments.
- To measure the comparison between various measurement techniques.
- To study about the various storage and display devices.
- To understand the concepts of various transducers and the data acquisition systems.

UNIT-I: INTRODUCTION 9

Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement – Statistical evaluation of measurement data – Standards and calibration – Principle and types of analog and digital voltmeters, ammeters.

UNIT-II: ELECTRICAL AND ELECTRONIC INSTRUMENTS 9

Principle and types of multi meters – Single and three phase watt meters and energy meters – Magnetic measurements – Determination of B-H curve and measurements of iron loss – Instrument transformers – Instruments for measurement of frequency and phase.

UNIT-III: COMPARATIVE METHODS OF MEASUREMENTS 9

D.C potentiometers, D.C bridges (Wheat stone, Kelvin and Kelvin Double bridge) & A.C bridges (Maxwell, Anderson and Schering bridges), transformer ratio bridges, self-balancing bridges. Interference & screening – Multiple earth and earth loops – Electrostatic and electromagnetic Interference – Grounding techniques.

UNIT-IV: STORAGE AND DISPLAY DEVICES 9

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

UNIT-V: TRANSDUCERS AND DATA ACQUISITION SYSTEMS 9

Classification of transducers – Selection of transducers – Resistive, capacitive & inductive Transducers – Piezoelectric, Hall effect, optical and digital transducers – Elements of data acquisition system – Smart sensors – Thermal Images.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Sawhney A.K., "A Course in Electrical and Electronics Measurements and Instrumentation", DhanpatRai& Sons,19th Edition 2015.
2. David A Bell, "Electronic Instrumentation and Measurements", 3rd Edition, Oxford University Press,2006.
3. Golding E.W. and Widdis F.G., "Electrical Measurements and Measuring Instruments", A.H. Wheeler & Co., Ahmedabad , 2011.
4. Helfrick A.D and Cooper W.D., "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall India Pvt. Ltd., New Delhi, 2010 .
5. Kalsi H.S., "Electronic Instrumentation", Tata McGraw-Hill, New Delhi, 2010.

COURSE OUTCOMES:

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

CO1: Acquire knowledge on basic functional elements of instrumentation.
CO2: Understand the concepts of fundamentals of electrical and electronic instruments.
CO3: Analysis the comparison methods of measurement techniques.
CO4: Acquire knowledge on various storage and display devices.
CO5: Understand the concepts various transducers and the data acquisition systems.

19EEPC506 **MICROPROCESSORS AND MICROCONTROLLERS LABORATORY** **SEMESTER V**

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To learn the practical aspects of Microprocessors and Microcontroller.

LIST OF EXPERIMENTS

1. Simple arithmetic operations: addition / subtraction / multiplication / division
2. Programming with control instructions:
   (i) Ascending / Descending order, Maximum / Minimum of numbers
   (ii) Programs using Rotate instructions
   (iii) Hex / ASCII / BCD code conversions
3. Interface Experiments: with 8085
   (i) A/D Interfacing & D/A Interfacing
4. Traffic light controller
5. I/O Port / Serial communication
6. Programming Practices with Simulators / Emulators / open source
7. Read a key, interface display
8. Demonstration of basic instructions with 8051 Micro controller execution, including:
   (i) Conditional jumps, looping
   (ii) Calling subroutines
9. Programming I/O Port and timer of 8051
   (i) Study on interface with A/D & D/A
   (ii) Study on interface with DC & AC motor
10. Stepper Motor Interfacing with 8051

Contact periods:

Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 45 Periods** **Total: 45 Periods**

COURSE OUTCOMES:

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

CO1: Understand and apply computing platform and software for engineering problems.
CO2: Apply programming logics for code conversion.
CO3: Acquire knowledge on A/D and D/A.
CO4: Understand basics of serial communication and basics of software Simulators.
CO5: Impart knowledge in DC, AC and stepper motor interfacing.

19EEPC507 MEASUREMENTS AND CONTROL SYSTEMS LABORATORY **SEMESTER V**

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To impart practical experience on the theoretical knowledge gained in the field of measurements, instrumentation and control systems.

LIST OF EXPERIMENTS

1. Measurement of resistance, inductance and capacitance using bridge circuits
2. Dynamics of displacement transducer
3. Dynamics of flow sensor
4. Instrumentation amplifier
5. Analog-Digital and Digital-Analog converters (ADC and DACs)
6. Transfer function of armature controlled and field controlled DC motor
7. Transfer function of separately excited DC generator
8. Simulation of stability analysis
9. Design and simulation of PI and PID controllers for a second order system
10. AC and DC position control system
11. Design of Lag, Lead and Lag-Lead Compensators
12. Synchro

Contact periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:

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

CO1: Experiment the various measuring techniques for electrical quantity.
CO2: The basics of signal conditioning circuits and various types of converters.
CO3: Develop transfer function model of electrical systems like DC machines.
CO4: Design suitable controllers for closed loop operation of second order systems.
CO5: Study the simulation packages.

19EEHS601 TECHNOLOGY MANAGEMENT SEMESTER VI

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn the intricacies of technology selection.
- To get an insight into the role of technology in today's business.

UNIT-I: INTRODUCTION 9

Evolution, growth of technology, role and significance of technology management, forms of technology – Process, product technology, impact of technology on society and business, technology and competition.

UNIT-II: TECHNOLOGY FORECASTING 9

Technology forecasting, characteristics, principles, process, forecasting methods and techniques.

UNIT-III: ACQUISITION OF NEW TECHNOLOGY 9

Alternative for acquiring new technology, reasons to obtain new technology, management of acquired technology, measures of scale and mechanisms for acquiring technologies. Technology Transfer – Models, modes of transfer, dimensions of technology transfer, features of technology package – Routes of technology transfer.

UNIT-IV: HUMAN ASPECTS OF TECHNOLOGY MANAGEMENT 9

Integration of people and technology, factors considered in technology management – Organizational, psychological, organizational structure and technology – Technological change and industrial relations.

UNIT-V: SOCIAL ASPECTS OF TECHNOLOGY MANAGEMENT 9

Technology Assessment and Environmental Impact Analysis (EIA) – EIA – Process, scope, issues in report preparation, elements of environmental problem, case study on social impact of technology.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Sanjiva Shankar Dubey, "Technology and Innovation Management", PHI Learning Private Ltd., 2017.
2. Gerard H. Gaynor, "Hand Book Technology of Management", McGraw Hill professional, 2009.
3. Khalil T., "Management of Technology: The Key to competitiveness and wealth creation" Tata McGraw Hill, Delhi,2013.
4. Ralph Katz, "The Human Side of Managing Technological Innovation: A Collection of Readings", 2nd Edition Oxford University Press, 2003.

COURSE OUTCOMES:

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

CO1: Learn to manage ideas and knowledge in a technology-based organization.
CO2: Equipped with skills needed to implement technology policies and strategies.
CO3: Formulate technology policies and strategies for businesses.

CO4: Appropriately choose the new technologies.
CO5: Foresee future technological requirements.

19EEPC602 **POWER SYSTEM ANALYSIS** **SEMESTER VI**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To model the power system under steady state operating condition.
- To understand and apply iterative techniques for power flow analysis.
- To model and carry out short circuit studies on power system under symmetrical fault.
- To model and carry out short circuit studies on power system under unsymmetrical fault.
- To model and analyze stability problems in power system.

UNIT-I: INTRODUCTION **9**

Need for system planning and operational studies – Basic components of a power system – Single line diagram – Per phase and per unit analysis – Generator – Transformer – Transmission line and load representation for different power system studies – Primitive network – Construction of Y-bus using inspection and singular transformation methods – Z-bus – Building algorithm.

UNIT-II: POWER FLOW ANALYSIS **9**

Importance of power flow analysis in planning and operation of power systems – Statement of power flow problem – Classification of buses – Development of power flow model in complex variables form – Iterative solution using Gauss-Seidel method – Q-limit check for voltage controlled buses – Power flow model in polar form – Iterative solution using Newton-Raphson method.

UNIT-III: ANALYSIS OF BALANCED FAULTS **9**

Importance of short circuit analysis – Assumptions in fault analysis – Analysis using Thevenin's theorem – Fault analysis using Z-bus – Computations of short circuit capacity, post fault voltages and currents.

UNIT-IV: ANALYSIS OF UNBALANCED FAULTS **9**

Introduction to symmetrical components – Sequence impedances – Sequence circuits of synchronous machine, transformer and transmission lines – Sequence networks – Analysis of single line to ground, line to line and double line to ground faults using Thevenin's theorem and Z-bus.

UNIT-V: STABILITY ANALYSIS **9**

Importance of stability analysis in power system planning and operation – Classification of power system stability – Rotor angle and voltage stability – Single Machine Infinite Bus (SMIB) system: Development of swing equation – Equal area criterion – Determination of critical clearing angle and time – Solution of swing equation by Modified Euler method and Runge-Kutta fourth order method.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. John J. Grainger and William D. Stevenson Jr, "Power System Analysis", Tata Mc Graw Hill, 2015.
2. Nagrath I. J. and Kothari D. P., "Modern Power System Analysis", Tata Mc Graw Hill, Publishing Co. Ltd., New Delhi, 4th Edition 2011.

3. Wadhwa C. L., "Electrical Power Systems", New Age International Pvt. Ltd., New Delhi, 2017.
4. Olle. I. Elgerd, "Electric Energy Systems Theory – An Introduction", Tata Mc Graw Hill Publishing Company Limited, New Delhi, 2nd Edition, 2012.
5. Hadi Saadat, "Power System Analysis", Tata Mc Graw Hill Education Pvt. Ltd., New Delhi, 3rd Edtiton, 2011.
6. Pai M A., "Computer Techniques in Power System Analysis", Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 3rd Edition, 2017.

COURSE OUTCOMES:

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

CO1: Model the power system under steady state operating conditions.
CO2: Illustrate numerical methods to solve the power flow problem.
CO3: Model and analyze the system under faulted conditions.
CO4: Model and analyze the transient behavior of power system under fault conditions.
CO5: Evaluate the power system network for the stable operation.

19EEPC603 **POWER ELECTRONICS** **SEMESTER VI**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To get an overview of different types of power semiconductor devices and their switching characteristics.
- To understand the operation, characteristics and performance parameters of controlled rectifiers.
- To study the operation, switching techniques and basics topologies of DC-DC switching regulators.
- To learn the different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
- To study the operation of AC voltage controller and various configurations.

UNIT-I: INTRODUCTION **9**

Basic structure and switching characteristics of power diode – Power transistor – SCR – Triac – GTO – MOSFET and IGBT – Ratings of SCR – di/dt and dv/dt protection – Introduction of ICT – SIT – SITH and MCT – IGCT – Gate driving circuits.

UNIT-II: CONTROLLED RECTIFIERS **9**

Operation of 1-phase half wave and full wave rectifiers with R-RL and RLE load (Fully controlled and Half controlled) operation and analysis of rectifiers – Operation of 3-phase half wave rectifier and full wave rectifier with R and RL loads – Effect of source impedance in 1-phase full converter – Phase dual converter operation.

UNIT-III: DC CHOPPERS **9**

Classification and operation of different types of choppers – Control strategies – Regulators – Buck regulator – Boost regulator – Buck-Boost regulator – SEPIC converters and Resonant converters – SMPS – Applications

UNIT-IV: INVERTERS **9**

Types of inverters – Operation of 1-phase – 3-phase bridge inverters (120 deg and 180 deg modes) – Current source inverter – 1-phase ASCSI– Types of PWM techniques (single pulse, multiple pulse and sine PWM) – Modulation index – Introduction to multilevel inverter – Applications

UNIT-V: AC VOLTAGE CONTROLLERS **9**

Types of control (Phase and Integrated cycle control) – Operation of 1-phase voltage regulator with R-RL loads – Operation of 3-phase AC voltage controller with R load – 1-phase step up and step down cyclo converters – Matrix Converter.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Muhammad H. Rashid "Power Electronics – Circuits- Devices and Applications", Prentice Hall of India-New Delhi-4th Edition, 2014.
2. Ned Mohan,"Power Electronics-Converter Applications and Design Wiley", 3rd Edition, Reprint 2009.
3. Dr.Bhimbra P.S.,"Power Electronics", Khanna Publishers, 3rd Edition, Reprint 2014.

4. Singh M. D and Khanchandani K.B.,"Power Electronics", Tata McGraw Hill Publishing Co. Ltd,New Delhi- 3rd Reprint 2012.
5. Dubey G. K, Doradla S.R, Joshi A and Sinha R.M.K.,"Thyristorised Power Controllers", New Age International Publishers Ltd., 1st Edition, Reprint 2012.
6. Vedam Subramaniam, "Power Electronics", New Age International Pvt. Ltd.2nd Edition, Reprint, 2012.

COURSE OUTCOMES:

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

CO1: Acquire knowledge about fundamental concepts and techniques used in power electronics.
CO2: Illustrate and compare performance of various controlled rectifiers.
CO3: Demonstrate the operation of switching regulators.
CO4: Acquire knolwedge about various types of inverters and PWM techniques.
CO5: Acquire knolwedge about various types of AC voltage controllers.

19EEPC604 POWER ELECTRONICS AND DRIVES LABORATORY SEMESTER VI

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To design, evaluate and analyze the performance of power electronic converters circuits and drives.

LIST OF EXPERIMENTS

1. V-I characteristics of SCR and TRIAC
2. V-I characteristics of MOSFET and IGBT
3. V-I characteristics of GTO and IGCT
4. Single phase half controlled rectifier
5. Single phase fully controlled bridge rectifier
6. Buck and Boost converter
7. Single phase PWM inverter
8. Single phase voltage control using SCR and TRIAC
9. Three phase PWM Inverter
10. Switched mode power converter
11. Characteristics of PMBLDC Motor
12. Simulation of PE circuits (1φ & 3φ semi converter, 1φ & 3φ full converter, DC-DC converters, AC voltage controllers)

Contact periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:

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

CO1: Analyze the characteristics of power semiconductor devices.
CO2: Build and test various power electronic converters.
CO3: Design of control techniques and circuits for power converters.
CO4: Evaluate the performance of solid state drives.
CO5: Simulation of converters, inverter, AC voltage controller and chopper.

19CAHS003 COMMUNICATION SKILLS LABORATORY SEMESTER VI

L	T	P	C
0	0	2	1

COURSE OBJECTIVES:

- To equip students with the English language skills required for the successful undertaking of academic studies with primary emphasis on academic speaking and listening skills.
- To provide guidance and practice in basic general and classroom conversation and to engage in specific academic speaking activities.
- To strengthen the reading skills of students of engineering.
- To enhance their writing skills with specific reference to technical writing.
- To develop effective communication skills.

UNIT I: 6

Listening – Listening & answering – listening to a lecture & pronunciation – **Speaking** – Giving & asking personal information – **Reading** – Strategies for effective reading and Reading comprehension – **Writing** – Develop a paragraph: topic sentence, supporting sentences and concluding sentence – Descriptive paragraph writing.

UNIT II: 6

Listening– Listening to process information–stress & intonation patterns – **Speaking** – Small talk – converse with reasonable accuracy over a wide range of everyday topics – **Reading** – Read for details – Use of graphic organizers to review and aid comprehension – **Writing**–State reasons and examples to support ideas in writing – Write a paragraph with reasons and examples– Opinion paragraph writing.

UNIT III: 6

Listening – Lexical chunking for accuracy and fluency – factors influence fluency – listen for and follow the gist – listen for details – **Speaking** – Informal talk – describing health & symptoms – **Reading** – Connectors and Pronouns in a passage – Speed reading techniques – **Writing** – Elements of a good essay – Types of essays – descriptive, narrative, issue-based, argumentative and analytical.

UNIT IV: 6

Listening– Active listening – **Speaking** – Giving verbal and non-verbal feedback – Listening & participating in conversations – Strategies for presentations: group/pair presentations – **Reading** – Genre and Organization of Ideas – **Writing** – Email writing – visumes – Job application – Project writing – Writing convincing proposals.

UNIT V: 6

Listening – Listening & responding to explanations in academic & business contexts – **Speaking** – Participating in a group discussion – **Reading** – Critical reading and thinking – understanding how the text positions the reader – **Writing** – Statement of Purpose – Letter of recommendation – Vision statement

Contact periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 30 Periods Total: 30 Periods

REFERENCES:

1. Ladousse, Gillian Porter, "Role Play", Oxford University Press: Oxford, 2014
2. Hughes, Glyn and Josephine Moate, "Practical English Classroom", Oxford University Press: Oxford, 2014.
3. Davis, Jason and Rhonda Liss, "Effective Academic Writing (Level 3)", Oxford University Press: Oxford, 2006.
4. Debra Daise, Charl Norloff and Paul Carne, "Reading and Writing (Level 4)", Oxford University Press: Oxford, 2010.
5. Withrow, Jeans and et al., "Inspired to Write. Readings and Tasks to Develop Writing Skills". Cambridge University Press: Cambridge, 2004.
6. Robert M Sherfield and et al. "Developing Soft Skills" 4th edition, New Delhi: Pearson Education, 2009.

COURSE OUTCOMES:

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

CO1: Listen and respond appropriately.
CO2: Make effective presentations and participate in group discussions.
CO3: Read and evaluate texts critically.
CO4: Write winning job applications.
CO5: Display critical thinking in various professional contexts.

19EEPC701 RENEWABLE ENERGY SYSTEMS SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To acquire knowledge about renewable energy sources and technologies.
- To adequate inputs on a variety of issues in harnessing renewable energy.
- To recognize current and possible future role of renewable energy sources.

UNIT-I: RENEWABLE ENERGY (RE) SOURCES 9

Environmental consequences of fossil fuel use, Importance of renewable sources of energy, Sustainable design and development, Types of RE sources, Limitations of RE sources, Present indian and international energy scenario of conventional and RE sources.

UNIT-II: WIND ENERGY 9

Power in the wind – Types of wind power plants(WPPs)–Components of WPPs – Working of WPPs – Siting of WPPs – Grid integration issues of WPPs.

UNIT-III: SOLAR PV AND THERMAL SYSTEMS 9

Solar radiation, radiation measurement, solar thermal power plant, central receiver power plants, solar ponds – Thermal energy storage system with PCM – Solar photovoltaic systems : Basic principle of SPV conversion – Types of PV systems – Types of solar cells, photovoltaic cell concepts: cell, module, array,PV Module I-V characteristics, efficiency &quality of the cell, series and parallel connections, maximum power point tracking, applications.

UNIT-IV: BIOMASS ENERGY 9

Introduction – Bio mass resources –Energy from bio mass: conversion processes – Biomass cogeneration – Environmental benefits. Geothermal Energy: basics, direct use, geothermal electricity. Mini/micro hydro power: classification of hydropower schemes, classification of water turbine, turbine theory, essential components of hydroelectric system.

UNIT-V: OTHER ENERGY SOURCES 9

Tidal Energy: Energy from the tides, barrage and non barrage tidal power systems. Wave Energy: Energy from waves, wave power devices. Ocean thermal energy conversion (OTEC) – Hydrogen production and storage – Fuel cell : Principle of working – Various types – construction and applications. Energy Storage System – Hybrid energy systems.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Scott Grinnell, "Renewable Energy & Sustainable Design", Cengage Learning, USA, 2016.
2. Twidell & Wier, "Renewable Energy Resources", CRC Press (Taylor & Francis), 2011.
3. Tiwari and Ghosal, "Renewable energy resources", Narosa Publishing House, 2007.
4. Ramesh R & Kumar K. U., "Renewable Energy Technologies",Narosa Publishing House, 2004.
5. Mittal K. M ., "Non-Conventional Energy Systems", Wheeler Publishing Co. Ltd, New Delhi, 2003.
6. Kothari D. P and Singhal K. C., "Renewable energy sources and emerging technologies", P.H.I, New Delhi, 2013.

COURSE OUTCOMES:

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

CO1: Explain the various renewable energy resources and technologies and their applications.

CO2: Get adequate inputs on a various types of wind energy.

CO3: Knowledge in applying solar energy in a useful way.

CO4: Understand basics about biomass energy.

CO5: Knowledge in capturing and applying other forms of energy sources like tidal and ocean energies.

19EEMC702 CONSTITUTION OF INDIA SEMESTER VII

L	T	P	C
3	0	0	0

COURSE OBJECTIVES:

- To familiarize about central and state government functionalities in india.

9

UNIT-I: INTRODUCTION

Historical background – Constituent assembly of india – Philosophical foundations of the indian Constitution – Preamble – Fundamental rights – Directive principles of state policy – Fundamental duties – Citizenship – Constitutional remedies for citizens.

UNIT-II: STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT 9

Union government – Structures of the union government and functions – President – Vice president – Prime minister – Cabinet – Parliament – Supreme court of india – Judicial review.

UNIT-III: STRUCTURE AND FUNCTION OF STATE GOVERNMENT 9

State government – Structure and functions – Governor – Chief minister – Cabinet – State legislature – Judicial system in states – High courts and other subordinate courts.

UNIT-IV: CONSTITUTION FUNCTIONS 9

Indian federal system – Center – State relations – President's rule – Constitutional amendments – Constitutional functionaries – Assessment of working of the parliamentary system in india.

UNIT-V: ELECTION COMMISSION 9

Election commission – Role and functioning, chief election commissioner and election commissioners – State election commission – Role and functioning – Institute and bodies for the welfare of SC/ST/OBC and women.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Durga Das Basu, "Introduction to the Constitution of India", LexisNexis, 23rdEdition, 2018.
2. Brij Kishore Sharma, "Introduction to the Constitution of India", Prentice Hall of India, New Delhi, 7thEdition, 2015.
3. Bakshi P.M., "The Constitution of India" Universal Law Publishing, 13thEdition, 2014.

COURSE OUTCOMES:

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

CO1: Explain the basics of Indian constitution.
CO2: Discuss about structure and function of central government.
CO3: Discuss about structure and function of state government.
CO4: Describe about constitution functions.
CO5: Compare the roles and responsibilities of central and state election commissioners.

19EEPC703 POWER SYSTEM & RENEWABLE ENERGY LABORATORY SEMESTER VII

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- To remember previously learned information about power system problem and apply to practical situations for planning and evaluation.
- To train the students in Renewable Energy Sources and technologies.

LIST OF EXPERIMENTS

1. Computation of parameters and modeling of transmission lines.
2. Formation of bus admittance and impedance matrices.
3. Load flow analysis using Gauss-Seidel and Newton-Raphson method.
4. Symmetric and unsymmetrical fault analysis.
5. Load-frequency dynamics of single-area and two-area power systems.
6. Economic dispatch in power systems.
7. Experiment on VI-Characteristics and efficiency of 1kWp solar PV system.
8. Experiment on shadowing effect & diode based solution in 1kWp solar PV system.
9. Experiment on performance assessment of micro wind energy generator.
10. Simulation study on solar PV energy system.
11. Simulation study on wind energy generator.

Contact periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:

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

CO1: Acquire knowledge on formation of bus admittance and impedance matrices and solution of networks.

CO2: Analyze the power flow using GS and NR method.

CO3: Find symmetric and unsymmetrical fault.

CO4: Understand and analyze renewable energy systems.

CO5: Simulate the various renewable energy sources.

19EEEE704	MINI PROJECT	SEMESTER VII

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- To develop their own innovative prototype of ideas.
- To train the students in preparing mini project reports and examination.

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

Contact Periods:

Lecture: 0 **Periods** **Tutorial:** 0 **Periods** **Practical:** 60 **Periods** **Total:** 60 **Periods**

COURSE OUTCOMES:

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

CO1: On completion of the mini project work students will be in a position to take up their final year project work and find solution by formulating proper methodology.

19CAHS004 PROFESSIONAL ETHICS IN ENGINEERING SEMESTER VIII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the importance of Values and Ethics in their professional careers.
- To know the different ideas of engineering ethics.
- To Infer moral judgment concerning the profession
- To inculcate the sense of social responsibility.
- To know the global issues of ethics.

UNIT-I: HUMAN VALUES 9

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.

UNIT-II: ENGINEERING ETHICS 9

Senses of engineering ethics – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral autonomy – Kohlberg‘s theory – Gilligan‘s theory – Consensus and controversy – Models of professional roles – Theories about right action – Self-interest – Customs and religion – Uses of ethical theories.

UNIT-III: ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as experimentation – Engineers as responsible experimenters – Codes of ethics – A balanced outlook on law.

UNIT-IV: SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and risk – Assessment of safety and risk – Risk benefit analysis and reducing risk – Respect for authority – Collective bargaining – Confidentiality – Conflicts of interest – Occupational crime – Professional rights – Employee rights – Intellectual property rights (IPR) – Discrimination.

UNIT-V: GLOBAL ISSUES 9

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.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2009.
2. Govindarajan M., Natarajan S. and Senthil Kumar V. S., “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.
3. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
4. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.
5. John R. Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi,

2003
6. Edmund G. and Robert L. Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, 2001.

COURSE OUTCOMES:

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

CO1: Apply human values.
CO2: Apply ethical issues related to Engineering.
CO3: Realize the code of Ethics.
CO4: Realize the responsibilities and rights in the society.
CO5: Know Global Issues.

19EEEE802	PROJECT WORK	SEMESTER VIII

L	T	P	C
0	0	16	8

COURSE OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

Contact Periods:

Lecture: 0 **Periods** **Tutorial:** 0 **Periods** **Practical:** 240 **Periods** **Total:** 240 **Periods**

COURSE OUTCOMES:

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

CO1: On completion of the project work students will be in a position to take up their project work to formulating proper model.

19EEPE601 PRINCIPLES OF VIRTUAL INSTRUMENTATION SEMESTERVI

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the virtual instrumentation concepts towards measurements.
- Perform the graphical programming using LabVIEW.
- To understand the concepts of data acquisition system.
- Analyze the performance of various instrument control.
- Perform the applications of virtual instrumentation.

UNIT-I: VIRTUAL INSTRUMENTATION 9

Introduction – Block diagram and architecture of a virtual instrument – Conventional Instruments versus virtual instruments – Data flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT-II: GRAPHICAL PROGRAMMING 9

Front panel – Block diagram – VIs – Sub-VIs – Simple examples – Looping: For loop, while loop – Shift registers – Case and sequence; structures, formula nodes. Arrays – Clusters, charts and graphs – Local and global variables – Property node, string and file I/O. Publishing measurement data in the web.

UNIT-III: DATA ACQUISITION 9

DAQ – Components – Buffers – Triggering – Analog I/O – Digital I/O – Counters and timers – DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.

UNIT-IV: INSTRUMENT CONTROL 9

VI chassis requirements. Common instrument interfaces: Current loop, RS232C / RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, compact RIO – Firewire. PXI system controllers – Ethernet control of PXI. Networking basics for office – Industrial applications – VISA and IVI.

UNIT-V: APPLICATION OF VIRTUAL INSTRUMENTATION 9

VI toolsets, Distributed I/O modules Instrument Control – Process database management system – Simulation of systems using VI – Development of control system – Industrial communication – Image acquisition and processing – Motion control.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Sanjay Gupta and Joseph John,"Virtual Instrumentation using LabVIEW", Tata McGraw-Hill, Second Edition 2010.
2. Jovitha Jerome,"Virtual Instrumentation Using LabVIEW",PHI Learning Pvt. Ltd 1st Edition, 2010.
3. Gupta S. and Gupta J.P.,"PC interfacing for data acquisition and process control", 2nd Edition, Instrument Society of America, 1994.
4. Gary Johnson and Richard Jennings,"Lab view graphical programming", Tata McGraw Hill, 2011.
5. Lisa K Wells and Jeffrey Travels, "Labview for everyone", Prentice Hall, 3rd Edition 2009

COURSE OUTCOMES:

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

CO1: Explain the concepts of virtual instruments.

CO2: Apply the programming concepts using LabVIEW.

CO3: Demonstrate the program in LabVIEW for system monitoring, processing and controlling operations.

CO4: Demonstrate the program in LabVIEW and interfacing with related hardware's.

CO5: Develop real time applications using LabVIEW.

19EEPE602 NEURAL AND FUZZY SYSTEMS SEMESTER VI

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To acquire the knwledge about the behavior of human neural network and concept of fuzziness.
- To understand the methods of training of artificial intelligent systems.
- To apply the basic concepts of fuzzy logic systems.
- To understand the concepts of fuzzification and defuzzification.
- To possess knowledge about the principle and concepts of fuzzy arithmetic and vector.

UNIT-I: INTRODUCTION TO NEURAL NETWORKS 9

Introduction – Biological and Artificial neural networks – Learning rules – Training – ADALINE – MADALINE – BAM – Discrete Hopfield networks.

UNIT-II: ARTIFICIAL NEURAL NETWORKS 9

Theory, architecture and applications of Back propagation network – Counter propagation network – Kohenen's Self Organising Maps.

UNIT-III: INTRODUCTION TO FUZZY LOGIC 9

Fuzzy sets and membership – Chance Vs Ambiguity – Classical sets – Fuzzy sets – Fuzzy relations – Tolerance and equivalence relations – Value assignments.

UNIT-IV: FUZZIFICATION AND DEFUZZIFICATION 9

Fuzzification – Membership value assignments – Fuzzy to Crisp conversions – Lambda – Cuts for Fuzzy sets and relations – Defuzzification methods.

UNIT-V: FUZZY ARITHMETIC, NUMBERS, VECTORS AND EXTENSION PRINCIPLE 9

Extension principle – Fuzzy numbers – Interval analysis in arithmetic – Approximate methods of extension: Vertex method, DSW algorithm, restricted DSW algorithm – Fuzzy vectors – Classical predicate logic – Approximate reasoning – Fuzzy tautologies, contradictions, equivalence and logical proofs.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Laurene Fausett,"Fundamentals of Neural Networks", Prentice Hall, New Jersey, 2004.
2. Rajasekaran S and Vijayalakshmi Pai G.A.,"Neural Networks, Fuzzy Logic and Evolutionary Algorithm: Synthesis and Applications" PHI Learning Pvt. Ltd., 2017.
3. Timothy J.Ross,"Fuzzy logic with Engineering Applications", Wiley India Pvt. Ltd., 3rd Edition, 2011.
4. Robert J.Schalkoff, "Artificial Neural Networks", McGraw Hill, Singapore, 2011.
5. Sivanandam S.N and Deepa S.N., "Principles of Soft Computing", Wiley India Pvt. Ltd., 3rd Edition, 2019.

COURSE OUTCOMES:

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

CO1: Understand the behavior of human neural network and concept of fuzziness.

CO2: Explore the methods of training of Artificial Intelligent systems.
CO3: Know the basic cocepts of fuzzy logic systems.
CO4: Apply the concepts of fuzzification and defuzzification.
CO5: Understand the principle and concepts of fuzzy arithmetic and vector.

19EEPE603 POWER SYSTEM ECONOMICS SEMESTER VI

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study about the charateristics and operation of various power plants.
- To acquire knowledge on optimal operation of generating plants in power system.
- To learn about hydro thermal coordination and applications of economic scheduling.
- To acquire knowledge on unit commitment in power generating plants.
- To analyze the generation system reliability.

UNIT-I: CHARACTERISTICS AND OPERATION OF POWER PLANTS 9

Characteristics operation of power plants – Choice of power plants – Hydro, thermal and Nuclear – Size of plant – Input / Output curves – Review of economic dispatch and loss formula calculations.

UNIT-II: OPTIMAL OPERATION OF GENERATING PLANTS 9

Economic scheduling – Cost and loss calculation for optimum economy – Practical calculation, Evaluation and application of generation – Analog and digital methods – Simple problems.

UNIT-III: HYDRO THERMAL COORDINATION 9

Long term co-ordination – Mathematical formulation – Short term co-ordination: methods and scheduling by Kirchmayer's method – Gradient approach – Hydro units in series – Evaluation and applications of economic scheduling of thermal and hydro stations.

UNIT-IV: UNIT COMMITMENT 9

Constraints in unit commitment for thermal and hydro plants – Cost function formulation – solution methods: priority list, dynamic programming methods – Optimal UC with security constraint.

UNIT-V: GENERATION SYSTEM RELIABILITY ANALYSIS 9

Purpose and classification of load forecasting and system reliability – Generation system reliability – Co-ordination methods – Economic operation of power systems – Simple problems.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Elgerd O.I.,"Electric Energy System Theory an Introduction", Tata McGraw Hill, New Delhi, 2008.
2. Sivanagaraju S. and Sreenivasan G.,"Power System Operation and Control", Pearson Education India, 2010.
3. Kirchmayer E. K.,"Economic Operation of Power Systems", John Wiley and sons, New Delhi, 1985.
4. Allen Wood J and Wollenberg B.F.,"Power Generation Operation and Control", John Wiley and sons, New Delhi, 2007.
5. Hawany E.L and Christensen G.S.,"Optimal Economic Operation of Electric Power Systems", Academic Press, New York, 1979.
6. Sullivan R.L., "Power System Planning", McGraw Hill, New York, 1977.

COURSE OUTCOMES:

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

CO1: Understand the Thermal and Hydro generator characteristics.

CO2: Apply mathematical tool to examine the performance of different generating sources in coordination.

CO3: Evaluate the optimal scheduling of generators in power system using conventional optimization techniques.

CO4: Analyze the importance of constraints in unit commitment.

CO5: Analyze the importance of maintaining reliability of generation system.

19EEPE604 POWER QUALITY ENGINEERING SEMESTER VI

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the power quality problem.
- To educate on protection of voltage sags and methods of control.
- To study overvoltage problems.
- To study the effects of harmoincs in power system.
- To impart knowledge on various methods of power quality monitoring.

UNIT-I: INTRODUCTION TO POWER QUALITY 9

Overview of power quality phenomena – Classification of power quality issues – Power quality measures and standards – THD – TIF – DIN – C – Message weights – Flicker factor – Transient phenomena – Occurrence of power quality problems – Power acceptability curves – IEEE guides, standards and recommended practices.

UNIT-II: VOLTAGE SAGS AND INTERRUPTIONS 9

Sources of sags and interruptions – Estimating voltage sag performance – Motor starting sags – Estimating the sag severity mitigation of voltage sags – Active series compensators – Static transfer switches and fast transfer switches.

UNIT-III: OVERVOLTAGES 9

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 computer analysis tools for transients – PSCAD and EMTP.

UNIT-IV: HARMONICS 9

Harmonic distortion: Voltage and current distortion – Harmonic indices – Harmonic sources from commercial and industrial loads – Locating harmonic sources – Power system response characteristics – Resonance – Harmonic distortion evaluation – Devices for controlling harmonic distortion – Passive filters – Active filters – IEEE and IEC standards.

UNIT-V: POWER QUALITY MONITORING 9

Monitoring considerations: Power line disturbance analyzer – Power quality measurement equipment – Harmonic / spectrum analyzer – Flicker meters – Disturbance analyzer – Applications of expert system for power quality monitoring.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Roger. C. Dugan, Mark. F.McGranagham, Surya Santoso and Wayne Beaty H.,"Electrical Power Systems Quality", McGraw Hill, 3rd Edition, 2012.
2. Kisko Alexander Thomson Marc. T.,"Power Quality in Electrical Systems", McGraw Hill, Professional, 2007.
3. Mat H. J. Bollen and Ireen G. U.,"Signal Processing of Power Quality Disturbance", Willey, IEEE press, 2006.
4. Heydt G. T., "Electric power quality", Stars in a Circle Publications, 1994.
5. Math H. Bollen, "Understanding Power Quality Problems", IEEE Press,2000.

COURSE OUTCOMES:

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

CO1: Study and understand the basics and necessity of power quality.

CO2: Understand the basics of voltage sag and interruption.

CO3: Examine and compute the harmonic distortion.

CO4: Identify methods to manage the overvoltage.

CO5: Understand and design the active and passive filters and design the power quality monitoring equipment.

19EEPE605 AUTOMOTIVE ELECTRONICS FOR ELECTRICAL ENGINEERING **SEMESTER VI**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To familiarize the electronics involved in automotive systems.
- To understand the fundamentals involved in ignition systems.
- To identify appropriate sensors for automobiles based on applications.
- To implement a simple and safe control systems in automobiles.
- To analyze the safety issues that occur in automotive systems.

UNIT-I: FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS 9

Evolution of electronics in automobiles, emission laws, introduction to Euro standards, equivalent Bharat standards, charging systems: Working and design of charging circuit, alternators, requirements of starting system, starter motors and starter circuits.

UNIT-II: IGNITION AND INJECTION SYSTEMS 9

Ignition systems: Ignition fundamentals, electronic ignition system, programmed ignition, distribution less ignition, direct ignition, spark plugs, electronic fuel control, basics of combustion, engine fuelling and exhaust emission, electronic control of carburetion, petrol fuel injection, diesel fuel injection.

UNIT-III: SENSORS AND ACTUATORS 9

Working principle and characteristics of airflow rate, engine crank shaft angular position, hall effect, throttle angle, temperature, exhaust gas oxygen sensors. Fuel injector, exhaust gas recirculation actuators, stepper motor actuator and vacuum operated actuator.

UNIT-IV: ENGINE CONTROL SYSTEM 9

Control modes for fuel control, engine control subsystems, ignition control methodologies, different ECUs used in engine management. Vehicle networks: CAN standard. Diagnostic systems in modern automobiles.

UNIT-V: CHASSIS AND SAFETY SYSTEMS 9

Traction control system, cruise control system, electronic control of automatic transmission, antilock braking system, electronic suspension system, working of airbag, centralised door locking system, climate control of cars.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Tom Denton, "Automobile Electrical and Electronic Systems", Institute of the motor industry, 5th Edition 2018.
2. William B Ribbens, "Understanding Automotive Electronics", 8th Edition, Jonathan simpson Publishers, 2017.
3. Hillier V. A.W., "Fundamentals of Automotive Electronics",6th Edition 2012, Nelson Thornes.
4. Ronald K Jurgen, "Automotive Electronic Handbook", McGraw Hill, 2nd Edition, 1999.
5. Robert Bosch, "Automotive Electrics and Automotive Electronics", Springer, 5th Edition, 2014.

6. Bogdan M. Wilamowski and David Irwin J.,"The Industrial Electronics Handbook", CRC Press, 2nd Edition, 2011.

COURSE OUTCOMES:

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

CO1: Perceive the electronics involved in automotive systems.
CO2: Understand the fundamentals involved in ignition systems.
CO3: Choose appropriate sensors for automobiles based on applications.
CO4: Work as a team and implement simple and safe control systems in automobiles.
CO5: Analyze the safety issues that occur in automotive systems.

19EEPE606 HVDC TRANSMISSION SYSTEM SEMESTER VI

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand about HVDC and HVAC transmission system.
- To analysis about the converter circuits.
- To understand the concepts of converter control, power flow and ability to discuss firing angle control.
- To grasp the knowledge of selecting suitable protection method for various converter faults.
- To Illustrate about the harmonic filtering in HVDC systems.

UNIT-I: GENERAL ASPECTS OF HVDC AND HVAC TRANSMISSIONS 9

Introduction – Comparison between AC and DC transmissions – DC links – DC cables and line insulators – Comparison between ac and dc cables – Important HVDC projects – Components of a HVDC system – HVDC transmission based on VSC – Types and applications of MTDC systems.

UNIT-II: CONVERTER CIRCUITS AND ANALYSIS 9

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

UNIT-III: CONVERTER CONTROL 9

Principle of control – Control characteristics – Constant minimum firing angle control – Constant current control – Constant extinction angle control – Tap changer control – Power and frequency control – Stability control – Starting and stopping of DC link – Power control.

UNIT-IV: FAULTS AND PROTECTION 9

Bypass valve – SCR valves malfunctions – Over voltage and current oscillations – DC circuit breakers – DC lightning arrestors – Simple problems.

UNIT-V: HARMONICS, FILTERS AND GROUND RETURN 9

Characteristic and uncharacteristic harmonics – Harmonic ac and dc filters – Interference with communication systems – Ground return-land, shore and sea electrodes – Cathodic protection – DC corona.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Padiyar K. R.,"HVDC Transmission Systems", New Age International Pvt.Ltd, 2019.
2. Kimbark E. W.,"Direct Current Transmission", Vol I, Wiley-Interscience,New york,1971.
3. Adamson and Hingorani H. G., "High Voltage DC Power Transmission", Garaway Ltd. England 1960.
4. Wadhwa C. L.,"Electrical Power Systems", New Age International Pvt. Ltd, New Delhi, 2011.
5. Arillaga J., "High Voltage Direct Current Transmission", Peter Peregrinus, London, 1998.

COURSE OUTCOMES:

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

CO1: Identify the merits and necessity of HVDC transmission.

CO2: Analysis about the converter circuits.

CO3: Concepts of converter control, power flow and ability to discuss firing angle control.

CO4: Select suitable protection method for various converter faults.

CO5: Illustrate about harmonic filtering in HVDC systems.

19EEPE607 **FACTS CONTROLLERS** **SEMESTER VI**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To enhance the transmission capability of power transmission control.
- To study about static var compensator and its applications.
- To study about thyristor controlled series capacitor and its applications.
- To understand the concepts of emerging facts controllers.
- To acquire knowledge about Co-ordination of facts controllers.

UNIT-I: INTRODUCTION TO POWER TRANSMISSION CONTROL 9

The concept of flexible AC transmission – Reactive power control in electrical power transmission lines – Uncompensated transmission line – Series and shunt compensation. Calculation of surge impedance loading and midpoint voltage, transmission problems and needs: the emergence of FACTS – Challenges of deregulation, objectives of FACTS – Thyristor controlled FACTS controllers and converter based FACTS controllers.

UNIT-II: STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS 9

Voltage control by SVC – Advantages of slope in dynamic characteristics – Influence of SVC on system voltage.Applications – Enhancement of transient stability – Steady state power transfer – Enhancement of power system damping – Prevention of voltage instability.

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

Operation of the TCSC – Different modes of operation – Modeling of TCSC – Variable reactance model – Modeling for stability studies. Applications – Improvement of the system stability limit – Enhancement of system damping – Voltage collapse prevention.

UNIT-IV: EMERGING FACTS CONTROLLERS 9

Static Synchronous Compensator (STATCOM) – Operating principle – V-I characteristics Unified Power Flow Controller (UPFC) – Principle of operation – Modes of operation – Applications – Modeling of UPFC for power flow studies, Interline Power Flow Controllers (IPFC) – Basic operating principles and characteristics, control structures.

UNIT-V: CO-ORDINATION OF FACTS CONTROLLERS 9

FACTs controller interactions – SVC–SVC interaction – Co-ordination of multiple controllers using linear control techniques – Quantitative treatment of control coordination.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Mohan Mathur R and Rajiv K. Varma,"Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc., 2002
2. Padiyar K. R.,"FACTS Controllers In Power Transmission And Distribution", New Age International Pvt. Ltd., Publishers, New Delhi, 2009.
3. Yong Huo Song and John A. T., "Flexible AC Transmission System", Institution of Electrical Engineers(IEE), 1999.
4. Xiao – Ping Zang, Christian Rehtanz and Bikash Pal., "Flexible AC Transmission System: Modelling And Control" Springer, 2012.

5. Narain G. Hingorani and Laszio.Gyugyl, “Understanding Facts Concepts and Technology of Flexible AC Transmission System”, IEEE Press, A John Wiley & Sons, Inc. Publication, 2000.

COURSE OUTCOMES:

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

CO1: Understand the problems and issues associated with AC transmission systems.
CO2: Comprehend the operation and control of various FACTS controllers.
CO3: Develop the modeling of various FACTS controllers.
CO4: Analyze the performance of power System with FACTS controllers.
CO5: Suggest suitable FACTS device for enhancing the transmission capability.

19EEPE608 ENERGY AUDITING AND MANAGEMENT SEMESTER VI

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the basic energy management schemes in electrical systems.
- To learn about the concepts of action planning and energy monitoring.
- To study about thethermal utilities and heat recovery systems.
- To learn about the electrical utilities.
- To acquire knowledge in energy assement and waste minimization.

UNIT-I: BASICS OF ENERGY MANAGEMENT 9

Energy scenario – Energy sector reforms – Impact on environment – Strategy for future and conservation – Basics of energy and it forms (Thermal and Electrical). Energy Audit: Need – Types and methodology – Audit Report – Energy cost, benchmarking and energy performance – System Efficiency. Facility as an energy system – Methods for preparing process flow, material and energy balance diagrams.

UNIT-II: ACTION PLANNING AND MONITORING 9

Energy management system – Performance assessment – Goal setting by manager – Action plan implementation – Financial management:investment – Financial analysis techniques, ROI, risk and sensitivity analysis, role of energy service companies. Project management: steps in detail. – Energy monitoring and interpretance of variances for remedial actions. Environmental concerns: UNFCC – Kyoto protocol – COP – CDM – PCF – Sustainable development.

UNIT-III: STUDY OF THERMAL UTILITIES 9

Combustion of oil, coal and gas – Performance evaluation of boilers – Boiler blow down – Boiler water treatment – Energy conservation opportunity – Cogeneration: Principal – Options – Classification – Influencing factors and technical parameters. Waste heat recovery: Classification – Application – Benefits – Different heat recovery devices.

UNIT-IV: STUDY OF ELECTRICAL UTILITIES 9

Electricity billing – Electricity load management – Motor efficiency and tests – Energy efficient motors – Factors affecting motor efficiency and loss minimization – Motor load survey. Lighting System: Types and features – Recommended luminance levels – Lighting system energy efficiency study – Energy efficient technologies: Maximum demand controllers – Intelligent PF controllers – Soft starters and VFDs – Variable torque load uses – Energy efficient transformers, light controllers and electronic ballasts.

UNIT-V: ENERGY ASSESSMENT IN UTILITY SYSTEMS 9

Performing financial analysis: Fixed and variable costs – Payback period – Methods – Factors affecting analysis – Waste minimization techniques: Classification – Methodology. performance assessment of HVAC systems: Measurements, procedure – Evaluation. Assessment of pumps: Measurements, procedure – Evaluation.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Murphy W.R and G.Mckay Butter Worth, "Energy Management", Heinemann Publications, 2013.
2. Paul O' Callaghan, "Energy Management", Mc-Graw Hill Book Company – 1st Edition; 2012.
3. JohnC. Andreas, "Energy Efficient Electric Motors", Marcel Dekker Inc Ltd – 2nd Edition; 2015.
4. Turner W.C., "Energy Management Handbook", John Wiley and Sons, 5th Edition, 2013.

COURSE OUTCOMES:

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

CO1: Possess knowledge on energy management and analyze the feature of energy audit.
CO2: Plan energy management action and develop the understanding of implementation.
CO3: Familiarize with thermal utilities.
CO4: Familiarize with electrical utilities.
CO5: Perform assessment of different systems.

19EEPE609 DIGITAL SIGNAL PROCESSING SEMESTER VI

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge about the signals and systems & their mathematical representation.
- To impart knowledge about the discrete time systems.
- To design and transformation techniques & their computation.
- To design and apply theoretically the FIR and IIR Filters.
- To acquire knowledge on DSP processors and their applications in simple control systems.

UNIT-I: INTRODUCTION 9

Classification of systems: Continuous, discrete, linear, causal, stability, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, nyquist rate, aliasing effect.

UNIT-II: DISCRETE TIME SYSTEM ANALYSIS 9

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

UNIT-III: DISCRETE FOURIER TRANSFORM & COMPUTATION 9

Discrete Fourier Transform – Properties, magnitude and phase representation – Computation of DFT using FFT algorithm – DIT &DIF using radix 2 FFT – Butterfly structure.

UNIT-IV: DESIGN OF DIGITAL FILTERS 9

FIR & IIR filter realization – Parallel & cascade forms. FIR design: Windowing techniques – Need and choice of windows – Linear phase characteristics. Analog filter design – Butterworth and Chebyshev approximations; IIR Filters, digital design using impulse invariant and bilinear transformation warping, pre warping.

UNIT-V: DIGITAL SIGNAL PROCESSOR 9

Introduction – Architecture – Features – Addressing formats – Functional modes – Introduction to commercial DS Processors.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Bjohn G. Proakis, Dimitrias G and Manolakis, "DSP Principles Algorithms and Applications", Prentice Hall of India – 4th Edition, 2014.
2. Emmanuel C. Ifeachor, University of Plymouth. Barrie.W.Jervis, Sheffield Hallam University, "Digital Signal Processing a Practical Approach", Pearson Education, 2nd Edition, 2015.
3. Sanjit K. Mitra, "Digital Signal Processing: A computer Based approach",Tata McGrawHill, 4th Edition, 2014.
4. Farzad Nekoogar and Gene moriarty.,"Digital Control Using Digital Signal Processing" P.H. International Inc. New Jersey, 2012.
5. Poorna Chandra S and Sasikala B.,"Digital Signal Processing", Vijay Nicole/TMH,2013.

6. Robert Schilling and Sandra L.Harris, "Introduction to Digital Signal Processing using Matlab", Cengage Learning, 2014.

COURSE OUTCOMES:

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

CO1: Classify the digital signals and systems and apply various transformation techniques to solve problems.

CO2: Analyze the transformation techniques & their computation.

CO3: Design digital IIR and FIR filters for the given specifications.

CO4: Examine the DSP controllers and understand its functioning for control applications.

CO5: Design and simulate digital filters with signal processing algorithm.

19EEPE610 COMPUTER SYSTEM ARCHITECTURE SEMESTER VI

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart the knowledge of computer hardware and execute a software program expressed in assembly language.
- To illustrate the computer control and CPU functions of various addressing modes.
- To design and analyze the pipe lined control units.
- To acquire knwoledge with I/O devices and standard I/O interfaces.
- To design memory organization and evaluate quantitatively and improve computer system performance.

UNIT-I: DATA REPRESENTATION, MICRO-OPERATIONS AND ORGANIZATION 9

Data representation – Data types – Complements – Fixed point representation – Floating point representation – Other binary codes – Error detection codes – Register transfer and micro operations – Register transfer language – Register transfer – Bus and memory transfers – Arithmetic micro-operations – Logic micro-operations – Shift micro-operations – Arithmetic logic shift unit – Basic computer organization and design – Instruction codes – Computer registers – Computer instructions – Timing and control – Instruction cycle – Memory reference instructions – Input-output – Interrupt – Design of accumulator logic.

UNIT-II: CONTROL AND CENTRAL PROCESSING UNIT 9

Micro programmed control – Control memory – Address sequencing – Micro-program example – Design of control unit. Central processing unit: general register organization – Stacks organization – Instruction formats – Addressing modes – Data transfer and manipulation – Program control – Reduced instruction set computer.

UNIT-III: PIPELINE, VECTOR PROCESSING AND COMPUTER ARITHMETIC 9

Parallel processing – Pipelining – Arithmetic pipeline – Instruction pipeline – RISC pipeline – Vector processing – array processors – Addition and subtraction algorithms – Multiplication algorithms – Division algorithms – Floating-point arithmetic operations – Decimal arithmetic unit – Decimal arithmetic operations.

UNIT-IV: INPUT-OUTPUT ORGANIZATION 9

Input-output organization – Peripheral devices – Input-output interface – Asynchronous data transfer – Modes of transfer – Priority interrupt – Direct memory access – Input-output processor – Serial communication.

UNIT-V: MEMORY ORGANIZATION 9

Memory organization: Memory hierarchy – Main memory – Auxiliary memory – Associative memory – Cache memory – Virtual memory – Memory management hardware.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Morris Mano M.,"Computer System Architecture", Pearson Education, 3rd Edition, 2017.
2. Vincent P.Heuring, Harry F.Jordan and Venkatesh T.G., "Computer Systems Design and Architecture", Pearson Education Asia Publications, 2nd Edition, 2008.

3. John P.Hayes, “Computer Architecture and Organization”, Tata McGraw Hill, 3rd Edition, 2012.
4. Andrew S.Tanenbaum, “Structured Computer Organization”, 6th Edition, Pearson Education, 2012.
5. William Stallings, “Computer Organization and Architecture”, 10th Edition, Pearson Education, 2016.

COURSE OUTCOMES:

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

CO1: Demonstrate the organisation of computer hardware and execute a software program expressed in assembly language.
CO2: Illustrate the computer control and CPU functions of various addressing modes.
CO3: Design and analyze the pipe lined control units.
CO4: Communicate with I/O devices and standard I/O interfaces.
CO5: Design memory organization and evaluate quantitatively and improve computer system performance.

19EEPE701 POWER SYSTEM STABILITY SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To furnish knowledge and analyze about various stability problems in electrical power system.
- To acquire knowledge in steady state stability.
- To analyze the transient stability using swing equation.
- To analyze the transient stability using equal area criterion.
- To impart knowledge on excitation system and its effect on stability.

UNIT-I: INTRODUCTION TO STABILITY 9

Stability of power system – Simple two machine stability problems – Mechanical analogy of power transmission systems – Importance of stability to system operation and design – Effect of instability – Representation of power system components – Stability studies on network analysis.

UNIT-II: STEADY STATE STABILITY 9

Introduction to stability of electric power systems – Significance of steady state stability – Power limit of transmission system – Two machine system with negligible losses – Clarke diagram for two machine system with negligible losses – Power angle characteristic and steady state stability limit of salient pole synchronous machines– Two machine system with losses – Clarke diagram for two machine system with resistance – Steady state stability with automatic voltage regulators.

UNIT-III: TRANSIENT STABILITY – SWING EQUATION 9

General background – Swing equation for synchronous machine – Numerical solution of swing equation – Multi machine stability – Factors affecting transient stability.

UNIT-IV: TRANSIENT STABILITY – EQUAL AREA CRITERION 9

Concepts of equal area criterion – Application of equal area criterion to stability studies under fault conditions – Determination of critical clearing angle – Reduction of a power system to a single equivalent machine connected to infinite bus – Equivalent power angle curve of two finite machines – Graphical integral method of swing curve determination.

UNIT-V: EXCITATION SYSTEM AND ITS EFFECT ON STABILITY 9

Introduction – Definition of terms – Quick response excitation systems – Compounding the excitation of generators – Modern trend in excitation systems – Voltage regulator capability to improve transient stability – Super-excitation for stability – Two axis excitation control – High initial response excitation systems – Exciter response – Determination by graphical integration – Point by point method of calculation.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Gangadhar K. A.,"Power System Analysis and Stability", Khanna Publishers, New Delhi, 6th reprint 2004
2. Kimbark E. W.,"Power System Stability", Volume III, Wiley – IEEE Press 3rd Reprint, 1995.

3. Kundur P., “Power System Stability and Control”, Tata Mc Graw Hill, 3rd reprint, 2007.
4. Pai M. A, Sengupta K and Padiyar K. R.,“Small Signal Analysis of Power System”, Alpha Science International,Tata- McGraw hills, 2004.
5. Paul M. Anderson and Fouad A. A.,“Power system Control and stability”, IEEE Press, 2003.

COURSE OUTCOMES:

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

CO1: Establish the modeling of power system suitable for performing stability analysis.
CO2: Analyze the stability of simple power systems using analytical and graphical approach.
CO3: Apply computer simulation tools for stability analysis of large power systems.
CO4: Apply control methods for tuning of turbine of voltage controllers in power system.
CO5: Evaluate the power system for stable operation.

19EEPE702 POWER PLANT INSTRUMENTATION SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the important process variables and their measurements and thereby develop control loops for optimal performance of power plant.
- To measure the process variable in power plants.
- To analyzers the power plants and its performance.
- To study about the control loops in boiler.
- To understand the importance ofturbine and its control.

UNIT-I: METHODS OF POWER GENERATION 9

Methods of power generation – Hydro, thermal, nuclear, solar and wind power –Importance of instrumentation in power generation – Basic building block for all types of power generation plants – Details of boiler processes – P and I diagram of boiler – Cogeneration.

UNIT-II: MEASUREMENTS IN POWER PLANTS 9

Measurement of feed water flow, air flow, steam flow and coal flow – Drum level measurement–Steam pressure and temperature measurement – Turbine speed and vibration measurement – Flue gas analyzer – Fuel composition analyzer.

UNIT-III: ANALYZERS IN POWER PLANTS 9

Analysis of impurities in feed water and steam – Flue gas oxygen analyzer – Dissolved oxygen analyzer – Chromatography – pH Meter – Fuel analyzer – Pollution monitoring instruments

UNIT-IV: CONTROL LOOPS IN BOILER 9

Combustion Control – Air/fuel ratio control – Furnace draft control – Drum level control – Main steam and reheat steam temp control – Super heater control – Attemperator – De-aerator control – Distributed control system in power plants – Interlocks in boiler operation.

UNIT-V: TURBINE AND CONTROL 9

Types of steam turbines – Impulse and reaction turbines – Compounding – Turbine governing system – Speed and load control – Transient response rise – Free governor mode operation – Automatic load frequency control – Turbine oil system – Oil pressure drop relay – Oil cooling system– Turbine run up system.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Sam Dukelow,"Control of Boilers", Instrument Society of America, 1991
2. Gill A. B.,"Power Plant performance", Butterworth and Co (Publishers) Ltd, 2016.
3. Liptak B. G.,"Instrumentation in Process Industries", Chilton Book Company, 2005.
4. Jain R. K.,"Mechanical and Industrial Measurements",Khanna Publishers, New Delhi, 1999.
5. Krishnaswamy K and Ponnibala. M.,"Power Plant Instrumentation", PHI Learning Pvt. Ltd., New Delhi, 2011.

COURSE OUTCOMES:

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

CO1: Understand the operation of hydro, thermal, nuclear, wind and solar power plants.

CO2: Select instruments for monitoring various parameters related to thermal power plant.

CO3: Analyze and select appropriate control strategy for boiler.

CO4: Gain knowledge on turbine monitoring system and able to analyze the problems related to turbine governing.

CO5: Design instrumentation systems for generating plants.

19EEPE703 LOGIC AND DISTRIBUTED CONTROL SYSTEMS SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the fundamentals of PLC.
- To exploring the intermediate and advanced functions.
- To interface and backplane bus standards for instrumentation systems.
- To identity logical process control in automation.
- To design and analysis of DCS with communication standards.

UNIT-I: PROGRAMMABLE LOGIC CONTROLLER (PLC) BASICS 9

Definition – Overview of PLC systems – Input and output modules – Power supplies – Isolators – General PLC programming procedures – Programming on-off outputs – Auxiliary commands and functions – Creating ladder diagrams from process control descriptions – Register basics – Timer functions – Counter functions.

UNIT-II: PLC INTERMEDIATE AND ADVANCED FUNCTIONS 9

Arithmetic functions – Number comparison functions – Skip and MCR functions – Data move systems – PLC advanced intermediate functions – Utilizing digital bits – Sequencer functions – Matrix functions – Alternate programming languages – Analog PLC operation – Networking of PLC – PID control of continuous processes – PLC installation – Troubleshooting and maintenance – Controlling a Robot.

UNIT-III: INTERFACE AND BACKPLANE BUS STANDARDS FOR INSTRUMENTATION SYSTEMS 9

Field bus: Introduction – Concept – International field bus standards – HART protocol: Method of operation – Structure – Operating conditions – Applications – Foundation field bus – Profibus.

UNIT-IV: DISTRIBUTED CONTROL SYSTEMS OPERATION 9

Evolution of DCS – Building blocks – Detailed descriptions and functions of field control units – Process – Interfacing issues – Operator stations–Data highways – Redundancy concepts.

UNIT-V: COMMUNICATION IN DCS 9

DCS – Supervisory computer tasks and configuration – System integration with PLC and computers – Special requirement of networks used for control – Protocols – Link access mechanisms – Manufacturers automation protocols – Case studies in DCS.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. John. W. Webb and Ronald A. Reis, "Programmable Logic Controllers–Principles and Applications", Printice Hall Inc., New Jersy, 5th Edition 2002.
2. Frank D. Petruzella.,"Programmable Logic Controllers", McGraw Hill Book Company Book, 3rd Edition 2005.
3. Lukcas M. P.,"Distributed Control Systems", Van Nostrand Reinhold Company, New York, 1986,
4. Curtis D. Johnson, "Process control Instrumentation Technology", 8th Edition Pearson

Education 2006.
5. Bela G. Lipkak, "Process software and digital networks – vol 3", CRC press, 4th Edition,2012.
6. Krishna Kant., "Computer based Industrial Control", Prentice Hall of India, 10th Printing 2009.

COURSE OUTCOMES:

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

CO1: Recognize and develop ladder diagrams, testing the capability of PLC's control and trouble shooting of PLC.

CO2: Configure PLC's to perform various tasks in the process environment.

CO3: Configure and integrate DCS with PLC and computers, developing software for these systems.

CO4: Identity logical process control in automation.

CO5: Impart the knowledge about data acquisition system.

19EEPE704 RESTRUCTURED POWER SYSTEM SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide a comprehensive treatment towards understanding of the new dimensions associated with the power systems tackling issues involving techno-commercial solutions, fundamentals of microeconomics, design of power markets and market architectural aspects and new operational challenges like congestion management and ancillary service management.

UNIT-I: INTRODUCTION TO RESTRUCTURING OF POWER INDUSTRY 9

Introduction, reasons for restructuring / deregulation of power industry, understanding the restructuring process – Entities involved, the levels of competition, the market place mechanisms, sector-wise major changes requirEdition Introduction to issues involved in deregulation, reasons and objectives of deregulation of various power systems across the world. fundamentals of economics – Introduction, consumer behavior, supplier behavior. Market equilibrium, short-run and long-run costs, various costs of production, relationship between short-run and long-run average costs, perfectly competitive market.

UNIT-II: MARKET MODELS AND TRANSMISSION CONGESTION MANAGEMENT 9

Introduction, market models based on contractual arrangements, comparison of various market models, electricity vis-à-vis other commodities, four pillars of market design. Market architecture. Definition of congestion, reasons for transfer capability limitation, importance of congestion management in deregulated environment, desired features of congestion management schemes. Classification of congestion management methods, calculation of ATC – Definition of various terms, ATC calculation using PTDF and LODF based on DC model, calculation of ATC using AC model. Non-market methods, market based methods, nodal pricing, inter-zonal intra-zonal congestion management, price area congestion management, capacity alleviation method.

UNIT-III: LOCATIONAL MARGINAL PRICES AND FINANCIAL TRANSMISSION RIGHTS 9

Mathematical preliminaries, fundamentals of locational marginal pricing, lossless DCOPF model for LMP calculation, loss compensated DCOPF model for LMP calculation, ACOPF model for LMP calculation, introduction to financial transmission rights, risk hedging functionality of financial transmission rights, simultaneous feasibility test and revenue adequacy, FTR issuance process, treatment of revenue shortfall, secondary trading of FTRs, flow Gate rights, FTR and market power, FTR and merchant transmission investment.

UNIT-IV: ANCILLARY SERVICE MANAGEMENT, PRICING OF TRANSMISSION NETWORK USAGE AND LOSSALLOCATION 9

Introduction to ancillary services, types of ancillary services, classification of ancillary services, load-generation balancing related services, voltage control and reactive power support services, black start capability service, co-optimization of energy and reserve services, international comparison. Pricing of transmission network usage and loss allocation – Introduction to transmission pricing, principles of transmission pricing, classification of transmission pricing methods, rolled-in transmission pricing methods, marginal transmission pricing paradigm, composite pricing paradigm, merits and de-merits of different paradigms, debated issues in transmission pricing, introduction to loss allocation, classification of loss

allocation methods and comparison.

UNIT-V: MARKET POWER, GENERATORS BIDDING & REFORMS IN INDIAN POWER SECTOR **9**

Attributes of a perfectly competitive market, the firm's supply decision under perfect competition, imperfect competition, market power, financial markets associated with electricity markets, introduction to optimal bidding by a generator company, optimal bidding methods. Reforms in indian power sector – Introduction, framework of indian power sector, reform initiatives during 1990-1995. Availability Based Tariff (ABT), The electricity act 2003, open access issues, power exchange, reforms in near future.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Daniel Kirschen and Goran Strbac., "Fundamentals of Power System economics", John Wiley & Sons Ltd, 2018.
2. Sally Hunt, "Making competition work in electricity", John Wiley & Sons, Inc., 2002.
3. Kankar Bhattacharya, Jaap E. Daadler and Math H. J Bollen, "Operation of restructured power systems", Kluwer Academic Pub., 2001.

COURSE OUTCOMES:

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

CO1: Understand the new dimensions associated with the power systems with techno-commercial issues.

CO2: Apply various solutions for the commercial problems through study of fundamentals of micro economics.

CO3: Design power markets and market architectural aspects as per the restructuring of power system.

CO4: Identify operational challenges and manage the same with optimum solution.

CO5: Suggest reform practices in developing countries with special focus on Indian power system.

19EEPE705 SPECIAL MACHINES AND CONTROLLERS SEMESTERVII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To explore the working of operation and performance of stepping motors.
- To grasp the operation and performance of switched reluctance motors.
- To understand the operation and performance of synchronous reluctance motors.
- To learn the operation and performance of permanent magnet brushless D.C machine.
- To acquire knwoledge the operation and performance of permanent magnet synchronous machine.

UNIT-I: STEPPING MOTORS 9

Constructional features – Principle of operation – Modes of excitation – Torque production in Variable Reluctance (VR) stepping motor – Dynamic characteristics – Drive systems and circuit for open loop control– Closed loop control of stepping motor.

UNIT-II: SWITCHED RELUCTANCE MOTORS 9

Constructional features – Principle of operation – Torque equation – Power controllers – Characteristics and control –Microprocessor based controller.

UNIT-III: SYNCHRONOUS RELUCTANCE MOTORS 9

Constructional features – Types – Axial and radial air gap motors – Phasor diagram – Characteristic–Vernier motor.

UNIT-IV: PERMANENT MAGNET BRUSHLESS DC MOTORS 9

Commutation in DC motors – Difference between mechanical and electronic commutators – Hall sensors – Optical sensors – Multiphase brushless motor – Square wave permanent magnet brushless motor drives – Torque and emf equation – Torque – Speed characteristics – Microprocessor based controller.

UNIT-V: PERMANENT MAGNET SYNCHRONOUS MOTORS 9

Principle of operation – EMF, power input and torque expressions – Phasor diagram – Power controllers – Torque – Speed characteristics – Self control – Vector control – Current control schemes.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Ramakrishnan., "Switched Reluctance Motor Drives", CRC press, 2001.
2. Jacek F Gieras and Micheal Wing, "Permanent Magnet Motor Technology", CRC press,2002.
3. AcarnelyP.P., "Stepping Motors", 4th Edition, IFT Publishers, 2002.

COURSE OUTCOMES:

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

CO1: Learnt the operation and performance of stepping motors.

CO2: Familiar with the operation and performance of switched reluctance motors.

CO3: Familiar with the operation and performance of synchronous reluctance motors.

CO4: Know the operation and performance of permanent magnet brushless D.C machine.
CO5: Learnt the operation and performance of permanent magnet synchronous machine.

19EEPE706 PRINCIPLES OF EMBEDDED SYSTEMS SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on the building blocks of an embedded system.
- To impart knowledge on the interrupts and software architectures of an embedded system.
- To understand the basics of real time operating system and example tutorials to discuss on one real time operating system tool.
- To design an embedded system using rtos.
- To familiarize the various embedded software development tools.

UNIT-I: FUNDAMENTALS OF EMBEDDED SYSTEMS 9

Classification of embedded systems – Embedded system on chip – Structural units in a processor – Processor selection – Memory selection – Allocation of memory to segment – Block memory Map of a system – Serial communication using PC bus and CAN bus – Parallel communication using ISA and PCI busses.

UNIT-II: INTERRUPTS AND SOFTWARE ARCHITECTURES 9

Interrupt basics – Shared data problem – Interrupt latency – Round robin architecture – Round robin with interrupts – Function – Queues – Scheduling architecture – Real time operating System architecture – Selecting an architecture.

UNIT-III: REAL TIME OPERATING SYSTEMS 9

Tasks and task states – Tasks and data – Semaphores and shared data – Message queues, Mailboxes and pipes – Timer functions – Events – Memory management – Interrupt routines in RTOS environment.

UNIT-IV: DESIGN USING RTOS 9

Overview – Principles – Encapsulating semaphores and Queues – Hard real-time scheduling Consideration – Saving memory space – Saving power.

UNIT-V: EMBEDDED SOFTWARE DEVELOPMENT TOOLS 9

Host and target machines – Linker / Locators for embedded software – Getting embedded Software into target – Testing on host machine – Instructions set simulators.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. David E. Simon.,"An Embedded Software Primer", Pearson Education, Reprint, 2008.
2. Navabi,"Embedded Core Design with FPGA's", Tata McGraw-Hill, Ist Edition, 2008.
3. Raj Kamal, "Embedded System-Architecture, Programming, Design", Tata Mc Graw Hill, 2013.
4. Peckol, "Embedded system Design", John Wiley & Sons, 2010.
5. Lyla B Das., "Embedded Systems-An Integrated Approach", Pearson, 2013.
6. Sarma C.R., "Embedded Systems Engineering", University Press (India) Pvt. Ltd, 2013.

COURSE OUTCOMES:

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

CO1: Acquire the functional understanding of communication between digital system.

CO2: Model the organization and understand the digital system.
CO3: Demonstrate the practical use embedded system.
CO4: Interpret the software and hardware components and their usage.
CO5: Provide in depth knowledge of embedded processor architecture behavior of embedded system and embeddedd software development tool.

19EEPE707 MEMS AND APPLICATIONS SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide the introduction of micro electro mechanical systems.
- To analyze the transducer modelling.
- To impart knowledge on smart transducers.
- To teach critical thinking in micro engineering process, material and design issues.
- To develop the various mems based applications.

UNIT-I: FUNDAMENTALS OF MEASUREMENT SYSTEMS 9

Basic principles of measurement systems – Primary transduction mechanisms – Physical variables – Sensor defects – Sensing mechanisms – Enabling Technologies – Silicon – Thick film – Optical.

UNIT-II: TRANSDUCER MODELLING 9

Electronic techniques – Bridge circuits – Amplifiers – Data conversion – Noise and recovery of signal from noise – Sensor networks and protocols.

UNIT-III: SMART TRANSDUCERS 9

Concepts – Software structures – Hardware structures – Fundamentals and limitations of photolithography – Pattern transfer with etching techniques – Pattern transfer with other physical and chemical techniques.

UNIT-IV: MICROMACHINING 9

Bulk micromachining – Surface micromachining – Other micromachining techniques – Packaging techniques – Micro scaling considerations.

UNIT-V: APPLICATIONS 9

Applications in automotive industry – Applications in biomedical industry – DNA sensors, Electronic noise – Future developments – Nanotechnology – Carbon Nano Tube (CNT).

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Chang Liu.,"Foundations of MEMS", Prentice Hall, 2012.
2. Marc Madou.,"Fundamental of Microfabrication", CRC Press,3rdEd, 2011.
3. Richard C. Jaeger.,"Introduction to Microelectronic Fabrication", Addison- Wesley, 2002.
4. Gad-El-Hak, "MEMS Handbook", CRC Press, 2005.
5. Nguyen N.T. and Wereley S.,"Fundamentals and Applications of Microfluidics", Artech House,2006.
6. Nitaigour Premchand Mahalik, "MEMS",TMH, 1stReprint, 2008.

COURSE OUTCOMES:

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

CO1: Understand the basics of electro and mechanical system.

CO2: Understand the basics of micro fabrication.
CO3: Develop models and simulate electrostatic sensors.
CO4: Develop models and simulate different types of actuators.
CO5: Recognize the materials properties of MEMS performance.

19EEPE708 BIOMEDICAL INSTRUMENTATION SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the physical foundations of biological systems.
- To realize the various electro physiological measurements in the human body.
- To acquire knowledge on the measurement of non-electrical parameters in the human body.
- To analyze the various medical imaging techniques and their applications.
- To apply the concepts on the working of medical assisting and therapy equipment.

UNIT-I: PHYSIOLOGY 9

Man instrument system – Problems encountered in measuring a living system – Transducers for biomedical applications – Cell and its structure – Resting and action potential – Propagation of action potentials – The heart and cardiovascular system – Electrophysiology of cardiovascular system – Physiology of the respiratory system – Nervous system – Central nervous system and Peripheral nervous system – Electrode theory – Bio-potential electrodes.

UNIT-II: ELECTRO PHYSIOLOGICAL MEASUREMENT 9

ECG – Vector cardiographs – EEG – EMG – ERG – EOG – Lead system and recording methods – Typical waveforms.

UNIT-III: NON- ELECTRICAL PARAMETER MEASUREMENTS 9

Measurement of blood pressure, blood flow and cardiac output – Plethysmography – Measurement of heart sounds – Gas analysers – Blood gas analysers – Oximeters.

UNIT-IV: MEDICAL IMAGING AND TELEMETRY 9

X-ray machine – Echocardiography – Computer tomography – MRI – Diagnostic ultrasound – PET – SPECT – Electrical impedance tomography – Thermograph – Biotelemetry.

UNIT-V: ASSISTING AND THE RAPEUTIC DEVICE 9

Pacemakers – Defibrillators – Ventilator – Anesthesia machine – Nerve and muscle stimulator – Heart lung machine – Kidney machine – Audiometers – Diathermy –Endoscopes – Lasers in biomedicine.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Leslie Cromwell,"Biomedical Instrumentation and Measurement", PHI, New Delhi, 2015.
2. Khandpur R.S.,"Handbook of Biomedical Instrumentation", 2nd Edition, Tata McGraw Hill 2016.
3. Geddes L. A and Baker L.E.,"Principles of Applied Biomedical Instrumentation", 3rd Edition, John Wiley, New York, 2015.
4. Richard Aston,"Principles of Bio-medical Instrumentation and Measurement", Merril Publishing Company, New York, 2016.
5. Ed.Joseph D. Bronzino, "The Biomedical Engineering Handbook" 2nd Edition, Boca Raton, CRC Press LLC, 2014.

COURSE OUTCOMES:

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

CO1: Understand the physical foundations of biological systems.

CO2: Realize the various electro physiological measurements in the human body.

CO3: Acquire knowledge on the measurement of non-electrical parameters in the human body.

CO4: Analyze the various medical imaging techniques and their applications.

CO5: Apply the concepts on the working of medical assisting and therapy equipment.

19EEPE709 INDUSTRIAL DRIVES AND CONTROL SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To familiarize speed control of DC drives and AC drives.
- To design the digital controller for drives.
- To select drive for particular application considering the present and future needs of industries.
- To familiarize in control of electric drives.

UNIT-I: SPEED CONTROL OF DC MOTORS 9

Concept of electric drive – Classification of electric drives – Speed/Torque characteristics braking methods –Methods of speed control – Ward leonard drives –Semi, full converter fed DC drives – Single, two and four quadrant operations –Dual converter fed DC drives.

UNIT-II: DIGITAL CONTROL OF DC MOTORS 9

Digital technique in speed control of DC motors – Advantages – Limitations – Closed loop control of DC drives – Analog, digital and hybrid speed control –Microprocessor applications to control of DC motor.

UNIT-III: SPEED CONTROL OF AC MOTORS 9

Speed control of AC motors – Speed / Torque characteristics – Braking methods. AC-AC controller fed AC drives, inverter fed AC drives, frequency control, V/F control of induction and synchronous motor – Self control, margin angle control and power factor control.

UNIT-IV: ROTOR SIDE CONTROL OF FREQUENCY CONTROLLED INDUCTION MOTOR DRIVES 9

Rotor side control of slip ring induction motor with thyristor chopper – Static control of rotor resistance – Slip-energy recovery scheme – Static scherbius and kramer systems – Applications of microprocessor to AC motor speed control.

UNIT V : INDUSTRIAL APPLICATIONS 9

Choice of selection of motors – Electric drive applications – Steel rolling mills – Cement mills – Paper mills – Textile mills – Sugar mills – Coal mines – Machine Tools.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Dubey G. K.,"Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi, 2nd Edition 2002.
2. Sen P.C.,"Thyristor DC Drives", Krieger Publishing Company 1991.
3. Vedam Subramaniam, "Electrical Drives and Applications", Tata McGraw Hill, New Delhi, 2nd, 2011.
4. Murphy J. M. D., "Thyristor Control of AC Motors", Pergamon Press, NewYork, 1973.
5. Krishnan R., "Electric Motor and Drives: Modeling, Analysis and Control", Pearson Education, New Delhi,2015.
6. Pillai S. K., "A First Course on Electrical Drives",New Age international Publishers, 3rd Edition, 2014.

COURSE OUTCOMES:

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

CO1: Illustrate the speed control of DC drives.
CO2: Design the digital controller for drives.
CO3: Analyze the speed control techniques for AC drives.
CO4: Analyze rotor side control of slip ring induction motor.
CO5: Understand the industrial applications of electric drives.

19EEPE710 ENERGY STORAGE TECHNOLOGY SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To recollect the historical perspective and technical methods of energy storage.
- To learn the basics of different energy storage methods.
- To evaluate the performance factors of energy storage systems.
- To identify the field of applications for renewable energy systems.
- To understand the basics of hydrogen fuel cell and flow batteries.

UNIT-I: ENERGY STORAGE: HISTORICAL PERSPECTIVE, INTRODUCTION AND CHANGES 9

Storage needs – Variations in supply and energy demand interruptions in energy supply – Transmission congestion – Demand for portable energy – Demand and scale requirements – Environmental and sustainability issues.

UNIT-II: TECHNICAL METHODS OF STORAGE 9

Introduction: Energy and energy transformations, potential energy (pumped hydro, compressed air, springs) – Kinetic energy (mechanical flywheels) – Thermal energy without phase change passive (adobe) and active (water) – Thermal energy with phase change (ice, molten salts, steam) – Chemical energy (hydrogen, methane, gasoline, coal, oil) – Electrochemical energy (batteries, fuel cells) – Electrostatic energy (capacitors) – Electromagnetic energy (superconducting magnets) – Different types of energy storage systems.

UNIT-III: PERFORMANCE FACTORS OF ENERGY STORAGE SYSTEMS 9

Energy capture rate and efficiency – Discharge rate and efficiency – Dispatch ability and load flowing characteristics, scale flexibility, durability – Cycle lifetime, mass and safety – Risks of fire, explosion, toxicity – Ease of materials, recycling and recovery – Environmental consideration and recycling, merits and demerits of different types of storage.

UNIT-IV: APPLICATION CONSIDERATION 9

Comparing storage technologies – Technology options – Performance factors and metrics – Efficiency of energy systems – Energy recovery – Battery storage system: Introduction with focus on lead acid and lithium – Chemistry of battery operation, power storage calculations, reversible reactions, charging patterns, battery management systems, system performance, areas of application of energy storage: Waste heat recovery, solar energy storage, green house heating, power plant applications, drying and heating for process industries, energy storage in automotive applications in hybrid and electric vehicles.

UNIT-V: HYDROGEN FUEL CELLS AND FLOW BATTERIES 9

Hydrogen economy and generation techniques, storage of hydrogen, energy generation – super capacitors: properties, power calculations – operation and design methods – Hybrid energy storage: Managing peak and continuous power needs, options – Level 1: (Hybrid power generation) Bacitor "Battery + Capacitor"combinations: need, operation and merits; Level 2: (Hybrid Power Generation) Bacitor + Fuel cell or Flow battery operation – Applications: Storage for hybrid electric vehicles, regenerative power, capturing methods.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Detlef Stolten, "Hydrogen and Fuel Cells: Fundamentals, Technologies and Applications", Wiley, 2014.
2. Jiujun Zhang, Lei Zhang, Hansan Liu, Andy Sun and Ru-Shi Liu, "Electrochemical Technologies for Energy Storage and Conversion", John Wiley and Sons, 2012.
3. Francois Beguin and Elzbieta Frackowiak, "Super capacitors", Wiley, 2015.
4. Doughty Liaw, Narayan and Srinivasan, "Batteries for Renewable Energy Storage", The Electrochemical Society, New Jersy, 2016.

COURSE OUTCOMES:

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

CO1: Recollect the historical perspective and technical methods of energy storage.
CO2: Learn the basics of different energy storage methods.
CO3: Evaluate the performance factors of energy storage systems.
CO4: Identify the field of applications for renewable energy systems.
CO5: Understand the basics of Hydrogen Fuel Cell and flow batteries.

19EEPE711 **SOLID STATE RELAYS** **SEMESTER VII**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To gain knowledge on the operational characteristics of static relays.
- To understand the opertaions of overcurrent relays.
- To analyze distance and frequency relays.
- To test and maintenance of protective relays.
- To implement the microprocessor based relays.

UNIT-I: INTRODUCTION TO STATIC RELAYS **9**

Advantages of static relays – Generalized characteristics and operational equations of relays – Steady state and transient performance of signal driving elements – Signal mixing techniques and measuring techniques – CT's and PT's in relaying schemes – Saturation effects.

UNIT-II: OVER CURRENT RELAYS **9**

Static relay circuits (Using Analog and Digital IC's) for over current, inverse – Time characteristics, differential relay and directional relay.

UNIT-III: DISTANCE AND FREQUENCY RELAYS **9**

Static relay circuits for generator loss of field, under frequency, distance relays, impedance, reactance, mho, reverse power relays.

UNIT-IV: CARRIER CURRENT PROTECTION AND TESTING **9**

Static relay circuits for carrier current protection – Steady state and transient behaviour of static relays – Testing and maintenance – Tripping circuits using thyristors.

UNIT-V: MICROPROCESSOR BASED RELAYS **9**

Hardware and software for the measurement of voltage, current, frequency, phase angle – Microprocessor implementation of over current relays – Inverse time characteristics – Impedance relay – Directional Relay – Mho Relay.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Rao T.S.M.,"Power System Protection-Static Relays", Tata McGraw Hill, Reprint 2011.
2. Rao,"Digital Numerical Relays", McGraw Hill, 1st Edition 2005.
3. Van C. Warrington, "Protective Relays-Their Theory and Practice", Chapman and Hall, 2nd Edition, 1968.
4. Ravindranath B and Chander M., "Power System Protection and Switchgear", Wiley Eastern, 2nd Edition, 2018.

COURSE OUTCOMES:

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

CO1: Illustrate the operational characteristics of relays.
CO2: Explain the functional blocks of various protections relaying schemes.
CO3: Analyze different applications of static the relay.
CO4: Gain knowledge on different protection circuits and maintenance of equipment.
CO5: Test the different microprocessor based relays.

19EEPE712 COMPUTER AIDED DESIGN OF ELECTRICAL APPARATUS **SEMESTER VII**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the importance of computer aided design method.
- To provide basic electromagnetic field equations and the problem formulation for CAD applications.
- To get familiarized with finite element method as applicable for electrical engineering .
- To introduce the organization of a typical CAD package.
- To introduce finite element method for the design of different electrical apparatus.

UNIT-I: INTRODUCTION **9**

Conventional design procedures – Limitations – Need for field analysis based design – Review of basic principles of energy conversion – Development of Torque/Force.

UNIT-II: MATHEMATICAL FORMULATION OF FIELD PROBLEMS **9**

Electromagnetic field equations – Magnetic vector/scalar potential – Electrical vector /scalar potential – Stored energy in electric and magnetic fields – Capacitance – Inductance – Laplace and Poisson's equations – Energy functional.

UNIT-III: PHILOSOPHY OF FEM **9**

Mathematical models – Differential/Integral equations – Finite difference method – Finite element method – Energy minimization – Variational method – 2D field problems – Discretisation – Shape functions – Stiffness matrix – Solution techniques.

UNIT-IV: CAD PACKAGES **9**

Elements of a CAD System –Pre-processing – Modelling – Meshing – Material properties – Boundary Conditions – Setting up solution – Post processing.

UNIT-V: DESIGN APPLICATIONS **9**

Voltage stress in insulators – Capacitance calculation – Design of solenoid actuator – Inductance and force calculation – Torque calculation in switched reluctance motor.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Salon S.J., 'Finite Element Analysis of Electrical Machines', Springer, YesDEE publishers, Indian reprint, 2007.
2. Nicola Bianchi, "Electrical Machine Analysis using Finite Elements", CRC Taylor & Francis, 2005.
3. Joao Pedro, Bastos A and Nelson Sadowski, "Electromagnetic Modeling by Finite Element Methods", Marcell Dekker Inc., 2003.
4. Silvester P. P and Ferrari, "Finite Elements for Electrical Engineers", Cambridge University Press, 1983.
5. Lowther D. A and Silvester P.P., "Computer Aided Design in Magnetics", Springer Verlag, New York, 1986.
6. User Manuals of MAGNET, MAXWELL & ANSYS Softwares.

COURSE OUTCOMES:

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

CO1: Analyze electrical apparatus and their application to power system.
CO2: Model electrical apparatus and their application to power system.
CO3: Solve mathematcial model.
CO4: Implement CAD packages.
CO5: Design voltage stress, capcitance and inducatnce calculation.

19EEPE713 SMART GRID TECHNOLOGY SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To demonstrate the various aspects of the smart grid, including technologies, components, architectures, applications.
- To learn about the needs of a utility, including meeting a utility's objectives, helping to adopt new technologies into the grid.
- To acquire knowledge in sensing and measurements in smart grid.
- To avail the information of the power system to centralized control centre.
- To learn about smart meter, sensors and intelligent devices to measure the electrical quantity.

UNIT-I: SMARTGRIDS: MOTIVATION, STAKES ANDPERSPECTIVES 9

Introduction – Information and communication technologies serving the electrical system – Integration of advanced technologies – Definitions of smart grids – Objectives addressed by the smart grid concept – Socio-economic and environmental objectives – Stakeholders involved the implementation of the smart grid concept – Research and scientific aspects of the smart grid – smart grids from the customer's point of view.

UNIT-II: INFORMATION AND COMMUNICATION TECHNOLOGY 9

Data communication, dedicated and shared communication channels, layered architecture and protocols, communication technology for smart grids, standards for information exchange, information security for the smart grid – Cyber security standards – IEEE1686 – IEC62351.

UNIT-III: SENSING AND MEASUREMENT 9

Synchro phasor technology – Phasor measurement unit, smart metering and demand side integration – Communication infrastructure and protocol for smart metering – Data concentrator, meter data management system. Demand side integration – Services, implementation and hardware support of DSI.

UNIT-IV: CONTROL AND AUTOMATION 9

Distribution automation equipment – Substation automation equipment's: current transformer, potential transformer, intelligent electronic devices, bay controller, remote terminal unit. Distribution management systems – SCADA: modeling and analysis tools, applications.

UNIT-V: REGULATION OF SMARTGRIDS AND ENERGY STORAGE SYSTEMS 9

Regulation and economic models – Evolution of the value chain – The emergence of a business model for smart grids – Regulation can assist in the emergence of smart grids – The standardization of smart grids – Energy storage technologies – Methods – Batteries, flow battery, fuel cell and hydrogen electrolyser, flywheel, super – Conducting magnetic energy storage system, super capacitor.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Janaka Ekanayake, Nick Jenkins and Kithsiri Liyanage "Smart Grid Technologies and applications", John Wiley Publishers Ltd., 2012.

2. Lars T. Berger and Krzysztof Iniewski.,"Smart Grid applications, Communications and Security", John Wiley Publishers Ltd., 2012.
3. Yang Xiao, "Communication and Networking in Smart Grids", CRC Press Taylor and Francis Group, 2012.
4. Caitlin G. Elsworth, "The Smart Grid and Electric Power Transmission", Nova Science Publishers Inc, August 2010.
5. Nouredine Hadjsaid and Jean-Claude Sabonnadiere,"Smart Grids", Wiley Publishers Ltd., 2012.

COURSE OUTCOMES:

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

CO1: Develop and demonstrate the various aspects of the smart grid, including technologies, components, architectures, applications.

CO2: Design a smart grid and to meet the needs of a utility, including meeting a utility's objectives, helping to adopt new technologies into the grid.

CO3: Create a framework for knowledgeable power engineers to operate the grid more effectively.

CO4: Transfer the available information from any part of the power system to centralized control centre.

CO5: Handle the smart meter, sensors and intelligent devices to measure the electrical quantity.

19EEPE714 MODERN CONTROL THEORY SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To grasp the knowledge about Z-trasnform and sample data systems.
- To understand the concepts and examine the properties of non-linear systems.
- To understand the concepts the stability of nonlinear systems.
- To design and evaluate the optimal controller.
- To apply advanced control strategies to practical engineering problems.

UNIT-I: Z – TRANSFORM AND SAMPLED DATA SYSTEMS 9

Sampled data theory – Sampling process – Sampling theorem – Signal reconstruction – Sample and hold circuits – Z-Transform – Theorems on Z-Transforms – Inverse Z-Transforms. Pulse transfer function – Response of sampled data system to step and ramp inputs – Steady state error – Stability studies – Jury's test and bilinear transformation.

UNIT-II: STATE SPACE ANALYSIS OF DISCRETE SYSTEMS 9

State variables – Canonical forms – Diagonalisation – Solutions of state equations – Controllability and observability – Effect of sampling time on controllability – Pole placement by state feedback – Linear observer design – First order and second order problems.

UNIT-III: NON-LINEAR SYSTEMS 9

Types of nonlinearity – Typical examples –Singular points – Limit cycles. Describing function –Stability analysis of non-linear systems through describing functions. Phase plane analysis – Construction of phase trajectories.

UNIT-IV: STABILITY ANALYSIS 9

Liapunov stability analysis – Stability in the sense of liapunov – Definiteness of scalar functions – Quadratic forms – Second method of liapunov – Liapunov stability analysis of linear time invariant systems and non-linear system.

UNIT-V: OPTIMAL CONTROL 9

Introduction to optimal control, statement of the optimal control problem, general introduction to the principle of optimality, discrete time linear quadratic problem, optimal state feedback solution. Formation of optimal control problems – Hamiltonian formulation – Solution of optimal control problems – Evaluation of Riccati s equation state and output regulator problems.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Gopal M., "Digital Control and State Variable Methods", Tata MC Graw Hill, 3rd Edition2008.
2. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", 12th Edition, Pearson Education, 2004.
3. Kirk D. E., "Optimal Control Theory-An Introduction", Prentice Hall, 2nd Edition 1998.
4. Nagrath I.J and Gopal M., "Control Systems Engineering", Wiley Eastern Limited, New Delhi, 5th Edition 2008.
5. Kuo B. C., "Digital Control Systems", Oxford University Press, 2nd Edition, 2007.

6. Loan D. Landau, Gianluca Zito, “Digital Control Systems, Design, Identification and Implementation”, Springer, 2006.

COURSE OUTCOMES:

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

CO1: Realization of the discrete systems and mathematical modeling.
CO2: Examine the properties of non–linear systems.
CO3: Analyze the stability of nonlinear systems.
CO4: Design and evaluate the optimal controller.
CO5: Apply advanced control strategies to practical engineering problems.

19EEPE715 POWER SYSTEM TRANSIENTS SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the importance of and effects of transients on power system.
- To study the generation of switching transients and their control using circuit – theoretical concept.
- To study the mechanism of lighting strokes and the production of lighting surges.
- To study the propagation, reflection and refraction of travelling waves.
- To study the impact of voltage transients caused by faults, circuit breaker action, load rejection on integrated power system.

UNIT-I: INTRODUCTION AND SURVEY 9

Review and importance of the study of transients – Causes for transients. RL circuit transient with sine wave excitation – Double frequency transients – Basic transforms of the RLC circuit transients. Different types of power system transients – Effect of transients on power systems – Role of the study of transients in system planning.

UNIT-II: SWITCHING TRANSIENTS 9

Over voltages due to switching transients – Resistance switching and the equivalent circuit for interrupting the resistor current – Load switching and equivalent circuit – Waveforms for transient voltage across the load and the switch – Normal and abnormal switching transients. Current suppression – Current chopping – Effective equivalent circuit. Capacitance switching – effect of source regulation – Capacitance switching with a restrike, with multiple restrikes. Illustration for multiple restriking transients – Ferro resonance.

UNIT-III: LIGHTNING TRANSIENTS 9

Review of the theories in the formation of clouds and charge formation – Rate of charging of thunder clouds – Mechanism of lightning discharges and characteristics of lightning strokes – Model for lightning stroke – Factors contributing to good line design – Protection using ground wires – Tower footing resistance – Interaction between lightning and power system.

UNIT-IV: TRAVELING WAVES ON TRANSMISSION LINE COMPUTATION OF TRANSIENTS 9

Computation of transients – Transient response of systems with series and shunt lumped parameters and distributed lines. Traveling wave concept – Step response – Bewely's lattice diagram – Standing waves and natural frequencies – Reflection and refraction of travelling waves.

UNIT-V: TRANSIENTS IN INTEGRATED POWER SYSTEM 9

The short line and kilometric fault – Distribution of voltages in a power system – Line dropping and load rejection – Voltage transients on closing and reclosing lines – Over voltage induced by faults – Switching surges on integrated system qualitative application of EMTP for transient computation.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Allan Greenwood, "Electrical Transients in Power Systems", Wiley Inter Science, New York, 2nd Edition, 1991.

2. Pritindra Chowdhari, “Electromagnetic transients in Power System”, John Wiley and Sons Inc., 2nd Edition, 2009.
3. Indulkar C.S, Kothari D.P and Ramalingam K., “Power System Transients – A statistical approach”, PHI Learning Pvt. Ltd., 2nd Edition, 2010.
4. Naidu M.S and Kamaraju V., “High Voltage Engineering”, McGraw Hill, 5th Edition, 2013.
5. Begamudre R.D., “Extra High Voltage AC Transmission Engineering”, Wiley Eastern Limited, 1986.
6. Hase Y., “Handbook of Power System Engineering”, Wiley India, 2012.

COURSE OUTCOMES:

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

CO1: Understand and analyze switching and lightning transients.
CO2: Acquire knowledge on generation of switching transients and their control.
CO3: Analyze the mechanism of lighting strokes.
CO4: Understand the importance of propagation, reflection and refraction of travelling waves.
CO5: Understand the concept of circuit breaker action, load rejection on integrated power system.

19EEPE801 OPTIMIZATION TECHNIQUES SEMESTER VIII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the concept of optimization techniques and algorithms for solving various electrical engineering problems.
- To formulate deterministic mathematical programs for practical system.
- To acquire knowledge on the concepts of various classical and modern methods for constrained and unconstrained with single and multivariable form of problems.
- To impart and recognize the limitations of different solution methodology.
- To understand the various optimization toolbox.

UNIT-I: CLASSICAL OPTIMIZATION TECHNIQUES 9

Single variable optimization – Multivariable optimization with no constraints: semi definite case, saddle point – Multivariable optimization with equality constraints: solution by direct substitution, solution by the method of constrained variation, solution by the method of Lagrange multipliers – Multivariable optimization with inequality constraints: Kuhn-Tucker conditions, constraint qualification.

UNIT-II: SIMPLEX METHOD 9

Standard form of a linear programming problem – Geometry of linear programming problems – Definitions and theorems – Solution of a system of linear simultaneous equations – Pivotal reduction of a general system of equations – Motivation of the simplex method – Simplex algorithm – Revised simplex method.

UNIT-III: UNCONSTRAINED & CONSTRAINED OPTIMIZATION TECHNIQUES 9

Unconstrained optimization techniques: gradient of a function – Steepest descent (Cauchy) method – Newton's method – Marquardt method – Quasi-Newton methods – Broydon – Fletcher – Goldfarb – Sanno method. Constrained optimization techniques: characteristics of a constrained problem – Generalized reduced gradient method – Sequential quadratic programming – Augmented lagrange multiplier method – Checking convergence of constrained optimization problems.

UNIT-IV: EVOLUTIONARY ALGORITHM 9

Genetic Algorithms (GA) – Principles of random search methods – Similarities and differences between GAs and traditional methods – GAs for constrained optimization – GAs operators – Real-coded GAs – Advanced GAs – Solution of simple problems. Particle Swarm Optimization (PSO) – Background, operation and basic flow of PSO – Applications of PSO. Ant Colony Optimization (ACO): Ant foraging behavior – Theoretical considerations – ACO algorithm – Comparison between GA, PSO and ACO.

UNIT-V: OPTIMIZATION TOOLBOX 9

Relevant software basics: introduction – Matrices and vectors – Matrix and array operations – Built-in functions – Saving and loading data – Script files – Function files. Optimization Toolbox: linear least squares with linearity constraints – Nonlinear curve fitting via least square with bounds – Linear programming – Quadratic programming– Use of GA toolbox.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Singiresu S. Rao,"Engineering Optimization – Theory and Practice", John Wiley & Sons, 4th Edition2009.
2. Kalyanmoy Deb,"Optimization For Engineering Design", Prentice Hall of India, New Delhi, 2nd Edition 2012.
3. Sivanandam S.N and Deepa S.N., "Introduction of Genetic Algorithms Springer", Newyork, 2019.
4. Rudra Pratap, "Getting Started with MATLAB 7", Oxford University Press, 2005.
5. "Optimization Toolbox Manual", The Mathworks Inc., 2000, www.mathworks.com.

COURSE OUTCOMES:

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

CO1: Understand the fundamental concept of optimization techniques.

CO2: Formulate deterministic mathematical programs for practical system.

CO3: Impact the knowledge on the concepts of various classical and modern methods for constrained and unconstrained with single and multivariable form of problems.

CO4: Recognize the limitations of different solution methodology.

CO5: Known about various optimization toolbox.

19EEPE802 DISTRIBUTED GENERATION AND MICRO GRID **SEMESTER VIII**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the technical impacts of DGs in power systems.
- To comprehend the technical and economical issues occur during the grid integration of DGs.
- To familiarize the different distributed energy resources of PV, wind and fuel cell.
- To operate and control the DC and AC microgrid.
- To analyze the performance of microgrid.

UNIT-I: INTRODUCTION TO DISTRIBUTED GENERATION 9

Renewable sources in distributed generation – Current scenario in distributed generation – Planning of DGs – Siting and sizing of DGs – Optimal placement of DG sources in distribution systems. Standards for interconnecting distributed resources to electric power systems: IEEE 1547.

UNIT-II: DISTRIBUTED GENERATIONS 9

Solar energy – Photo voltaic system – Solar cells – PV modules – System design – Solar water heating – Types. Solar thermal power generation – Water pumping applications;.Wind power generation – Power extraction – Types of wind mills. Fuel cells – Types – Losses in fuel cell – Applications.

UNIT-III: GRID INTEGRATION OF DGs AND ENERGY STORAGE SYSTEMS 9

Different types of interfaces – Inverter based DGs and rotating machine based interfaces – Aggregation of multiple DG units – Energy storage systems – Batteries, ultra-capacitors, flywheels.

UNIT-IV: MICROGRIDS 9

Types of micro-grids – Autonomous and non-autonomous grids – Sizing of micro-grids – Modeling and analysis – Micro-grids with power electronic interfacing units – AC and DC microgrids.

UNIT-V: OPERATION OF MICROGRID 9

Modes of operation: grid connected and islanded mode – Transients in micro-grids – Protection of microgrids – Power quality issues in microgrids, microgrid economics – Introduction to smart microgrids – Case studies.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Rai G.D., “Non Conventional energy Sources”, Khanna Publications ,New Delhi.2004.
2. Lee Willis H and Walter G. Scott , “Distributed Power Generation – Planning and Evaluation”, Marcel Decker Press, 2000.
3. Robert Lasseter and Paolo Piagi, “Micro-grid: A Conceptual Solution”, PESC 2004, June 2004.
4. Loi Lei Lai and Tze Fun Chan, “Distributed Generation-Induction and Permanent Magnet Generators”, IEEE Press, John Wiley & Sons, Ltd., England. 2007.

5. John Twidell and Tony Weir, “Renewable Energy Resources”, Taylor and Francis Publications, Second Edition 2006.

COURSE OUTCOMES:

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

CO1: Apply the technical impacts of DGs in power systems.
CO2: Anayze the technical and economical issues occur during the grid integration of DGs.
CO3: Familiarize the different distributed energy resources of PV, wind, fuel cell.
CO4: Modeling of DC and AC microgrid.
CO5: Analyze the performance of microgrid.

19EEPE803 POWER SYSTEM DYNAMICS SEMESTER VIII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the concepts of dynamics and its stability problems.
- To model the synchronous machines.
- To examine the excitation system and speed-governing controllers.
- To acquire knowledge on small signal stability of a single-machine infinite bus system with excitation system and power system stabilizer.
- To acquire knowledge on dynamic stability simulation of multi machine power system.

UNIT-I: INTRODUCTION 9

Basics of system dynamics – Numerical techniques – Introduction to software packages to study the responses. Concept and importance of power system stability in the operation and design – Distinction between transient and dynamic stability – Complexity of stability problem in large system – Necessity for reduced models – Stability of interconnected systems.

UNIT-II: SYNCHRONOUS MACHINE MODELLING 9

Synchronous machine – Flux linkage equations – Park's transformation – Per unit conversion – normalizing the equations – Equivalent circuit – Current space model – Flux linkage state space model. Sub-transient and transient inductances – Time constants. Simplified models (one axis and constant flux linkage) – Steady state equations and phasor diagrams.

UNIT-III: MACHINE CONTROLLERS 9

Exciter and voltage regulators – Function and types of excitation systems – Typical excitation system configuration – Block diagram and state space representation of IEEE type 1 excitation system – Saturation function – Stabilizing circuit. Function of speed governing systems – Block diagram and state space representation of IEEE mechanical hydraulic governor and electrical hydraulic governors for hydro turbines and steam turbines.

UNIT-IV: TRANSIENT STABILITY 9

State equation for multi machine system with one axis model and simulation – Modelling of multi machine power system with one axis machine model including excitation system and speed governing system and simulation using R-K method of fourth order (Gill's technique) for transient stability analysis – Power system stabilizer. For all simulations, the algorithm and flow chart have to be discussed.

UNIT-V: DYNAMIC STABILITY 9

System response to small disturbances – Linear model of the unregulated synchronous machine and its modes of oscillation – Regulated synchronous machine – Distribution of power impact – Linearization of the load equation for the one machine problem – Simplified linear model – effect of excitation on dynamic stability – Approximate system representation – Supplementary stabilizing signals – Dynamic performance measure – Small signal performance measures.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Anderson P. M and Fouad A. A., "Power System Control and Stability", Galgotia

Publications, New Delhi, 2003.
2. Kundur P., "Power System Stability and Control", McGraw Hill Inc., USA, 1994.
3. Ramanujam R., "Power System Dynamics-Analysis and Simulation", PHI, 2009.
4. Pai M. A and Sauer W., "Power System Dynamics and Stability", Pearson EducationAsia, India, 2002.
5. James A. Momoh and Mohamed E. EI-Hawary, " Electric Systems, Dynamics and Stabilitywith Artificial Intelligence applications", Marcel Dekker, USA 1st Edition, 2000.
6. Gross C. A., "Power System Analysis," Wiley India, 2011.

COURSE OUTCOMES:

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

CO1: Understand and analyze power system operation, stability, control and protection.
CO2: Design and modelling of synchronous machines.
CO3: Study about excitation system and speed-governing controllers.
CO4: Understand the concept of small signal stability of a single-machine infinitebus system with excitation system.
CO5: Analyze the dynamic stability simulation.

19EEPE804 MICROCONTROLLER BASED SYSTEM DESIGN SEMESTER VIII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the architecture of PIC microcontroller.
- To acquire knowledge on interrupts and timers.
- To understand the importance of peripheral devices for data communication and transfer.
- To acquire knowledge in functional blocks of ARM processor.
- To grasp knowledge on embedded ARM applications.

UNIT-I: INTRODUCTION TO PIC MICROCONTROLLER 9

Introduction to PIC microcontroller – PIC 16C6x and PIC16C7x architecture – IC16cxx – Pipelining – Program memory considerations – Register file structure – Instruction set – Addressing modes – Simple operations.

UNIT-II: INTERRUPTS AND TIMER 9

PIC micro controller interrupts – External interrupts – Interrupt programming – Loop time subroutine timers – Timer programming – Front panel I/O – Soft keys – State machines and key switches – Display of constant and variability strings.

UNIT-III: PERIPHERALS AND INTERFACING 9

I^2C 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, and sensor interfacing.

UNIT-IV: INTRODUCTION TO ARM PROCESSOR 9

Architecture – ARM programmer's model – ARM development tools – Memory hierarchy – ARM assembly language programming – Simple examples – Architectural support for operating systems.

UNIT-V: ARM ORGANIZATION 9

3-Stage pipeline ARM organization – 5-Stage pipeline ARM organization – ARM instruction execution – ARM implementation – ARM instruction set – ARM coprocessor interface – Architectural support for high level languages – Embedded ARM applications.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Mazidi M. A.,"PIC Microcontroller" Rollin Mckinlay, Danny causey, Prentice Hall of India, 2007.
2. Peatman J. B., "Design with PIC Micro Controllers", PearsonEducation,3rd Edition, 2004.
3. Furber S.,"ARM System on Chip Architecture", Addison Wesley trade Computer Publication, 2000.

COURSE OUTCOMES:

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

CO1: Understand the concepts of architecture of PIC microcontroller.

CO2: Acquire knowledge on Interrupts and timers.

CO3: Understand the importance of Peripheral devices for data communication.
CO4: Acquire knowledge in architecture of ARM processors.
CO5: Grasp knowledge in embedded ARM applications.

19EEPE805 POWER SYSTEM OPERATION, CONTROL AND PROTECTION **SEMESTER VIII**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the concepts of power system.
- To familraize the different operation and control techniques in power system.
- To study the operation and computerized control of power system.
- To understand the basic concepts of protection schemes.
- To identify the various apparatus used in protection of power system.

UNIT-I: OPERATION OF POWER SYSTEM **9**

Economics of power generation – Load curves – Load factor –Diversity factor, reserve requirements – Overview of load forecasting – Unit commitment : Constraints in unit commitment – Problem formulation – Solution using priority list method and brute force method. Economic dispatch problem – Thermal system dispatching with network losses considered – Solution methods – The lambda-iteration method – Gradient method.

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

Real power – 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: Static and dynamic analysis of uncontrolled and controlled cases.

UNIT-III: REACTIVE POWER CONTROL **9**

Reactive power – Voltage control: Typical excitation system, modeling – Static and dynamic analysis; Production and absorption of reactive power – Methods of voltage vontrol – Shunt reactors – Shunt capacitors – Series capacitors – Synchronous condensers – Static VAR systems – Tap changing transformers. Computer control of power system (quantitative treatment only).

UNIT-IV: PROTECTIVE RELAYS AND CIRCUIT BREAKERS **9**

Attributes of protection schemes – Electromagnetic relays – Construction, operations and applications, types: Differential relay – Distance relay – Over current relay. Principles of operation of static relays – Static over current relay. Circuit Breaker: Elementary principles of arc extinction – Arc control devices – Restriking and recovery voltages – Bulk oil, minimum oil, air blast, vacuum and SF_6 circuit breaker – Selection of circuit breakers.

UNIT-V: POWER APPARATUS PROTECTION **9**

Protective relays for the protection of generators – Motors – Transformers – Bus and lines. Generation of over voltage: Lightning – Switching – Insulation failure – Methods of protection: Ground line – Peterson coil – Surge absorbers and diverters.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Chakrabarti Soni Ml, Gupta P. V and Bhatnagar U.S.,"A Text Book On Power System Engineering", Dhanpat Rai Publishing Company, 2009.
2. Olle. I. Elgerd, "Electric Energy Systems Theory – An Introduction", Tata McGraw Hill

Publishing Company Limited, New Delhi, 2nd Edition, 2016, 46th reprint.
3. Mehta V. K and Mehta Rohit, "Principles of Power Systems", S Chand & Co Ltd, 4th Revised Edition, 2006.
4. Gangadhar K. A., "Power System Analysis and Stability", KP, New Delhi, 2017.
5. Wadhwa C. L., "Electrical Power Systems", Wiley Eastern Ltd., New Delhi, 2006.
6. Hadi Saadat, "Power System Analysis", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21streprint, 3rd dition, 2010.

COURSE OUTCOMES:

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

CO1: Understand the concepts of power system.
CO2: Analyze the performance of the power system for different operation and control techniques.
CO3: Study the operation and computerized control of power system.
CO4: Understand the basic protection schemes.
CO5: Identify the various apparatus used in protection of power system.

19CAOE01	GEOGRAPHICAL INFORMATION SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To introduce the fundamentals and components of Geographic Information System.
- To provide details of spatial data structures and input, management and output processes.

UNIT- I: FUNDAMENTALS OF GIS **9**

Introduction to GIS – Basic spatial concepts – Coordinate Systems – GIS and Information Systems – Definitions – History of GIS – Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software – Types of data – Spatial, Attribute data – Types of attributes – Scales/ levels of measurements.

UNIT- II: SPATIAL DATA MODELS **9**

Database Structures – Relational, Object Oriented – ER diagram – Spatial data models – Raster Data Structures – Raster Data Compression – Vector Data Structures – Raster vs Vector Models – TIN and GRID data models – OGC standards – Data Quality.

UNIT- III: DATA INPUT AND TOPOLOGY **9**

Scanner – Raster Data Input – Raster Data File Formats – Vector Data Input – Digitizer – Topology – Adjacency, Connectivity and containment – Topological Consistency rules – Attribute Data linking – ODBC – GPS – Concept GPS based mapping.

UNIT- IV: DATA ANALYSIS **9**

Vector Data Analysis tools – Data Analysis tools – Network Analysis – Digital Education models – 3D data collection and utilization.

UNIT- V: APPLICATIONS **9**

GIS Applicant – Natural Resource Management – Engineering – Navigation – Vehicle tracking and fleet management – Marketing and Business applications – Case studies.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Kang-Tsung Chang, "Introduction to Geographic Information Systems", McGraw Hill Publishing, 2nd Edition, 2011.
2. Ian Heywood, Sarah Cornelius, Steve Carver and Srinivasa Raju, "An Introduction to Geographical Information Systems", Pearson Education, 2nd Edition, 2007.

COURSE OUTCOMES:

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

CO1: Have basic idea about the fundamentals of GIS.
CO2: Understand the types of data models.
CO3: Get knowledge about data input and topology.
CO4: Gain knowledge on data quality and standards.
CO5: Understand data management functions and data output.

19CAOE02	GREEN BUILDINGS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To introduce the different concepts of sustainable design and green building techniques and how they may be synthesized to best fit a specific construction project.

UNIT- I: INTRODUCTION **9**

Life Cycle impacts of materials and products – Sustainable design concepts – Strategies of Design for the Environment – The sun-earth relationship and the energy balance on the earth's surface, climate, wind – Solar radiation and solar temperature – Sun shading and solar radiation on surfaces – Energy impact on the shape and orientation of buildings – Thermal properties of building materials.

UNIT- II: ENERGY EFFICIENT BUILDINGS **9**

Passive cooling and day lighting – Active solar and photovoltaic – Building energy analysis methods - Building energy simulation – Building energy efficiency standards – Lighting system design – Lighting economics and aesthetics – Impacts of lighting efficiency – Energy audit and energy targeting – Technological options for energy management.

UNIT- III: INDOOR ENVIRONMENTAL QUALITY MANAGEMENT **9**

Psychrometry – Comfort conditions – Thermal comfort – Ventilation and air quality – Air-conditioning requirement – Visual perception – Illumination requirement – Auditory requirement – Energy management options – Air conditioning systems – Energy conservation in pumps – Fans and blowers – Refrigerating machines – Heat rejection equipment – Energy efficient motors – Insulation.

UNIT- IV: GREEN BUILDING CONCEPTS **9**

Green building concept – Green building rating tools – Leeds and IGBC codes – Material selection Embodied energy – Operating energy – Façade systems – Ventilation systems – Transportation – Water treatment systems – Water efficiency – Building economics.

UNIT- V: GREEN BUILDING DESIGN CASE STUDY **9**

Students to work through a controlled process of analysis and design to produce drawings and models of their own personal green building project. Topics include building form, orientation and site considerations; conservation measures; energy modeling; heating system and fuel choices; renewable energy systems; material choices; and construction budget – Case Study on green construction and design.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Kibert C., "Sustainable Construction: Green Building Design and Delivery", John Wiley & Sons, 2005.
2. Edward G. Pita, "An Energy Approach - Air - Conditioning Principles and Systems", Pearson Education, 2003.
3. Colin Porteous, "The New Eco–Architecture", Spon Press, 2002.

4. Energy Conservation Building Codes: www.bee–india.nic.in.
5. Lever More G J., "Building Energy Management Systems", E and FN Spon, London, 2000.
6. Ganesan T P., "Energy Conservation in Buildings", ISTE Professional Center, Chennai, 1999.
7. John Littler and Randall Thomas, "Design with Energy: The Conservation and Use of Energy in Buildings", Cambridge University Press, 1984.

COURSE OUTCOMES:

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

CO1: Describe the concepts of sustainable design.

CO2: Familiarize with green building techniques including energy efficiency management.

CO3: Understand the indoor environmental quality management in green building.

CO4: Perform the green building rating using various tools.

CO5: Create drawings and models of their own personal green building project.

19CAOE03	PLANNING OF SMART CITIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To have an exposure on development of smart cities considering various fields related and their challenges.

UNIT- I: SMART CITIES DEVELOPMENT POTENTIALS AND CHALLENGES **9**

Perspectives of smart cities: Introduction and overview – Implementation challenges – Methodological issues – Spatial distribution of startup cities – Re imagining post industrial cities – Implementation challenges for establishing smart urban information and knowledge management system.

UNIT- II: ROLE OF ICT, REMOTE SENSING, AND GEOGRAPHICAL INFORMATION SYSTEM **9**

Optimizing green spaces for sustainable urban planning – 3D city models for extracting urban environmental quality indicators – Assessing the rainwater harvesting potential – The strategic role of green spaces – Monitoring urban expansion.

UNIT- III: ENVIRONMENT, ENERGY, DISASTER MANAGEMENT AND SUSTAINABLE DEVELOPMENT **9**

Alternatives for energy stressed cities – Social acceptability of energy – Efficient lighting – Energy management – Urban dynamics and resource consumption – Issues and challenges of sustainable tourism – Green buildings: Eco-friendly technique for modern cities.

UNIT- IV: MULTIFARIOUS MANAGEMENT FOR SMART CITIES **9**

An Assessment of domestic water use practices – An issue of governance in urban water supply – Assessment of water consumption at urban household level – Water sustainability – Socio-economic determinants and reproductive healthcare system – Problems and development of slums.

UNIT- V: INTELLIGENT TRANSPORT SYSTEM **9**

Introduction to Intelligent Transportation Systems (ITS) – The range of ITS applications – Network optimization – Sensing traffic using virtual detectors - In-vehicle routing, and Personal route information – The smart car-commercial routing and delivery – Electronic toll collection – The smart card – Dynamic assignment – Traffic enforcement. urban Mobility and economic development.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE:

1. Poonam Sharma and Swati Rajput, "Sustainable Smart Cities in India Challenges and Future Perspectives", Springer 2017 Co.(P) Ltd. 2013.
2. Ivan Nunes Da Silva, "Rogerio Andrade Flauzino-Smart Cities Technologies" – ExLi4EvA, 2016.
3. Stan McClellan, Jesus A. Jimenez and George Koutitas (eds.), "Smart Cities Applications, Technologies, Standards, and Driving Factors", Springer International Publishing, 2018.

4. Stan Geertman, Joseph Ferreira, Jr. Robert Goodspeed and John Stillwell., "Planning Support Systems and Smart Cities" , Springer, 2015.

COURSE OUTCOME:

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

CO1: Identify the potential and challenges in smart city development.
CO2: Apply the different tools for sustainable urban planning.
CO3: Understand the concepts of environment, energy and disaster management.
CO4: Identify the proper methods for water and waste water management.
CO5: Familiarize with the intelligent transport systems.

19CAOE04	VASTU SCIENCE FOR BUILDING CONSTRUCTION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To impart basic knowledge of Vastu science and its impact on human well being.

UNIT- I: INTRODUCTION **9**

Traditional definition – Meaning of Vastu and Vaastu - its classification – Relationship to earth – Concept of existence and manifestation – Placatory influence on earth.

UNIT- II: SPACE THEORY IN VASTU **9**

Features of good building site – Good building shapes – Macro, micro, enclosed and material spaces – Relationship between built space, living organism and universe – Impact of built space on human psyche. Flow of energy within built space and outside – Zoning of functional areas – Fitting of components in the building – Significance of water bodies and energy – The cube as the basic structure.

UNIT- III: COSMOGRAM & SETTLEMENT CONCEPTS **9**

Orientation of building, site, layout and settlement – Positive and negative energies – importance of cardinal and ordinal directions – The celestial grid or- mandala and its type. The Vaastu Purusha Mandala and its significance in creation of patterns, and lay-outs, extension of this to aural and visual fields.

UNIT- IV: INTERFACE OF TIME, VIBRATION AND RHYTHM **9**

Theory of vibration and energy transfer – Equation of time and space – Manifestation in living organism – Human beings – Measurement of the energy – Kirlian energy of various forms – Documentation of objects – Filaments and streamers.

UNIT- V: MEASUREMENTS & MATERIALS **9**

Units of measurement – Mana shastra – Ayadi techniques – Tala system and Hasta system of measures – Musical measurements compared to space measurements – Resultant ambience in built space. Use of wood, stone, metal, brick and time – Making technology, corbelling technology, jointing technology – Foundations for heavy and light structures – Landscaping in and around buildings – Aesthetic in Indian Architecture.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Dr. Prasanna Kumar Acharya, “Manasara”, Oxford1 University Press, (English version), 1927.
2. Subramanya Sastri K.S., “Maya Matam”, Thanjavur Maharaja Sarjoji Saraswathil Mahal Library, Thanjavur, 1966.
3. Stella Kramresh, “The Hindu Temple Vol.1 & II”, Motital Banarsidass Publishers Pvt. Ltd., Delhi, 1994.
4. Bruno Dagens, “ Mayamatam, Vol.1 & IIIGNCA and Motilal Bamarsidars Publishers Pvt. Ltd–s Delhi –1994.
5. George Birdsall – Feng Shui: The Key Concepts , January 2011.

COURSE OUTCOMES:

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

CO1: Obtain exposure on various concepts of Vastu.

CO2: Understand the theories in Vastu.

CO3: familiarize with the Cosmo gram and settlement concepts of Vastu.

CO4: Understand the role of Vasthu in energy flow manifestation in living beings.

CO5: Plan a structure considering various Vastu techniques.

19CAOE05 DISASTER MANAGEMENT AND MITIGATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

- To give knowledge about basics of disaster management.
- To impart knowledge about Hazards and Vulnerability.
- To give knowledge about mitigation and preparedness.
- To teach about response and recovery.
- To impart knowledge about the participants involved in the disaster management activity.

UNIT- I: INTRODUCTION 9

Disaster throughout history, History of disaster management, Capacity by demand, UN International strategy for disaster reduction, The Hyogo framework for action, Post 2015 framework, Disaster trends.

UNIT- II: HAZARDS AND RISK VULNERABILITY 9

Hazard identification and hazard profiling, Hazard analysis, Types of hazards – Natural and technological components of risk – Likelihood and consequence, Trends and computation of likelihood and consequence. Risk evaluation – purpose, Risk acceptability Alternatives, Personnel. Political/ social, Economic vulnerability – Physical profile, Social profile, Environmental profile, Economic profile. Factors influencing vulnerability, Risk perception.

UNIT- III: MITIGATION AND PREPAREDNESS 9

Mitigation – Types of mitigation, Obstacles in mitigation, Assessment and selection of mitigation options, Emergency response capacity as incorporating mitigation into development and relief projects. Preparedness – Government preparedness, Public preparedness, Media as a public educator. Obstacles to public education and preparedness.

UNIT- IV: RESPONSE AND RECOVERY 9

Response the Emergency – Pre disaster, post disaster, Provision of water, Food and shelter, Volunteer management, Command, Control and Coordination. Recovery – short term and long term recovery components of recovery – Planning, coordination, information, money and supplies, Allocation of relief funds, personnel. Types of recovery – Government, infrastructure, Debris removal disposal and processing, Environment, housing, economic and livelihood, individual, family and social recovery special considerations in recovery.

UNIT- V: PARTICIPANTS 9

Governmental disaster management agencies – Fire, law, Emergency management, Emergency medical service, Military and other resources. Structures – Local, regional, National. Bilateral assistance and its types. Types of national agencies involved in international disaster management. Political implications of bilateral assistance. Nongovernmental organizations – Operations, NGO/ military coordination, standard of conduct. The role of private sector and academia. Multilateral organizations – UN agencies and programmers', Regional & International organizations. International financial institutions – The world bank, IMF, ADB, IADB. Special considerations.

Contact periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Brassard, Caroline, Giles, David W and Howitt, Arnold M., "Natural Disaster Management in the Asia–Pacific", Policy and Governance.
2. "Disaster Management", Global Challenges and Local Solutions, Universities Press, 2009.
3. Jack Pinkowski, "Disaster Management Handbook", CRC Press, January 22, 2008.
4. Disaster Management Guidelines, GOI–UNDP Disaster Risk Reduction Programme (2009 -2012).

COURSE OUTCOMES:

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

CO1: Able to get knowledge about basics of Disaster management.
CO2: Able to impact knowledge about Hazards and vulnerability.
CO3: Able to know about Mitigation and preparedness.
CO4: Able to attain knowledge about response and recovery.
CO5: Able to learn about the participants involved in the disaster management activity.

19CAOE06	OPEN SOURCE TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Exposed to differentiate open source software and commercial software.
- Familiarity with Linux operating system.
- Development of web applications using open source web technologies like Apache, My Sql and PHP (LAMP/XAMP).

UNIT-I: OPEN SOURCE **9**

Introduction to Open Source – Open Source vs. Commercial Software – What is Linux? - Free Software – Where I can use Linux? Linux Kernel – Linux Distributions.

UNIT-II: LINUX **9**

Introduction to Linux Essential Commands - File system Concept - Standard Files - The Linux Security Model - Vi Editor - Partitions creation - Shell Introduction - String Processing - Investigating and Managing Processes - Network Clients – Installing Application.

UNIT-III: APACHE **9**

Apache Explained - Starting, Stopping, and Restarting Apache - Modifying the Default Configuration - Securing Apache - Set User and Group - Consider Allowing Access to Local Documentation - Don't Allow public html Web sites - Apache control with .htaccess.

UNIT-IV: MYSQL **9**

Introduction to MYSQL - The Show Databases and Table - The USE command - Create Database and Tables - Describe Table - Select, Insert, Update, and Delete statement - Some Administrative detail - Table Joins - Loading and Dumping a Database.

UNIT-V: PHP **9**

Introduction- General Syntactic Characteristics - PHP Scripting - Commenting your code - Primitives, Operations and Expressions - PHP Variables - Operations and Expressions Control Statement - Array - Functions - Basic Form Processing - File and Folder Access - Cookies - Sessions - Database Access with PHP - MySQL - MySQL Functions - Inserting Records - Selecting Records - Deleting Records - Update Records.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Ellen Siever, Stephen Figgins, Robert Love, Arnold Robbins, “Linux in a Nutshell”, Sixth Edition, OReilly Media, 2009.
2. James Lee and Brent Ware ,"Open Source Web Development with LAMP using Linux, Apache, MySQL, Perl and PHP", , Dorling Kindersley(India) Pvt. Ltd, 2008.
3. Eric Rosebrock, Eric Filson ,"Setting Up LAMP: Getting Linux, Apache, MySQL, and PHP and working Together", Published by John Wiley and Sons, 2004.

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to:

CO1: Differentiate the open source software and commercial software.

CO2: Identify, install and run Linux operating system.

CO3: Identify and install open source web technology Apache and manage applications.

CO4: Manage users and privileges in MySQL and to handle SQL functions.

CO5: Design and develop complete website using PHP.

19CAOE07	ETHICAL HACKING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand numerous methods of real-world information intelligence.
- To learn about vulnerability scanners.
- To understand techniques used to sniff traffic across a network.
- To familiarize with the methodologies that can be used to hack into a target.
- To appreciate the wide variety of attacks that can be performed against a wireless network.

UNIT-I: INTRODUCTION TO HACKING **9**

Terminologies, Categories of penetration test, Writing reports, Structure of a penetration Testing report, Vulnerability assessment summary, Risk assessment, Methodology, Linux basics: File structure, Cron Job, Users, Common applications, Back track, Services.

UNIT-II: INFORMATION GATHERING, TARGET ENUMERATION AND PORT SCANNING TECHNIQUES **9**

Active, Passive and sources of information gathering, Copying Websites locally, Neo Trace, Cheops-ng, Intercepting a response, What Web, Net craft, Basic parameters, Xcode Exploit scanner, Interacting with DNS servers, Fierce, Zone transfer with host command and automation, DNS Cache snooping – Attack scenario, Automating attacks, SNMP – Problem, Sniffing passwords, Solar winds Toolset, Sweep, Brute Force and Dictionary – Tools , Attack, Enumeration, Intelligence gathering using shodan, Target enumeration and Port scanning techniques.

UNIT-III: VULNERABILITY ASSESSMENT & NETWORK SNIFFING **9**

Introduction to vulnerability assessment – Pros and cons, NMap, Updation of database, Testing SCADA environments with Nmap, Nessus, Sniffing: Types, Hubs versus Switches, Modes, MITM attacks, ARP protocol basics – working, Attacks, DoS attacks, Dsniff tool, Using ARP spoof to perform MITM attacks, Sniffing the Traffic with Dsniff, Sniffing pictures with Drifnet, Urlsnarf and Webspy, Sniffing with Wireshark, Ettercap – ARP poisoning, Hijacking session with MITM attack, ARP poisoning with CAIN and Abel, Sniffing session Cookies with Wire shark, Hijacking the session, SSL strip: Stripping HTTPS traffic, Requirements, Automating man in the middle attacks, DNS spoofing, DHCP spoofing.

UNIT-IV: BASICS OF EXPLOITATION **9**

Remote exploitation : Understanding network protocols, Attacking network remote services, Common target protocols, Tools for cracking network remote services, Attacking SMTP, Attacking SQL servers, Client side exploitation methods: E-Mails leading to malicious attachments and malicious links, Compromising client side update, Malware loaded on USB sticks, Post exploitation: Acquiring situation awareness, Privilege escalation, Maintaining access, Data mining, Identifying and exploiting further targets, Windows exploit development basics.

UNIT-V: WIRELESS & WEB HACKING **9**

Wireless hacking : Requirements, Air cracking, Hidden SSIDs, Monitor mode, Monitoring tool – Beacon frames on Wire shark, Airodump-ng, Wireless adapter in monitor mode, Determining the target, Cracking a WPA/WPA2 wireless network Using Air cracking, Capturing packets and Four-Way handshake, Web hacking : Attacking the authentication, Brute force and dictionary attacks, Types of authentication, Crawling restricted links, Testing for the vulnerability, Authentication bypass with insecure cookie handling, SQL Injection,

XSS – DOM based, BeEF, CSRF, Bypassing CSRF and BeEF with XSS, Vulnerability in FCK editor, Efront.

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Rafay Baloch, "Ethical Hacking and Penetration Testing Guide", CRC Press, 2015.
2. Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy", Syngress Media, 2nd Revised Edition, 2013.
3. Michael T. Simpson, Kent Backman, James E. Corley, "Hands On Ethical Hacking and Network Defense", Cengage Learning, 2012.

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to:

CO1: Comprehend the basic concepts of hacking.
CO2: Know the core concepts related to malware, hardware and software vulnerabilities and their causes.
CO3: Recognize ethics behind hacking and vulnerability disclosure.
CO4: Appreciate the Cyber Laws and impact of hacking.
CO5: Exploit the vulnerabilities related to computer system and networks using state of the art tools and technologies.

19CAOE08	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand smart objects and IoT architectures.
- To learn about various IoT-related protocols.
- To build simple IoT systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT.
- To develop IoT infrastructure for popular applications.

UNIT-I: FUNDAMENTALS OF IoT **9**

Evolution of internet of things –Enabling technologies – IoT architectures: oneM2M, IoT World Forum (IoTWF) and alternative IoT models – Simplified IoT architecture and core IoT functional stack – fog, Edge and cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart objects and Connecting smart objects.

UNIT-II: IOT PROTOCOLS **9**

IoT access technologies: Physical and MAC layers, topology and security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network layer: IP versions, Constrained nodes and constrained networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over low power and lossy networks – Application transport methods: Supervisory control and data acquisition – Application layer protocols: CoAP and MQTT.

UNIT-III: DESIGN AND DEVELOPMENT **9**

Design methodology – Embedded computing logic – Microcontroller, System on chips –IoT system building blocks – Arduino – Board details, IDE programming – Raspberry Pi - Interfaces and raspberry Pi with Python programming.

UNIT-IV: DATA ANALYTICS AND SUPPORTING SERVICES **9**

Structured Vs Unstructured data and data in motion Vs data in rest – Role of machine learning – No SQL databases – Hadoop ecosystem – Apache Kafka, Apache spark – Edge streaming analytics and network analytics – Xively cloud for IoT, Python Web application framework – Django – AWS for IoT – System management with NETCONF – YANG.

UNIT-V: CASE STUDIES AND INDUSTRIAL APPLICATIONS **9**

Cisco IoT system – IBM Watson IoT platform – Manufacturing – Converged plant wide Ethernet model (CPwE) – Power utility industry – Grid blocks reference model – Smart and connected cities: Layered architecture, Smart lighting, Smart parking architecture and Smart traffic control.

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", Cisco Press, 2017.
2. Arshdeep Bahga and Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015.
3. Olivier Hersent, David Boswarthick and Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012 .

4. Jan Ho ller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand, David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
5. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), Architecting the Internet of Things, Springer, 2011.
6. Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, O'Reilly Media, 2011.

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to:

CO1: Explain the concept of IoT.
CO2: Analyze various protocols for IoT.
CO3: Design a PoC of an IoT system using Rasperry Pi/Arduino.
CO4: Apply data analytics and use cloud offerings related to IoT.
CO5: Analyze applications of IoT in real time scenario.

19CAOE09	SOFTWARE TESTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the criteria for test cases.
- To learn the design of test cases.
- To understand test management and test automation techniques.
- To apply test metrics and measurements.

UNIT-I: INTRODUCTION **9**

Testing as an engineering activity – Testing as a process – Testing maturity model- Testing axioms – Basic definitions – Software testing principles – The tester's role in a software development organization – Origins of defects – Cost of defects – Defect classes – The defect repository and test design – Defect examples - developer/tester support of developing a defect repository.

UNIT-II: TEST CASE DESIGN STRATEGIES **9**

Test case design strategies – Using black box approach to test case design – Boundary value analysis – Equivalence Class partitioning – State based testing – Cause-effect graphing – Compatibility testing – User documentation testing – Domain testing - Random testing – Requirements based testing – Using white box approach to test design – Test adequacy criteria – Static testing vs. structural testing – Code functional testing – Coverage and control flow graphs – Covering code logic – Paths – Code complexity testing – Additional white box testing approaches- Evaluating test adequacy criteria.

UNIT-III: LEVELS OF TESTING **9**

The need for levels of testing – Unit test – Unit test planning – Designing the unit tests – The test harness – Running the unit tests and recording results – Integration tests – Designing integration tests – Integration test planning – Scenario testing – Defect bash elimination system Testing – Acceptance testing – Performance testing – Regression Testing – Internationalization testing – Adhoc testing – Alpha, Beta tests – Testing OO systems – Usability and accessibility testing – Configuration testing –Compatibility testing – Testing the documentation- Website testing.

UNIT-IV: TEST MANAGEMENT **9**

People and organizational issues in testing – Organization structures for testing teams – Testing services – Test Planning – Test plan components – Test plan attachments – Locating test items – test management – test process – Reporting test results – Introducing the test specialist – Skills needed by a test specialist – Building a testing group- The structure of testing group, The technical training program.

UNIT-V: TEST AUTOMATION **9**

Software test automation – Skills needed for automation – Scope of automation – Design and architecture for automation – Requirements for a test tool – Challenges in automation – Test metrics and measurements – Project, Progress and Productivity metrics.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Srinivasan Desikan and Gopalaswamy Ramesh, "Software Testing – Principles and Practices", Pearson Education, 2006.
2. Ron Patton, "Software Testing", Second Edition, Sams Publishing, Pearson Education, 2007.
3. Iene Burnstein, "Practical Software Testing", Springer International Edition, 2003.
4. Edward Kit," Software Testing in the Real World – Improving the Process", Pearson Education, 1995.
5. Boris Beizer," Software Testing Techniques" , 2nd Edition, Van Nostrand Reinhold, New York, 1990.
6. Aditya P. Mathur, "Foundations of Software Testing Fundamental Algorithms and Techniques", Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008.

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to:

CO1: Design test cases suitable for a software development for different domains.
CO2: Identify suitable tests to be carried out.
CO3: Prepare test planning based on the document.
CO4: Document test plans and test cases designed.
CO5: Use automatic testing tools, develop and validate a test plan.

19CAOE10	USER INTERFACE DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic concepts user interface design.
- To design Menus and GUI.
- To understand the components of windows control.
- To visualize web controls.

UNIT-I: INTRODUCTION **8**

Human-Computer interface - Characteristics of graphics interface - Direct manipulation Graphical system - Web user interface – Popularity – Characteristic & principles.

UNIT-II: HUMAN COMPUTER INTERACTION **10**

User Interface design process - Obstacles – Usability - Human characteristics in design – Human Interaction speed - Business functions - Requirement analysis - Direct - Indirect methods - Basic business functions - Design standards - System timings - Human consideration in screen design - Structures of menus - Functions of menus - Contents of menu – Formatting - Phrasing the menu - Selecting menu choice – Navigating menus - Graphical menus.

UNIT-III: WINDOWS **9**

Characteristics - Components - Presentation styles - Types - Managements - organizations - Operations - Web systems - Device-based controls Characteristics - Screen-based controls - Operate control – Text boxes – Selection control - Combination control - Custom control – Presentation control.

UNIT-IV: MULTIMEDIA **9**

Text for web pages - Effective feedback - Guidance and Assistance - Internationalization - Accessibility – Icons - Image – Multimedia - Coloring.

UNIT-V: WINDOWS LAYOUT-TEST **9**

Prototypes - Kinds of tests – Retest – Information search - Hypermedia - WWW -Software tools -Visualizations to present and explore big data -Visualization of text data and protein sequences.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Wilbent O. Galitz,"The Essential Guide To User Interface Design", John Wiley & Sons, 2001.
2. Ben Sheiderman, "Design The User Interface", Pearson Education, 1998.
3. Alan Cooper, "The Essential of User Interface Design", Wiley Dream Tech, 2002.

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to:

CO1: Design the GUI components.

CO2: Design the Menu components.

CO3: Design the windows based controls.

CO4: Realize multimedia components.

CO5: Design windows layout for big data.

19CAOE11	AUTOMOTIVE ELECTROICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the concepts of Automotive Electronics and its evolution.
- To introduce overview of automotive systems and subsystems.
- To understand sensors and sensor monitoring mechanisms aligned to automotive systems, different signal conditioning techniques, interfacing techniques and actuator mechanisms.
- To understand, design and model various automotive control systems using Model based development technique.
- To understand role of Embedded in various communication systems, wired and wireless protocols used in vehicle networking.

UNIT-I: AUTOMOTIVE MECHANICAL SYSTEMS: VEHICLE SYSTEMS 9

Power train system (Air system, Fuel system (carburetor and diesel fuel injection, Ignition system, Exhaust system and other auxiliary systems (cooling, lubrications and electrical systems), Transmission system (Front, rear and 4 wheel drive, manual, automatic transmission, differential). Braking system (drum, disc, hydraulic, pneumatic), Steering system (rack and pinion, power steering).

UNIT-II: ELECTRONICS IN AUTOMOTIVE SYSTEMS 9

Need for electronics in automotive systems: Performance (speed, power, and torque), Control (emission, fuel economy, drivability, and safety) and legislation (environmental legislation for pollution and Safety Norms). Overview of vehicle electronic systems: Basic electrical components and their operation in an automobile: Power train subsystem (Starting systems, Charging systems – Ignition systems – Electronic fuel control), Chassis subsystem (ABS, TCS, and ESP) – Comfort and safety subsystems (Night vision, Airbags, Seatbelt Tensioners, Cruise control– Lane– Departure– Warning, Parking).

UNIT-III: INTEGRATED DEVELOPMENT ENVIRONMENT 9

Introduction to integrated development environment (IDE) – Getting started, HW / SW configuration (boot service, Host – Target interaction) – Booting reconfiguration – Managing IDE – Target servers, agents, Cross development, debugging – Introduction to an IDE for lab board – RTOS, PC based debugger.

UNIT-IV: EMBEDDED SYSTEM IN AUTOMOTIVE APPLICATIONS 9

Engine management systems – Gasoline / Diesel systems, various sensors used in system – Electronic transmission control – Vehicle safety system – Electronic control of braking and traction – Body electronics – Infotainment systems – Navigation systems – System level tests – Software calibration using engine and vehicle dynamometers – Environmental tests for electronic control unit – Application of control elements and control methodology in automotive system.

UNIT-V: EMBEDDED SYSTEM COMMUNICATION PROTOCOLS 9

Introduction to control networking – Communication protocols in embedded systems – SPI, I2C, USB – Vehicle communication protocols – Introduction to CAN, LIN, FLEXRAY, MOST, KWP2000.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. JoergSchaeuffele, Thomas Zurawka, "Automotive Software Engineering Principles, Processes, Methods and Tools", SAE International, 2005.
2. Robert Bosch, "Automotive Handbook", John Wiley and Sons, 6th Edition, 2014. Denton. T., "Automobile Electrical and Electronic Systems", 4th Edition, 2012.
3. Ronald K. Jurgen, "Automotive Electronics Handbook", McGraw Hill Publications, 1999. Nicholas Navit, "Automotive Embedded System Handbook", CRC Press, Taylor and Francis Group, 2009.
4. Knowles D., "Automotive Electronic and Computer Controlled Ignition Systems", Prentice Hall, 1998.
5. William B. Ribbens, "Learning Automotive Electronics", Newnes Publishing, 6th Edition 2003.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1: Describe various mechanical systems in an automobile.

CO2: Illustrate different types of electronic systems in an automobile.

CO3: Outline the various stages of integrated development environment to design an embedded system.

CO4: Explain the various embedded systems used in automotive applications.

CO5: Compare Vehicle Communication Protocols.

19CAOE12 HARDWARE DESCRIPTIVE LANGUAGE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart the skill in various modeling in Verilog.
- To understand the basics of Verilog HDL.
- To learn the features in Verilog HDL.
- To understand the branching in Verilog,
- To be familiar with programming in digital circuits.

UNIT-I: OVERVIEW OF DIGITAL DESIGN WITH VERILOG HDL 9

Overview of Digital Design with Verilog HDL, Evolution of CAD, emergence of HDLs, typical HDL-flow, Trends in HDLs. Hierarchical Modeling Concepts Top-down and bottom-up design methodology, differences between modules and module instances, parts of a simulation, design block, stimulus block.

UNIT-II: BASIC CONCEPTS 9

Basic Concepts, Lexical conventions, data types, system tasks, compiler directives. Modules and Ports, Module definition, port declaration, connecting ports, hierarchical name referencing.

UNIT-III: GATE-LEVEL MODELING 9

Gate-Level Modeling - Modeling using basic Verilog gate primitives, description of and/or and buf/not type gates, rise, fall and turn-off delays, min, max, and typical delays. Dataflow Modeling, Continuous assignments, delay specification, expressions, operators, operands, operator types.

UNIT-IV: BEHAVIORAL MODELING 9

Behavioral Modeling, Structured procedures, initial and always, blocking and non-blocking statements, delay control, generate statement, event control, conditional statements, Multiway branching, loops, sequential and parallel blocks.

UNIT-V: LOGIC DESIGN USING VERILOG 9

Basic concepts – Identifiers – Procedural assignments – Design of combinational and sequential circuits using data flow – Structural gate level – Switch level modeling and behavioral modeling – Test benches.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Bhasker J., "Verilog HDL", Prentice Hall, 2000.
2. Stephen Brown, "Fundamental of Digital logic with Verilog Design", Tata McGraw Hill, 2008.
3. Samir Palnitkar, "Verilog HDL", Pearson, 2nd Edition, 2003.
4. Zainalabedin Navabi, "Verilog digital systems design", McGraw Hill, 2nd Edition, 1999.
5. Charles H Roth Jr., "Digital System Design using VHDL", Thomson learning, 2004.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1: Understand the fundamentals of Verilog HDL.

CO2: Gain the knowledge about various modeling in Verilog HDL.

CO3: Be familiar with features in Verilog HDL.

CO4: Understand the fundamentals branching Verilog HDL.

CO5: Analyze the logic design using Verilog HDL.

19CAOE13 EMBEDDED SYSTEM DESIGN USING ARM PROCESSOR

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand ARM7TDMI assembly instructions and their formats and usage.
- To be very good in writing ARM7 based assembly level programs.
- To understand how various coprocessors are interfaced in a SoC.
- To be very conversant and knowledgeable in cache design, virtual memory and memory protection concepts and their implementation details in a typical SoC designs.
- To know about various families of ARM and different case studies.

UNIT-I: ARM ARCHITECTURE 9

Advanced RISC machine – Architecture inheritance – ARM programming model – ARM development tools – 3 and 5 stages pipeline ARM organization – ARM instruction execution and implementation – ARM Co-Processor interface.

UNIT-II: ASSEMBLY LANGUAGE PROGRAMMING 9

ARM instruction types – Data transfer, Data processing and control flow instructions – ARM instruction set – Co-processor instructions – Data processing instruction – Data transfer instruction – Control flow instructions.

UNIT-III: THE THUMB INSTRUCTION SET 9

Thumb bit in the CPSR – Thumb programmer‘s model – Thumb branch instructions – Thumb software interrupt instruction – Thumb data processing instructions – Thumb single register data transfer instructions – Thumb multiple register data transfer instructions – Thumb breakpoint instructions – Thumb implementation – Thumb applications.

UNIT-IV: MEMORY HIERARCHY 9

Memory size and speed – On-chip memory – Caches – Cache design – Memory management – Examples and exercises. Abstraction in software design – Date type – Floating point data type and architecture – Expressions – Conditional statement – Loops – Functions and procedures – Use of memory.

UNIT-V: ARM PROCESSOR AND CPU CORES. 9

ARM cores – ARM architecture – ARM7TDMI, ARM8, ARM9TDMI, ARM10TDMI, ARM710T – ARM810 – ARM920T AND ARM940T – ARM1020E – Case study.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Steve Furber, “ARM System on Chip Architecture‖ Addison”, Wesley Professional, 2nd Edition, Aug 2000.
2. Andrew N. Sloss, Dominic Symes and Chris Wright, “ARM System Developer‘s Guide Designing and Optimizing System Software”, Morgan Kaufmann Publishers, Elsevier, 2004.
3. Ricardo Reis, “Design of System on a Chip: Devices and Components”, Springer, 1st Edition, July 2004.
4. Jason Andrews-Co, “Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology)”, Newnes, BK and CD– ROM (Aug 2004).
5. Rashinkar P., Paterson and Singh L., “System on a Chip Verification – Methodologies and

Techniques", Kluwer Academic Publishers, 2001.
6. David Seal, "ARM Architecture reference Manual", Addison – Wesley Professional; 2nd Edition, 2001.
7. Alan Clement, "The principle of computer Hardware", 3rd Edition, Oxford University Press.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1: Explain ARM architecture.
CO2: Illustrate special features of ARM instruction set.
CO3: Make use of thumb instruction set to write assembly language program.
CO4: Explain memory and I/O management with ARM processor.
CO5: Review different ARM CPU cores.

19CAOE14 BIOINSPIRED COMPUTING TECHNOLOGIES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the concept of Genetic algorithm.
- To learn the operators in Genetic algorithm.
- To understand the concept of PSO algorithm.
- To introduce advanced optimization algorithm.
- To know about hybrid optimization algorithm.

UNIT-I: INTRODUCTION **9**

Features of Evolutionary Computation –Advantages of Evolutionary Computation – Applications of Evolutionary Computation. Genetic Algorithms: Introduction –Conventional Optimization and Search Techniques –Advantages and Limitations of Genetic Algorithm– Terminologies and Operators of GA

UNIT-II: OPERATORS AND APPLICATIONS **9**

Advanced Operators and Techniques in Genetic Algorithm–Classification of Genetic Algorithm –Application of GA in solving combinatorial optimization problems

UNIT-III: PSO ALGORITHM **9**

PSO Algorithm –Accelerated PSO – Implementation –Convergence Analysis –Binary PSO – Applications. Ant Colony Optimization–Characteristics- Algorithm –Applications.

UNIT-IV: ADVANCED OPTIMIZATION ALGORITHM **9**

Cuckoo Life Style – Flowchart –Algorithm , Bat Algorithms – Echolocation of Bats – Flowchart– Algorithm, Bee-Inspired Algorithms – Flowchart – Algorithm

UNIT-V: HYBRID OPTIMIZATION ALGORITHM **9**

Teacher-Learner Based Optimization algorithm –Jaya Algorithm–Hybrid Optimization Algorithm (Any Two)

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Sivanandam S. N. and Deepa S.N., "Introduction to Genetic Algorithms", 1st Edition, Springer, USA, 2008.
2. OmidBozorg - Haddad, "Advanced Optimization by Nature-Inspired Algorithms", Springer, Volume 720, Singapore, 2018.
3. SrikantaPatnaik, Xin-She Yang and Kazumi Nakamatsu, "Nature-Inspired Computing and Optimization Theory and Applications", Springer, Volume 10,USA, 2017.
4. Nancy Arana-Daniel, Carlos Lopez-Franco, Alma Y Alanis, "Bio-inspired Algorithms for Engineering", Butterworth-Heinemann 2018.
5. David E. Goldberg, "Genetic Algorithm in search, Optimization and Machine Learning" Pearson Education India, 2008.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1: Explain concept of Genetic algorithm.

CO2: Illustrate operators in Genetic algorithm.

CO3: Gain knowledge on the concept of PSO algorithm.

CO4: Explain the concepts on advanced optimization algorithm.

CO5: Review about hybrid optimization algorithm.

19CAOE15	VEHICULAR COMMUNICATION AND NETWORKING TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the vehicle-to-x (v2x) communication.
- To conceptualize standards and technologies.
- To understand the basics wireless propagation and channel characteristics. .
- To learn Medium access control (MAC). .
- To introduction to vehicular networks. .

UNIT-I: VEHICLE-TO-X (V2X) COMMUNICATION 9

Vehicle-to-X (V2X) Communication for Intelligent Transportation Systems (ITS) - safety and non-safety applications, use cases, network service requirements of different applications, V2X communication regimes.

UNIT-II: STANDARDS AND TECHNOLOGIES 9

Standards and Technologies - layered architecture, infrastructure-based vs. infrastructure-less technologies, Long-Term Evolution (LTE), Dedicated Short Range Communication (DSRC), Wireless Access in Vehicular Environments (WAVE).

UNIT-III: WIRELESS PROPAGATION AND CHANNEL CHARACTERISTICS 9

Wireless Propagation and Channel Characteristics - path loss, shadowing, small-scale fading, delay spread and Doppler spread, coherence bandwidth and coherence time, techniques for combating wireless channel impairments; Physical Layer - digital modulation schemes in DSRC, design of OFDM in DSRC (symbol time, sub-carrier spacing, pilot spacing).

UNIT-IV: MEDIUM ACCESS CONTROL (MAC) 9

802.11p EDCA, multi-channel operation in the WAVE MAC; Routing - flooding, broadcast storm problem, Geocast; Security and Privacy in Vehicular Networks; Vehicular Network Simulation - mobility models, bidirectionally coupled road traffic and communication network simulators for vehicular network simulation.

UNIT-V: INTRODUCTION TO VEHICULAR NETWORKS

Introduction to Vehicular Networks: Controller Area Networks (CAN) , Field of application, Physical layer and bit coding, Frame types and format, Bit stuffing and synchronization, Error management, Overview of Other communication protocols: LIN, Flex ray.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Christophe Sommer and Falko Dressler, “Vehicular Networking”, Cambridge University Press, 2014.
2. Hannes Hartenstein and Kenneth Laberteaux(eds.), “VANET Vehicular Applications and Inter-networking Technologies”, John Wiley & Sons, 2009.
3. Claudia Campolo, Antonella Molinaro and Riccardo Scopigno, “Vehicular ad hoc Networks: Standards, Solutions, and Research”, Springer, 2015.
4. Theodore S. Rappaport, “Wireless Communications: Principles and Practice”, Second Edition, Prentice Hall, 2001.
5. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2005.

6. Dominique Paret, “Multiplexed Networks for Embedded Systems: CAN, LIN, FlexRay, Safe–by–Wire”, First Edition, Wiley, 2007.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1: Define vehicle-to-x (v2x) communication.

CO2: Solve specific problems with standards and technologies.

CO3: Gain knowledge of the basics wireless propagation and channel characteristics**.**

CO4: Review on Medium Access Control (MAC).

CO5: Explain about vehicular networks.

19CAOE16 ENERGY EFFICIENT LIGHTING SYSTEM

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the importance of lightning.
- To known the fundamentals of illumination and its methods.
- To familiar lighting control methods for various applications.
- To understand energy efficient lighting in building mangement system.
- To study the renewable energy methods for energy efficient lighting.

UNIT I : LIGHTING **9**

Lighting - Importance of lighting in buildings - Interior designing, Photography, Architecture - Difference between good and bad lighting - Challenges in lighting - Types of lighting.

UNIT II : ILLUMINATION FUNDAMENTALS & VARIOUS ILLUMINATION METHODS **9**

Introduction - Terms used in illumination - Laws of illumination - Polar curves - Photometry - Integrating sphere - Sources of light - Discharge lamps - Incandescent lamps - MV and SV lamps.

UNIT III: ENERGY EFFICIENT LIGHTING **9**

Smart lighting - Fluorescent lamps - Comparison between Tungsten filament lamps and Fluorescent tubes - Basic principles of light control - Types and design of lighting and flood lighting - CFL - LED - High Intensity Discharge lamps

UNIT IV: BUILDING MANAGEMENT SYSTEM **9**

Energy efficient landscape design - Natural lighting - Choice of building materials for energy efficient lighting - Light pipes - Light fixtures - Green buildings - Construction techniques.

UNIT V: CASE STUDY **9**

Solar lighting techniques - Lighting using wind power - Energy conservation building code - Energy efficient buildings in the country.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Philip Gordon., "Principles and Practices of Lighting Design: The Art of Lighting Composition", Blue Matrix Productions, 2011.
2. Jerry Yudelson, "Green Building Through Integrated Design" The McGraw - Hill Companies, Inc.,2009
3. Derek Phillips, "Daylighting: Natural Light in Architecture", Elsevier, 2004.
4. Jerry Yudelson , "Greening Existing Buildings", The McGraw - Hill Companies, Inc.,1st edition, 2010
5. Sam Kubba,"Handbook of Green Building Design and Construction", Elsevier Inc.,2012..
6. Solanki.C.S, "Solar Photovoltaic Technology and Systems", PHI, 2013
7. J. F. Manwell, J.G. MC Gowan and A.L. Rogers, "Wind Energy Explained: Theory, Design and Application", Wiley, 2nd edition, 2010.

COURSE OUTCOMES:

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

CO1: Understand the properties of light, importance of lighting in various fields and types of lighting.

CO2: Understand the properties and laws of illumination, working of discharge lamps, fluorescent lamps, tungsten filament lamps and light control techniques.

CO3: Compare the various lighting techniques and employ sutiable lighting control methods for various applications

CO4: Choose the building materials and construction techniques for energy efficient lighting.

CO5: Employ renewable energy methods for energy efficient lighting

19CAOE17	SENSORS AND TRANSDUCERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the concepts of measurement technology.
- To learn the various motion, proximity and ranging sensors used to measure various physical parameters.
- To understand the various force, magnetic and heading sensors used to measure various physical parameters.
- To know the various optical, pressure and temperature sensors used to measure various physical parameters.
- To understand the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

UNIT I : INTRODUCTION **9**

Basics of measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor output signal types.

UNIT II : MOTION, PROXIMITY AND RANGING SENSORS **9**

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).

UNIT III : FORCE, MAGNETIC AND HEADING SENSORS **9**

Strain gage, Load cell, Magnetic sensors – Types, principle, requirement and advantages: Magneto resistive – Hall effect – Current sensor, Heading sensors – Compass, gyroscope, inclinometers.

UNIT IV : OPTICAL, PRESSURE AND TEMPERATURE SENSORS **9**

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 & Nano sensors, LASER sensors.

UNIT V : SIGNAL CONDITIONING and DAQ SYSTEMS **9**

Amplification – Filtering – Sample and hold circuits – Data acquisition: single channel and multi channel data acquisition – Data logging – Applications – Automobile, aerospace, Home appliances, Manufacturing, Environmental monitoring.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Ernest O. Doebelin, “Measurement Systems - Applications and Design”, Tata McGraw-Hill, 2009.
2. Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12th Edition, Dhanpat Rai & Co, New Delhi, 2013.
3. Patranabis D., “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2010.
4. John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford

SciencePublications, 1999.
5. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd Edition, CRC Press, 2015.

COURSE OUTCOMES:

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

CO1: Expertise in various calibration techniques and signal types for sensors.
CO2: Apply the various sensors in the automotive and mechatronics applications.
CO3: Study the basic principles of various magnetic sensors.
CO4: Study the basic principles of various smart sensors.
CO5: Implement the DAQ systems with different sensors for real time applications.

19CAOE18	ELECTRICAL SAFETY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To identify the presence of electrical hazards and measures to minimize risks.
- To determining the cause of electrical accidents, fires and explosions.
- To apply various grounding and bonding techniques.
- To adequate safety method for low, medium and high voltage equipment.
- To know the various fundamentals and provide solutions to a practical case study.

UNIT I : INTRODUCTION AND HAZARDS OF ELECTRICITY 9

Introduction – Hazard analysis: Primary and secondary hazards – Arc, blast, shocks – Causes and effects – Summary of causes – Protection and precaution – Injury and death protective strategies – IE Rules 1956 – Basic rules for new installations: Power system, domestic and industry (Qualitative treatment only).

UNIT II : ELECTRICAL SAFETY EQUIPMENT 9

General inspection and testing procedure for electrical safety equipment – Electrical safety equipment for external protection: Flash and thermal protection – Head and eye protection – Insulation protection. Electrical safety equipment for internal protection: Over voltage, short circuit, earth fault, leakage current, high/low frequency – Single line diagram of industrial power system with safety control – Electrician's safety kit and materials.

UNIT III : SAFETY PROCEDURES 9

Introduction – Six-step safety method – Job briefings – Energized or De-energized – Safe switching of power systems – General energy control programs – Lockout – Tagout – Voltage measurement techniques – Placement of safety grounds – Flash hazard calculations and approach distances – Calculating the required level of arc protection (flash hazard calculations) – Barriers and warning signs – Tools and test equipment – Field marking of potential hazards – Shock avoidance techniques – One-minute safety audit.

UNIT IV : GROUNDING AND ELECTRICAL MAINTENANCE 9

Need for electrical equipment grounding – System grounding – Equipment grounding – Types of earthing – Earth testing for electrical equipment's in power house and industry – Eight step maintenance program – Maintenance requirements for specific equipment and location – IEC and UL standard.

UNIT V : VOLTAGE SAFETY SYNOPSIS AND MEDICAL SAFETY MANAGEMENT 9

Safety equipment's and safety procedures for low voltage and high voltage system – Electrical safety around electronic circuits – Electrical safety for medical equipment like over current safety, isolation, EMI and harmonics – Battery maintenance procedure – Stationary battery safety – Accident prevention – Accident investigation – First aid – Rescue techniques – Electrical safety program structure and development – Safety meetings – Safety audits.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. John Cadick, Mary Capelli-Schellpfeffer and Dennisneitzel, "Electrical Safety Handbook", Mcgraw Hill Publishing Company Ltd., 4th Edition, 2012.
2. Dennis Neitzel and Al Winfield, "Electrical Safety Handbook", McGraw – Hill Education, 4th Edition, 2012.
3. Mohamed A El-Sharkawi, "Electric safety: Practice and Standards", CRC press, New York, 2013.
4. Martha J. Boss and Gayle Nicoll, "Electrical Safety: Systems, Sustainability and Stewardship", CRC press, New York, 2014.
5. Ray A. Jones and Jane G. Jones, "The Electrical Safety Program Guide", National fire protection association, Quincy, 2011.
6. James H and Wiggins JR., "Managing Electrical Safety", Abs Consulting, Maryland, 2011.

COURSE OUTCOMES:

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

CO1: Expand skills in identifying the presence of electrical hazards, implementing measures to minimize risks.

CO2: Develop skills in investigative techniques for determining the cause of electrical accidents, fires and explosions.

CO3: Analyze and apply various grounding and bonding techniques.

CO4: Select appropriate safety method for low, medium and high voltage equipment.

CO5: Assess and provide solutions to a practical case study.

19CAOE19	ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To anderstand the basics of electric vehicle components and configuration.
- To analyze suitable drive scheme for developing an electric trains.
- To analyze energy storage system.
- To identify a energy management system.
- To understand the infrastructure for electric vehicles and business potential.

UNIT I : INTRODUCTION **9**

Conventional vehicles: Basics of vehicle performance, Vehicle power source characterization, Transmission characteristics and mathematical models to describe vehicle performance. Introduction to hybrid electric vehicles: History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Impact of modern drive-trains on energy supplies. Hybrid electric drive-trains: Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis.

UNIT II : ELECTRIC TRAINS **9**

Electric drive-trains: Basic concept of electric traction, introduction to various electric drive train topologies, Power flow control in electric drive-train topologies, fuel efficiency analysis. Electric propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC motor drives, Induction motor drives, permanent magnet motor drives, switch reluctance motor drives – Drive system efficiency.

UNIT III : ANALYSIS OF ENERGY STORAGE **9**

Energy storage: Introduction to energy storage requirements in hybrid and electric vehicles, Battery based energy storage and its analysis, Fuel cell based energy storage and its analysis, super capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, Sizing the power electronics, Selecting the energy storage technology, Communications, supporting subsystems.

UNIT IV : ENERGY MANAGEMENT STRATEGIES **9**

Introduction to energy management strategies used in hybrid and electric vehicles, Classification of different energy management strategies, Comparison of different energy management strategies, implementation issues of energy management strategies.

UNIT V : BUSINESS PERSPECTIVE OF ELECTRIC VEHICLE **9**

Design of a hybrid electric vehicle (HEV) – Design of a battery electric vehicle (BEV), hybrid electric heavy duty vehicles, fuel cell heavy duty vehicles. Business: E-mobility business, electrification challenges, Connected mobility and autonomous mobility – Case study: E-mobility indian roadmap perspective. Policy: EVs in infrastructure system, integration of EVs in smart grid, Social dimensions of EVs.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Mehrdad Ehsani, Yimin Gao, Sebatien Gay and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel cell vehicles: Fundamentals, Theory and Design", CRC press, 2004.
2. Mi C, Masrur M A and Gao D W., "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2017.
3. Onori S, Serrao L and Rizzoni G., "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.
4. Sandeep Dhameja, "Electric Vehicle Battery Systems", Butterworth - Heinemann, 2002.
5. Ronald K. Jurgen, "Electric and Hybrid - Electric Vehicles", SAE, 2010.

COURSE OUTCOMES:

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

CO1: Understand the basics of electric vehicle components and configuration.
CO2: Analyze suitable drive scheme for developing an electric vehicle.
CO3: Analyze a proper energy storage system.
CO4: Opt a proper energy management system.
CO5: Understand the infrastructure for electric vehicles and business potential.

19CAOE20	SCADA SYSTEM AND APPLICATION MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To acquiire knowledge about the SCADA system.
- To provide knowledge about the SCADA components.
- To grasp knowledge about SCADA communication.
- To understand the concepts of SCADA monitoring and control.
- To understand the concepts of SCADA application in power system.

UNIT I : INTRODUCTION TO SCADA **9**

Evolution of SCADA, SCADA definitions, SCADA functional requirements and components, SCADA hierarchical concept, SCADA architecture, General features, SCADA applications, benefits.

UNIT II : SCADA SYSTEM COMPONENTS **9**

Remote terminal unit (RTU), Interface units, human-machine interface units (HMI), Display monitors/data logger systems, Intelligent electronic devices (IED), Communication network, SCADA server, SCADA control systems and control panels.

UNIT III : SCADA COMMUNICATION **9**

SCADA communication requirements, Communication protocols: Past, present and future, structure of a SCADA communications protocol, Comparison of various communication protocols, IEC61850 based communication architecture, Communication media like fiber optic, PLCC etc. Interface provisions and communication extensions, Synchronization with NCC, DCC.

UNIT IV : SCADA MONITORING AND CONTROL **9**

Online monitoring the event and alarm system, Trends and reports, Locking list, Event disturbance recording. Control function: Station control, Bay control, Breaker control and disconnector control.

UNIT V : SCADA APPLICATIONS IN POWER SYSTEM **9**

Applications in generation, Transmission and distribution sector, Substation SCADA system functional description, System specification, system selection such as substation configuration, IEC61850 ring configuration, SAS cubicle concepts, Gateway interoperability list, Signal naming concept. System installation, Testing and commissioning.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Stuart A. Boyer, "SCADA-Supervisory Control and Data Acquisition", Instrument Society of America Publications,USA, 2016.
2. Gordon Clarke, Deon Reynders, "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes Publications, Oxford, UK, 2004.
3. William T. Shaw, "Cybersecurity for SCADA Systems", PennWell Books, 2006.
1. Martha J. Boss and Gayle Nicoll, "Electrical Safety: Systems, Sustainability and Stewardship", CRC press, New York, 2014.
4. David Bailey and Edwin Wright, "Practical SCADA for Industry", Newnes, 2003.

5. Michael Wiebe, "A guide to utility automation: AMR, SCADA, and IT Systems for Electric Power", PennWell 1999.
6. Dieter K. Hammer, Lonnie R. Welch and Dieter K. Hammer, "Engineering of Distributed Control Systems", Nova Science Publishers, USA, 1st Edition, 2002.

COURSE OUTCOMES:

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

CO1: Understand the concepts of SCADA system.
CO2: Acquire knowledge about the SCADA components.
CO3: Acquire knowledge about SCADA communication.
CO4: Understand the concepts of SCADA monitoring and control.
CO5: Understand the concepts of SCADA application in power system.

19CAOE21	TESTING OF MATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To apply knowledge of mechanics of materials for designing mechanical elements including design process, failure prevention under static & variable loadings.

UNIT I: INTRODUCTION 6

Strength of materials – Basic assumptions – Elastic and plastic behaviour – Average stress and strain – Concept of stress, Strain and the types of stresses and strains.

UNIT II: PLASTIC DEFORMATION OF CRYSTALS 9

Deformation by slip – Slip in a perfect lattice – Slip by dislocation movement – Critical resolved shear stress for slip – Deformation of single crystals – Polycrystalline materials – Deformation by twinning, stacking faults, strain hardening.

UNIT III: FRACTURE MECHANICS AND HARDNESS TESTING 12

Types of fracture, Griffith theory and modified Griffith – Orowan theory, metallographic aspects of fracture, crack propagation, concept of fracture curve. Concept of fracture curve – Fracture toughness KIC Testing. R-curve, J-Integral, drop weight test – Brinell hardness testing, Rockwell hardness testing, Vickers hardness testing and knoop hardness testing, Nano indentation, Problems.

UNIT IV: TENSION TESTING 9

ASTM Standards and specification, Engineering stress & strain, True stress strain curves, Holloman – Ludwig equation – Plastic Instability (Necking) – Testing machines – Types, testing procedures, Properties measured, Specimen dimensions, Problems.

UNIT-V: TORSION, SHEARING AND IMPACT TEST 9

ASTM Standards and specification Testing Machines and procedures. Impact testing: Principle – Izod and Charpy Impacts tests, ASTM Standards and specification. Ductile to Brittle Transition Temperature (DBTT), Factors affecting DBTT – Determination of DBTT.

Contact periods:

Lecture: 45 Periods Lecture: 45 Periods Lecture: 45 Periods Lecture: 45 Periods

REFERENCES:

1. George E. Dieter, “Mechanical Metallurgy” 3rd Edition, Mc Graw Hill, 2013.
2. Hull D and Bacon D J., “Introduction to dislocations”, Butterworth Heinemann, Oxford, 2001.
3. Wullf et al, Vol. III “Mechanical Behavior of Materials", John Wiley and Sons, New York,1983.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to

CO1: Understand the static force and inertia forces and their effect that exist in materials.
CO2: Perform balancing, vibration and critical speeds with respect to material.
CO3: Understand the standards, concepts and terminology of material testing.
CO4: Select the appropriate measuring device based on measuring requirements.
CO5: Gain knowledge regarding impacts and testing of materials.

19CAOE22	ROBOTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the functions of the basic components of a robot.
- To study the use of various types of end effectors and sensors.
- To impart knowledge in robot kinematics and programming.
- To learn robot safety issues and economics.

UNIT I: FUNDAMENTALS OF ROBOT 9

Robot – Definition – Robot anatomy – Coordinate systems, Work envelope, Types and classification – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of motion, Pay load – Robot parts and their functions – Need for robots – Different applications.

UNIT II: ROBOT DRIVE SYSTEMS AND END EFFECTORS 9

Pneumatic drives – Hydraulic drives – Mechanical drives – Electrical drives – D.C. Servo motors, Stepper motors, A.C. Servo motors – Salient features, Applications and comparison of all these drives, End effectors – Grippers – Mechanical grippers, Pneumatic and hydraulic grippers, Magnetic grippers, Vacuum grippers; Two fingered and Three fingered grippers; Internal grippers and external grippers; Selection and design considerations.

UNIT III: SENSORS AND MACHINE VISION 9

Requirements of a sensor, Principles and Applications of the following types of sensors – Position sensors – Piezo electric sensor, LVDT, Resolvers, Optical encoders, Pneumatic position sensors, Range sensors – Triangulations principles, Structured, Lighting approach, Time of flight, Range finders, Laser range meters, Touch sensors, Binary sensors., Analog sensors, Wrist sensors, Compliance sensors, Slip sensors, Camera, Frame grabber, Sensing and Digitizing image data – Signal conversion, Image storage, Lighting techniques, Image processing and analysis – Data deduction, Segmentation, Feature extraction, Object recognition, Other algorithms, Applications – Inspection, Identification, Visual serving and navigation.

UNIT IV: ROBOT KINEMATICS AND ROBOT PROGRAMMING 9

Forward kinematics, Inverse kinematics and Difference; Forward kinematics and Reverse kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of Freedom (in 3 Dimension) Jacobians, Velocity and Forces – Manipulator dynamics, Trajectory generator, Manipulator mechanism design – Derivations and Problems. Lead through programming, Robot programming languages – VAL Programming – Motion commands, Sensor commands, End effectors commands and Simple programs.

UNIT-V: IMPLEMENTATION AND ROBOT ECONOMICS 9

RGV, AGV; Implementation of robots in industries – Various steps; Safety considerations for robot operations – Economic analysis of robots.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Groover M P., “Industrial Robotics – Technology Programming and Applications”, McGraw Hill, 2012.

2. Klafter R D., Chmielewski T A and Negin M., “Robotic Engineering – An Integrated Approach”, Prentice Hall, 2003.
3. Craig JJ. “Introduction to Robotics Mechanics and Control”, Pearson Education, 2008.
4. Deb S R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co., 2013.
5. Fu.KS, Gonzalz R C and Lee C S G., “Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill Book Co., 1987.
6. Janakiraman P.A., “Robotics and Image Processing”, Tata McGraw Hill, 1995.
7. Koren Y., “Robotics for Engineers", Mc Graw Hill Book Co., 1992.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to

CO1: Explain the concepts of industrial robots, classification, specifications and coordinate systems. Also summarize the need and application of robots in different sectors.

CO2: Illustrate the different types of robot drive systems as well as robot end effectors.

CO3: Apply the different sensors and image processing techniques in robotics to improve the ability of robots.

CO4: Develop robotic programs for different tasks and familiarize with the kinematics motions of robot.

CO5: Examine the implementation of robots in various industrial sectors and interpolate the economic analysis of robots.

19CAOE23	INDUSTRIAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Assume Technical and Managerial roles in the Industries.
- Apply Engineering Principles to the working environment.
- Use quality tools to foresee and solve issues in the industrial situations.
- Work collaboratively.

UNIT I: FORECASTING 9

Characteristics and principles – Qualitative methods, Delphi technique, Market research – Time series methods – Moving average, Exponential smoothing, Box Jenkins method – Autoregressive moving average (ARMA) or autoregressive integrated moving average (ARIMA) models – Fitting regression models – Measurement of forecast errors, Coefficient of correlation – Problem solving.

UNIT II: FACILITIES PLANNING AND WORK STUDY 9

Factors affecting site location decisions – Principles and types of layout – Layout planning – Layout tools and computerized layout techniques – Design of group technology layout – Line balancing – Line balancing methods – Objectives of work study – Method study procedure, Recording techniques – Motion study – Principles of motion Economy – Techniques of work measurement – Time study – Synthesis method – Analytical estimating – Predetermined Motion Time System (PMTS) – Work sampling techniques.

UNIT III: LEAN MANUFACTURING 9

Elements of Just In Time (JIT) – Pull and push system, Kanban system – Optimized production technology and synchronous manufacturing – Implementation of Six sigma – Single Minute Exchange of Die (SMED) 5S concept – Concurrent engineering – Cellular manufacturing – Enablers of agile manufacturing – Rapid manufacturing - Business Process Reengineering (BPR) – Enterprises Resources Planning (ERP) – Role of KAIZEN, Quality circles and POKA YOKE in modern manufacturing – Seven wastes in lean manufacturing.

UNIT IV: AGGREGATE PRODUCTION PLANNING 9

Objectives of aggregate planning – Capacity Requirement Planning (CRP) process – Types of capacity planning – Strategies for aggregate capacity planning – Master production scheduling – Procedure for developing MPS – Materials Requirements Planning (MRP-I), Issues in MRP, Designing and Managing the MRP System, Evaluation of MRP – Manufacturing Resources Planning (MRP-II).

UNIT-V: SCHEDULING OF OPERATIONS 9

Operations planning and scheduling – Scheduling techniques – Stages in scheduling – Loading, dispatching, Expediting – Finite loading and infinite loading – Load charts and machine loading charts – Priority sequencing – Dynamic sequencing rules – Batch scheduling – Economic Batch Quantity (EBQ) or Economic Run Length (ERL) – Scheduling in repetitive, Batch and job shop manufacturing – Allocation of units for a single resource, Allocation of multiple resources – Resource balancing - Flexible manufacturing system.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Panneerselvam R., "Production & Operations Management", 3rd Edition, PHI Learning Private Limited, New Delhi, 2012.
2. Elwood S. Buffa, and Rakesh K. Sarin, "Modern Production/Operation Management", 8th Edition, John Wiley & Sons, 2000.
3. Dilworth B. James, "Operations Management Design, Planning and Control for Manufacturing and Services", Mcgraw Hill Inc., New York, 1992.
4. Vollman TE., "Manufacturing Planning and Control Systems", Galgotia Publications, 2002.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to

CO1: Apply the knowledge of Engineering and Sciences to improve the productivity of industries.

CO2: Design a system to meet the desired needs within realistic constraints.

CO3: Function in multidisciplinary teams.

CO4: Use the techniques, skills, and modern Engineering tools in manufacturing practice.

CO5: Perform as an effective industrial Engineer integrating high and low levels of management.

19CAOE24 MARKETING MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

- To impart elementary knowledge to the students regarding the various aspects of sales management.

UNIT I: SALESMANSHIP 9

Meaning, Definition, Characteristics, Concept, Kinds, Nature – Evolution, and psychology in selling, Scope, Limitations and importance – Sales management: meaning, definition, Characteristics, Principles, Functions and importance, Difference between sales management and marketing management.

UNIT II: SALESMAN 9

Types, Qualities, Objectives, Duties and responsibilities of good salesman, Recruitment, selection and training of salesman: Sources of recruitment, Principles of selection, Selection procedure, Meaning, Advantages, Disadvantages, Methods, Principles and limitation, Subject matter and Types of good training programme.

UNIT III: REMUNERATION/ COMPENSATION 9

Essentials of Good Remuneration Plan, Objectives – Methods, Factors determining Remuneration Plan, Comparative study of various plans. Motivating sales force: Meaning, Definition, Objectives, Importance and methods.

UNIT IV: SALES PLANNING 9

Meaning, Components, Elements, Types, Importance and limitations, Sales fields or territories: Meaning, Definition, Objectives, Factors determining Size, Allocation of sales territories, Steps in setting sales territories. Sales quota: Meaning, Definition, Objectives, Factors determining sales quota, Methods of determining sales quota, Types, Principles of successful sales quota, Advantages and disadvantages of sales quota.

UNIT-V: CONSUMER BEHAVIOUR 9

Meaning, Definition, Variables and factors affecting Consumer behaviour – Buying Motives: Meaning, Kinds, Chief buying motives – Different types of consumers – Behaviour and customer service.

Contact periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Santoki, "Sales Management", Kalyani Publisher.
2. Gupta S L., "Sales and Distribution Management", Excel Books, New Delhi, 2008.
3. Still R and Richard, "Sales Management", Pearson Prentice Hall, Delhi.
4. Schiffman, Kanuk and Kumar, "Consumer Behaviour", Pearson, 10th Edition.
5. Kotler and Keller, "Marketing Management", Pearson Publication.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to
CO1: Understand the concepts for salesmanship.
CO2: Developed knowledge of salesman responsibilities.

CO3: Understand the concepts for remuneration and compensation methods.
CO4: Developed knowledge of sales planning techniques.
CO5: Understand the use of consumer behavior concepts.

19CAOE25	ENERGY CONSERVATION AND MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study about the energy data, energy accounting and balancing of industries.

UNIT I: INTRODUCTION **9**

Energy – Power – Past & present scenario of world; National energy consumption data – Environmental aspects associated with energy utilization – Energy auditing: Need, Types, Methodology and barriers. Role of energy managers. Instruments for energy auditing.

UNIT II: ELECTRICAL SYSTEMS **9**

Components of EB billing – HT and LT supply, Transformers, Cable sizing, Concept of capacitors, Power factor improvement, Harmonics, Electric motors – Motor efficiency Computation, Energy efficient motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED lighting and scope of Encon in illumination.

UNIT III: THERMAL SYSTEMS **9**

Stoichiometry, Boilers, Furnaces and thermic fluid heaters – Efficiency computation and Encon measures. Steam: Distribution & usage: Steam traps, Condensate recovery, Flash steam utilization, Insulators & refractories.

UNIT IV: ENERGY CONSERVATION IN MAJOR UTILITIES **9**

Pumps, Fans, Blowers, Compressed air systems, Refrigeration and air conditioning Systems – Cooling towers – D.G. sets.

UNIT-V: ECONOMICS **9**

Energy economics – Discount rate, Payback period, Internal rate of return, Net present Value, Life cycle costing – ESCO concept.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Witte LC, Schmidt P S and Brown D R., "Industrial Energy Management and Utilisation", Hemisphere Publ, Washington, 1988.
2. Callaghn P W., "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981.
3. Energy Manager Training Manual (4 Volumes) available at www.energymanager training.com, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.
4. Dryden I G C., "The Efficient Use of Energy", Butterworths, London, 1982.
5. Turne W C., "Energy Management Hand book", Wiley, New York, 1982.
6. Murphy W R and Mc KAY G., "Energy Management", Butterworths, London 1987.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to

CO1: Understand the significance and procedure for energy conservation and audit.

CO2: Analyze, Calculate and Improve the energy efficiency and performance of electrical

utilities.

CO3: Analyze, Calculate and Improve the energy efficiency and performance of thermal utilities.

CO4: Analyze, Calculate and Improve the energy efficiency and performance of mechanical utilities.

CO5: Carry out the energy accounting and balancing.

19EEVAX01 YOGA FOR YOUTH EMPOWERMENT

L	T	P	C
1	0	0	1

COURSE OBJECTIVES:

- To create awareness and the benefits of yoga and meditation
- To study and analyze the influential factors, which affect the engineering students' healthy life

UNIT-I: PHYSICAL STRUCTURE AND ITS FUNCTIONS 5

Yoga - Purpose of life, philosophy of life, Physical structure, Importance of physical exercise, Rules and regulation of simplified physical exercises, hand exercise, leg exercise, breathing exercise, eye exercise, kapalapathy, maharasana, body massage, acupressure, body relaxation.

UNIT-II: YOGASANAS 5

Rules & Regulations – asana, pranayama, mudra, bandha.

UNIT-III: MIND 5

Bio magnetism & mind - imprinting & magnifying – eight essential factors of living beings, Mental frequency and ten stages of mind, benefits of meditation, such as perspicacity, magnanimity, receptivity, adaptability, creativity, Simplified Kundalini yoga: Agna, Santhi, thuriam, thuriyatheetham.

Contact Periods:

Lecture: 15 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 15 **Periods**

REFERENCES:

1. "Yoga for Modern Age" – Vethathiri Maharashi
2. "Mind" – Vethathiri Maharashi

COURSE OUTCOMES:

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

CO1: YOGA which gives healthy & better living, Physical, Mental mood, Intellectual & spiritual.

CO2: Work skillfully and perfectly towards the excellence.

CO3: Achieve meditation practices,which strengthen the mind and increases the will power.

CO4: Concentration, creativity and ultimately to transform the mind to achieve selfrealization.

19EEVAX02 ELECTRICAL WIRING, WINDING AND EARTHING, REPAIRING OF HOUSEHOLD APPLIANCES

L	T	P	C
1	0	0	1

COURSE OBJECTIVES:

- To develop an ability and skill to design the feasible protection systems needed for each main part of a power system in students.

LIST OF EXPERIMENTS:

1. Conductors, Insulators & types
2. Crimping & Crimping Tools, Soldering
3. Joints in Electrical Conductor
4. Concept of gauge of wire, conductor
5. Determination of Fuse size according to the load of circuit and its location
6. Study of different components used in house wiring.
7. Concept of earthing, purpose & types
8. Pipe earthing & Plate earthing
9. Earthing of domestic installation
10. Use of Megger & Test lamps in fault location
11. Energy meter installation.
12. Repair and service technique of home appliances

Contact Periods:

Lecture: 15 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 15 **Periods**

REFERENCES:

1. Phil Simons, "Electrical Wiring Residential".
2. J. Coker and W. Turner, "Electric Wiring".
3. Dr.Subharansu Sekhar Dash, Dr.K.Vijayakumar, "Electrical Engineering Practice Lab Manual".

COURSE OUTCOMES:

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

CO1: Explain the hazards of electricity and effects.
CO2: Select appropriate personal equipment for a variety of applications.
CO3: Make effective wiring.
CO4: Employ Safe Work Practices when working with and around electricity.
CO5: Make good earthing.

19EEVAX03 IOT APPLICATIONS

L	T	P	C
1	0	0	1

COURSE OBJECTIVES:

- To expose student and gain more knowledge about IOT technology
- To acquire knowledge on IOT design, assembling and testing of electric circuits with the software.
- To increase student's thinking ability by produce new invention that can make people life easier.

LIST OF EXPERIMENTS:

1. IoT-Based smart street light system.
2. IoT-Based weather station.
3. Health monitoring system
4. IoT-Based smart home
5. Attendance system
6. Water quality monitoring
7. Gas detector and auto exhaust

Contact Periods:

Lecture: 15 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 15 **Periods**

REFERENCES:

1. Marco Schwartz, "Internet of Things with Arduino", Packt Publishing, 2016.
2. Adeel Javed. "Building Arduino Projects for the Internet of Things: Experiments with Real-World Applications" 1st Edition, Kindle Edition, Apress Publisher, 2016.
3. Rajesh Singh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh, Mahendra Swain, "Internet of Things with Raspberry Pi and Arduino", CRC Press, 2019.

COURSE OUTCOMES:

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

CO1: Familiar with IOT environment and its applications.
CO2: Understand arduino programming and raspberry pi programming
CO3: Learn and understand about any new IDE, compiler and sensors.
CO4: Design Smart systems applications.

19EEVAX04 JAVA PROGRAMMING

L	T	P	C
1	0	0	1

COURSE OBJECTIVES:

- To build software development skills using java programming for real-world applications.
- To understand and apply the concepts of classes, packages, interfaces, array list, exception handling and file processing.
- To develop applications using generic programming and event handling.

LIST OF EXPERIMENTS:

1. Write a program to display any message and default value of all primitive data types of java.
2. Write a program to create a room class, the attributes of this class is room no, room type, room area and AC machine. In this class the member functions are set data and display data.
3. Write a program create a class 'simple object'. Using constructor display the message.
4. Create class named as 'a' and create a sub class 'b'. Which is extends from class 'a'. And use these classes in 'inherit' class.
5. Develop a java application with Employee class with Emp_name, Emp_id, Address, Mail_id, Mobile_no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10% of BP as HRA,12% of BP as PF,0.1% of BP for staff club fund. Generate pay slips for the employees with their gross and net salary.
6. Write a program to perform string operations using Array List. Write functions for the following
   a. Append-add at end
   b. Insert–add at particular index
   c. Search
   d. List all string starts with given letter
7. Write a java program to find the maximum value from the given type of elements using a generic function.

Contact Periods:

Lecture: 15 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 15 **Periods**

REFERENCES:

1. Herbert Schildt, "Java The complete reference", 8th Edition, McGraw Hill Education, 2011
2. Cay S. Horstmann, Gary cornell, "Core Java Volume –I Fundamentals", 9th Edition, Prentice Hall, 2013.
3. Paul Deitel, Harvey Deitel, "Java SE 8 for programmers", 3rd Edition, Pearson, 2015.

COURSE OUTCOMES:

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

CO1: Develop and implement Java programs for simple applications that make use of classes,packages and interfaces.

CO2: Develop and implement Java programs with arraylist, exception handling and multithreading

CO3: Design applications using file processing, generic programming and event handling.

19EEVAX05 PCB DESIGN AND FABRICATION

L	T	P	C
1	0	0	1

COURSE OBJECTIVES:

- To acquire knowledge on circuit board designing in assembling and testing of PCB based electronics circuits and become familiar with the simulation software.

LIST OF EXPERIMENTS:

1. Introduction to PCB Designing
2. Scope of PCB Designing
3. Hardware on Breadboard
4. Software Description
5. Design circuit on PCB software (Proteus, Express PCB, ARES)
6. Schematic Layout
7. Board creation
8. Fabrication Process.
9. Design of single sided PCB

Contact Periods:

Lecture: 15 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 15 **Periods**

REFERENCES:

1. R.S.Khandpur, " Printed Circuit Boards: Design, Fabrication, Assembly and Testing", Tata McGraw –Hill Education, 2005.
2. Jan Axelson, " Making Printed Circuit Boards", TAB Books, 1993.

COURSE OUTCOMES:

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

CO1: Apply knowledge of mathematics, science and engineering.
CO2: Design and conduct experiments as well as to analyze and interpret data.
CO3: Make schematic electronic circuits in the software.
CO4: Design and develop layout of PCB using PCB layout design tool with fabrication.
CO5: Design and fabricate simple electronic equipment prototype for demonstration, development and experimentation purposes
CO6: Understand the professional and ethical responsibility.

19EEVAX06 HOME AUTOMATION

L	T	P	C
1	0	0	1

COURSE OBJECTIVES:

- To design and develop project by applying the knowledge acquired in the field of electrical and electronics engineering

LIST OF EXPERIMENTS:

1. Automatic fan control under varying weather condition
2. Automatic home security system
3. Automatic water pump control system
4. Automatic plant watering system
5. Automatic detection of gas leakage and warning system.
6. Automatic car parking system

Contact Periods:

Lecture: 15 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 15 **Periods**

REFERENCES:

1. Robert L.Boylestad, "Electronic Devices and Circuit theory", 2002.
2. Floyd, "Electron Devices" Pearson Asia 5th Edition, 2001.
3. D.Roy Choudhary, Sheil B.Jani, 'Linear Integrated Circuits', II edition, New Age, 2003.
4. ARDUINO, user manual, Revision 02, 2014.
5. James Gerhart "Home Automation and Wiring", McGraw Hill Professional, 1999.
6. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition,2003.

COURSE OUTCOMES:

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

CO1: Design, implement and evaluate the solutions of engineering problems.

CO2: Understand the impact of the professional engineering solutions in societal and environmental contexts.

CO3: Comply with current trends through lifelong learning and to develop entrepreneurial Skills.

19EEVAX07 SIMULATION TOOLS FOR ELECTRICAL ENGINEERS

L	T	P	C
1	0	0	1

COURSE OBJECTIVES:

- To make the students acquire knowledge on mathematical modeling of power electronic circuits and implementing the same using simulation tools

LIST OF EXPERIMENTS:

1. Modeling and system simulation of basic power electronic circuits using MATLAB-SIMULINK
2. Simulation of chopper fed DC drives.
3. Simulation of closed loop control of V/F induction motor drives.
4. Simulation of cylco converter fed induction motor drives.
5. Modelling and simulation of PV solar power inverters.
6. Harmonic analysis using matlab simulink
7. Interfacing arduino with matlab.

Contact Periods:

Lecture: 15 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 15 **Periods**

REFERENCES:

1. Agam Kumar Tyagi, "MATLAB and Simulink for Engineers", University of Petroleum & Energy Studies, Oxford University Press, 2012.
2. R. Krishnan, "Electric Motor Drives: Modeling Analysis: Modeling, Analysis, and Control" Pearson Education India; 1st Edition, 2015.
3. Mohamed A. El-Sharkawi, "Fundamentals of Electric Drives", University of Washington Thomson Engineering, 2000.

COURSE OUTCOMES:

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

CO1: Comprehensive understanding on mathematical modeling of power electronic system and ability to implement the same using simulation tools

CO2: Design and implement power electronic control applications with simulation packages

CO3: Exposure to analysis of harmonics in power electronic circuits

19EEVAX08 **PLC AUTOMATION**

L	T	P	C
1	0	0	1

COURSE OBJECTIVES:

- To make the students acquire knowledge on PLC and its programming for various automation application

LIST OF EXPERIMENTS:

1. Introduction and Architecture of PLCs
2. Input and Output Devices
3. Hardware configuration of siemens S7 1200 systems
4. Siemens S7 addressing
5. Siemens S7 basic instruction set, compare, maths, data moves and logic functions
6. Configuration and use of data blocks
7. Time, counter and high speed counter
8. PWM concepts
9. PLC Programming and Exercise

Contact Periods:

Lecture: 15 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 15 **Periods**

REFERENCES:

1. Hackworth, "Programmable Logic Controllers Programming Methods And Applications", Pearson India, 1st Edition, 2011.
2. Frank D. Petruzella, "Programmable Logic Controllers". Mc graw hill publisher, 5th Edition, 2019
3. Stephen Philip Tubbs, "Programmable Logic Controller (Plc) Tutorial, Siemens Simatic S7-1200", publisher Stephen P. Tubbs, 2016.

COURSE OUTCOMES:

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

CO1: Understand the architecture of PLC and IO devices
CO2: Know hardware configuretions for siemens S7 1200 systems
CO3: Understand the timer, counter and PWM concepts.
CO4: Design and develop the PLC program for various applications.

19EEVAX09 STUDY OF WEATHER MONITORING SYSTEM

L	T	P	C
1	0	0	1

COURSE OBJECTIVES:

- To Interpret the application of weather monitoring station in research activities

LIST OF EXPERIMENTS:

1. Description of Weather Monitoring station.
2. Data Logger and Software
3. Communications
4. Troubleshooting and Maintenance.
5. Case Studies

Contact Periods:

Lecture: 15 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 15 **Periods**

REFERENCES:

1. Stephen Burt, "The weather observers handbook", Cambridge University Press, 2012.
2. User Manual on "Weather monitoring station", Met One Instruments, Inc, Oregon, 2014.

COURSE OUTCOMES:

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

CO1: Understand the role of weather monitoring station in analysis and design
CO2: Know the usage of software and data logger
CO3: Evaluate the applications of weather monitoring station