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 IV Semester)

REGULATIONS

2022

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	22CAHS101	Professional English - I	3	0	0	3
2	22CABS102	Matrices and Calculus	3	1	0	4
3	22CABS103	Engineering Physics	3	0	0	3
4	22CAES104	Engineering Graphics	1	0	4	3
5	22CAES105	C Programming	3	0	0	3
6	22EEES106	Basic Civil and Mechanical Engineering	3	0	0	3
7	22CAHS109	Heritage of Tamils	1	0	0	1
PRACTICAL						
8	22CAES106	Programming in C Laboratory	0	0	3	1.5
9	22CAES107	Engineering Practices Laboratory	0	0	3	1.5
		Total	**17**	**1**	**10**	**23**

SEMESTER II

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	22CAHS201	Professional English - II	3	0	0	3
2	22CABS202	Advanced Calculus and its Applications	3	1	0	4
3	22CAES203	Python Programming	3	0	0	3
4	22EEPC204	Electric Circuit Analysis	3	1	0	4
5	22CABS205	Physics for Electronics Engineering	3	0	0	3
6	22CABS104	Engineering Chemistry	3	0	0	3
7	22CAHS202	Tamils and Technology	1	0	0	1
PRACTICAL						
8	22CABS107	Physics and Chemistry Laboratory	0	0	3	1.5
9	22CAES206	Python Programming Laboratory	0	0	3	1.5
		Total	**19**	**2**	**6**	**24**

SEMESTER III

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	22CABS301	Transform Techniques and its Applications	3	1	0	4
2	22EEPC302	Electromagnetic Fields	3	1	0	4
3	22EEPC303	Digital Logic Circuits	3	0	0	3
4	22EEPC304	Electron Devices and Circuits	3	0	0	3
5	22EEPC305	Electrical Machines- I	3	0	0	3
6	22CAHS306	Environmental Science and Engineering	3	0	0	3
PRACTICAL						
7	22EEPC307	Electric Circuits and Electronic Devices Laboratory	0	0	3	1.5
8	22EEPC308	Electrical Machines-I Laboratory	0	0	3	1.5
		Total	**18**	**2**	**6**	**23**

SEMESTER IV

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	22CABS402	Numerical Methods	3	1	0	4
2	22EEPC401	Transmission and Distribution	3	0	0	3
3	22EEPC403	Measurements and Instrumentation	3	0	0	3
4	22EEPC404	Electrical Machines- II	3	0	0	3
5	22EEPC405	Linear Integrated Circuits	3	0	0	3
6	22EEPC406	Microprocessor and Microcontroller	3	0	0	3
PRACTICAL						
7	22EEPC407	Electrical Machines-II Laboratory	0	0	3	1.5
8	22EEPC408	Linear and Digital Circuits Laboratory	0	0	3	1.5
9	22EEPC409	Microprocessor and Microcontroller Laboratory	0	0	3	1.5
		Total	**18**	**1**	**9**	**23.5**

SEMESTER V

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	22EEPC501	Power System Analysis	3	0	0	3
2	22EEPC502	Control Systems	3	0	0	3
3	22EEES503	Data Structures and Algorithms	3	0	0	3
4	22EEPE5XX	Professional Elective I	3	0	0	3
5		Open Elective – I	3	0	0	3
6		Mandatory Course	3	0	0	0
PRACTICAL						
7	22EEPC504	Control and Instrumentation Laboratory	0	0	3	1.5
8	22EEES505	Data Structures and Algorithms Laboratory	0	0	3	1.5
		Total	**18**	**0**	**6**	**18**

SEMESTER VI

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	22EEPC601	Renewable Energy Systems	3	0	0	3
2	22EEPC602	Power Electronics	3	0	0	3
3	22EEPE6XX	Professional Elective II	3	0	0	3
4	22EEPE6XX	Professional Elective III	3	0	0	3
5	22EEPE6XX	Professional Elective IV	3	0	0	3
6		Open Elective – II	3	0	0	3
PRACTICAL						
7	22EEPC603	Power Electronics Laboratory	0	0	3	1.5
8	22EEPC604	Power System and Renewable Energy Laboratory	0	0	3	1.5
9	22CAHS108	Communication Skills Laboratory	0	0	2	1
		Total	**18**	**0**	**8**	**22**

SEMESTER VII

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	22EEPC701	High Voltage Engineering	3	0	0	3
2	22EEHS702	Human Values and Ethics	3	0	0	3
3	22EEPE7XX	Professional Elective V	3	0	0	3
4		Open Elective – III	3	0	0	3
5		Open Elective – IV	3	0	0	3
PRACTICAL						
6	22EEEE703	Mini Project	0	0	3	1.5
		Total	**15**	**0**	**3**	**16.5**

SEMESTER VIII

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	22EEHS801	Principles of Management	3	0	0	3
2	22EEPE8XX	Professional Elective VI	3	0	0	3
PRACTICAL						
3	22EEEE802	Project Work	0	0	20	10
		Total	**6**	**0**	**20**	**16**

Total Credits: 23+24+23+23.5+18+22+16.5+16=166

MANDATORY COURSES

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	22CAMC306	Constitution of India	3	0	0	0

PROFESSIONAL ELECTIVES (PE) – I (SEMESTER V)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	22EEPE501	Computer system Architecture	3	0	0	3
2	22EEPE502	Embedded C- Programming	3	0	0	3
3	22EEPE503	VLSI Design	3	0	0	3
4	22EEPE504	Electrical Machine Design	3	0	0	3
5	22EEPE505	Computer Control of Processes	3	0	0	3

PROFESSIONAL ELECTIVES (PE) – II (SEMESTER VI)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	22EEPE601	Multilevel Power Converters	3	0	0	3
2	22EEPE602	Digital Signal Processing System	3	0	0	3
3	22EEPE603	Non Linear Control	3	0	0	3
4	22EEPE604	Control of Power Electronics Circuits	3	0	0	3
5	22EEPE605	Process Modeling and Simulation	3	0	0	3

PROFESSIONAL ELECTIVES (PE) – III (SEMESTER VI)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	22EEPE606	Embedded Processors	3	0	0	3
2	22EEPE607	Power System Transient	3	0	0	3
3	22EEPE608	HVDC and FACTS	3	0	0	3
4	22EEPE609	Optimal Control	3	0	0	3
5	22EEPE610	Power System Operation and Control	3	0	0	3

PROFESSIONAL ELECTIVES (PE) – IV (SEMESTER VI)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	22EEPE611	Energy Management and Auditing	3	0	0	3
2	22EEPE612	Protection and Switchgear	3	0	0	3
3	22EEPE613	Embedded Control for Electrical Drives	3	0	0	3
4	22EEPE614	Embedded System for Automotive Applications.	3	0	0	3
5	22EEPE615	Electric Vehicle Design, Mechanics and Control	3	0	0	3

PROFESSIONAL ELECTIVES (PE) – V (SEMESTER VII)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	22EEPE701	Electric Vehicle Architecture	3	0	0	3
2	22EEPE702	Electrical Drives	3	0	0	3
3	22EEPE703	Special Electrical Machines	3	0	0	3
4	22EEPE704	Design of Electric Vehicle Charging System	3	0	0	3
5	22EEPE705	Testing of Electric Vehicles	3	0	0	3

PROFESSIONAL ELECTIVES (PE) – VI (SEMESTER VIII)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	22EEPE801	Energy Storage Systems	3	0	0	3
2	22EEPE802	Electrical Energy Generation, Utilization and Conservation	3	0	0	3
3	22EEPE803	Neural and Fuzzy System	3	0	0	3
4	22EEPE804	Power Quality	3	0	0	3
5	22EEPE805	Power System Economics	3	0	0	3

OPEN ELECTIVES

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	22ADOE01	Computer Vision	3	0	0	3
2	22ADOE02	Ethics and AI	3	0	0	3
3	22ADOE03	Network Security and Firewalls	3	0	0	3
4	22ADOE04	R Programming	3	0	0	3
5	22ADOE05	Programming with ASP.Net	3	0	0	3
6	22CSOE01	Computer Graphics and Simulation	3	0	0	3
7	22CSOE02	Data Integration & Big data	3	0	0	3
8	22CSOE03	Game Programming	3	0	0	3
9	22CSOE04	Storage Technologies	3	0	0	3
10	22CSOE05	Recommender Systems	3	0	0	3
11	22ECOE01	Computational Intelligence	3	0	0	3
12	22ECOE02	Wearable Devices	3	0	0	3
13	22ECOE03	VLSI Testing and Design for Testability	3	0	0	3
14	22ECOE04	IoT Based Systems Design	3	0	0	3
15	22ECOE05	Design Thinking	3	0	0	3
16	22EEOE01	Power Plant Engineering	3	0	0	3
17	22EEOE02	Sensors and Transducers	3	0	0	3
18	22EEOE03	Hybrid Energy Technology	3	0	0	3
19	22EEOE04	Biomedical Instrumentation	3	0	0	3
20	22EEOE05	Electric and Hybrid Vehicles	3	0	0	3
21	22ITOE01	Mobile Adhoc Networks	3	0	0	3
22	22ITOE02	Blockchain Technologies	3	0	0	3
23	22ITOE03	Open Source Technologies	3	0	0	3
24	22ITOE04	Android Application Development	3	0	0	3
25	22ITOE05	Digital and Mobile Forensics	3	0	0	3
26	22MEOE01	Testing of Materials	3	0	0	3
27	22MEOE02	Welding Technology	3	0	0	3
28	22MEOE03	Industrial Safety Engineering	3	0	0	3
29	22MEOE04	Marketing Management	3	0	0	3
30	22MEOE05	Maintenance Engineering	3	0	0	3

22CAHS101 **PROFESSIONAL ENGLISH - I**

SEMESTER I

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To improve the communicative competence of learners.
- To help learners use language effectively in academic /work contexts.
- To build on students' English language skills by engaging them in listening, speaking and grammar learning activities that is relevant to authentic contexts.
- To develop learners' ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.
- To use language efficiently in expressing their opinions via various media.

UNIT-I: INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION **9**

Listening - For general information - Listening and filling a form
Speaking - Self Introduction
Reading - Brochures and social media messages relevant to technical contexts.
Writing -Writing emails / letters (permission, accepting, declining)
Grammar - Present Tense, Parts of Speech.
Vocabulary - One word substitution; Abbreviations & Acronyms

UNIT-II: NARRATION AND SUMMATION **9**

Listening -Listening Comprehension –Monologues - Dialogues.
Speaking -Narrating personal experiences /oral presentation
Reading -Reading biographies, newspaper reports, Reading Comprehension
Writing - Paragraph writing, Short Report on an event (field trip etc.) - discourse markers (connectives & sequence words)
Grammar - Past tense; Subject-Verb Agreement.
Vocabulary - Word forms (prefixes& suffixes); Synonyms and Antonyms

UNIT-III: DESCRIPTION OF A PROCESS / PRODUCT **9**

Listening -Listen to a product and process descriptions and advertisements about a products.
Speaking -Picture description; giving instruction to use the product; advertising a product.
Reading -Reading advertisements, gadget reviews; user manuals.
Writing -Writing definitions; instructions; and Product /Process description.
Grammar -Degrees of comparison; Future Tense
Vocabulary -Homonyms; and Homophones.

UNIT-IV: CLASSIFICATION AND RECOMMENDATIONS **9**

Listening - Listening and transfer of information- Note-taking.
Speaking - Small Talk; Mini presentations and making recommendations.
Reading - Reading for specific information- interpreting visual materials (pictures, labels. signs, postcards).
Writing - Note-making / recommendations; Transferring information from non verbal (tables, chart, graph etc,) to verbal mode.

Grammar - wh-yes or no- tags.
Vocabulary - Collocations; Fixed / Semi fixed expressions.

UNIT-V: EXPRESSION **9**

Listening - Listening to speeches (experts)..
Speaking - Group discussion, Debate, & Role play activities
Reading - Cloze test, speed reading.
Writing - Essay Writing (Descriptive or narrative)- Cause & Effect Expressions
Grammar - Simple, Compound & Complex Sentences
Vocabulary - Idioms - Phrasal verbs.

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

REFERENCES:

1. Meenakshi Raman & Sangeeta Sharma, "Technical Communication" – Principles And Practices, Oxford Univ. Press, New Delhi 2022.
2. Dr.S. Mahalakshmi, "Professional English", VK Publications (India) Pvt. Ltd. (2022)
3. Meenakshi Raman & Sangeeta Sharma, "Professional English", Oxford Higher Education, 2018
4. Aysha Viswamohan, "English For Technical Communication" (With CD), Mcgraw Hill Education, ISBN: 0070264244.
5. Department of English, Anna University, "English for Engineers & Technologists" Orient Blackswan Private Ltd. (2020) edit.
6. Dr. S. Gunasekaran, "A Work Book of Technical English", Vishnu Prints Media, Chennai- (2020) edit.

COURSE OUTCOMES:

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

CO1: Listen and comprehend complex academic texts.
CO2: Read and infer the denotative and connotative meanings of technical texts.
CO3: Write definitions, descriptions, narrations and essays on various topics.
CO4: Speak fluently and accurately in formal and informal communicative contexts.
CO5: Express their opinions effectively in both oral and written medium of communication.

22CABS102 **MATRICES AND CALCULUS** **SEMESTER I**

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To obtain the knowledge of Eigen values and diagonalization of a matrix.
- 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 various techniques of integration.
- To acquire the knowledge of multiple integration and related applications.

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 a matrix by orthogonal transformation - Reduction of a quadratic form to canonical form by orthogonal transformation - Nature of quadratic forms.

UNIT-II: DIFFERENTIAL CALCULUS **9+3**

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

UNIT-III: 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-IV: INTEGRAL CALCULUS **9+3**

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

UNIT-V: MULTIPLE INTEGRALS **9+3**

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

Contact Periods:

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

REFERENCES:

1. Kreyszig E., "Advanced Engineering Mathematics", John Wiley & Sons, 10th Edition, 2018.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, New Delhi, 2018.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5th Edition, 2016.
4. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015.
5. Thomas G.B., Hass J. and Weir M.D., "Thomas Calculus", Pearson Education, 14th Edition New Delhi, 2018.
6. Anton H., Bivens I. and Davis S., "Calculus", Wiley, 10th Edition, 2016.

COURSE OUTCOMES:

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

CO1: Understand the matrix algebra techniques for solving practical problems.
CO2: Understand the limit definition and rules of differentiation to differentiate functions.
CO3: Apply differentiation to solve maxima and minima problems.
CO4: Apply different methods of integration in solving practical problems.
CO5: Apply multiple integrals ideas in solving areas and volumes.

22CABS103 **ENGINEERING PHYSICS** **SEMESTER I**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To make the students effectively to achieve understanding of mechanics of solids.
- To enable the students to gain knowledge of thermal conductivity of solids.
- To motivate the students towards the applications of acoustics and ultrasonics.
- To equip the students to understand the importance of quantum physics.
- To make the students to understand the basics of crystallography and its importance in studying materials properties.

UNIT-I: MECHANICS OF SOLIDS **9**

Elasticity- Hooke's law - Types of strain - Classification of Modulus of Elasticity- Poisson's Ratio - Stress-Strain diagram - Factors affecting elasticity - Moment, Couple and Torque - Derivation of Twisting Couple on a wire - Bending moment - Depression of a cantilever - Young's modulus by Uniform Bending – Non-Uniform bending - I shaped girders.

UNIT-II: THERMAL PROPERTIES **9**

Thermal Conductivity - Thermal Diffusivity - Specific Heat Capacity - Rectilinear Flow of Heat along a Uniform Bar - heat conduction in solids - flow of heat through compound media (parallel and perpendicular) - Determination of Thermal Conductivity of a Good Conductor by Forbe's Method: theory and experiment - Determination of Thermal Conductivity of a poor Conductor by Lee's Disc Method: theory and experiment.

UNIT-III: ACOUSTICS AND ULTRASONICS **9**

Classification of Sound – decibel - Weber-Fechner law – Absorption coefficient and its determination – Factors affecting acoustics of buildings and their remedies. Piezoelectric crystals - Production of ultrasonics – magnetostriction and piezoelectric methods – Non Destructive testing – pulse echo system through transmission and reflection modes – Medical application – Sonogram.

UNIT-IV: 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-V: CRYSTALLOGRAPHY **9**

Crystal structures: Crystal lattice – basis - unit cell and lattice parameters – crystal systems and Bravais lattices – Structure and packing fractions of SC, BCC, FCC, diamond and NaCl structures – crystal planes, directions and Miller indices – distance between successive planes – crystalline and non-crystalline materials – imperfections in crystals.

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

REFERENCES:

1. D.Halliday, R.Resnick and J.Walker, Principles of Physics, Wiley (Indian Edition), 2015.
2. N.Garcia, A.Damask and S.Schwarz, Physics for Computer Science Students. Springer Verlag, 2012.
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGrawHill (Indian Edition), 2017.
4. R.Wolfson, Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition), 2009.
5. Paul A. Tipler, Physics – Volume 1 & 2, CBS, (Indian Edition), 2004.
6. K.Thyagarajan and A.Ghatak, Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.

COURSE OUTCOMES:

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

CO1: Understand the importance of mechanics and their various properties.
CO2: Express their knowledge in thermal physics.
CO3: Apply acoustical and ultrasonic principles for industrial and medical applications.
CO4: Understand the importance of quantum physics.
CO5: Demonstrate a strong foundational knowledge about crystals.

22CAES104 **ENGINEERING GRAPHICS** **SEMESTER I**

L	T	P	C
1	0	4	3

COURSE OBJECTIVES:

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

- Drawing various types of conical and special engineering curves.
- Drawing orthographic projection of points, lines and 3D objects.
- Drawing projection of plane surfaces and projection of solids.
- Drawing section of solids and development of solids.
- Drawing isometric projections of simple solids and sketching of 3D objects.

CONCEPTS AND CONVENTIONS (Not for Examination)

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

UNIT-I: PLANE CURVES **3+12**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – Construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

UNIT-II: ORTHOGRAPHIC PROJECTION OF POINTS, LINES AND 3D OBJECTS **3+12**

Principal planes – First angle projection – Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes – Determination of true lengths and true inclinations by rotating line method and traces. Visualization concepts – Visualization principles – Representation of Three Dimensional objects – Layout of views – Sketching of multiple views from pictorial views of objects.

UNIT-III: PROJECTION OF PLANE SURFACES AND SOLIDS **3+12**

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

UNIT-IV: PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES **3+12**

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

UNIT – V: ISOMETRIC PROJECTIONS **3+12**

Principles of Isometric projection – Isometric scale – Isometric projections of simple solids and truncated solids: Prisms, pyramids, cylinders, cones – Conversion of orthographic views to pictorial views (Simple objects)

Contact Periods:
Lecture: 15 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 75 Periods

REFERENCES:

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill, 2nd Edition, 2019.
2. Bhatt, N.D., "Engineering Drawing", Charotar Publishing House Pvt. Ltd., 53rd Edition, 2019.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I & II combined), Subhas Publications, Bangalore, 27th Edition, 2017.
4. Parthasarathy N. S. and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
5. Kulkarni, D.M., Rastogi, A.P. and Sarkar, A.K., "Engineering Graphics with AutoCAD", PHI Learning, 2nd Edition, 2010.

COURSE OUTCOMES:

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

CO1: Construct the conic curves, involutes and cycloid.

CO2: Solve practical problems involving orthographic projection of points, lines and 3D objects.

CO3: Draw the projections of plane surfaces and simple solids.

CO4: Draw the section of solids and the development of simple solids.

CO5: Draw the isometric projections of simple solids and sketching of 3D objects.

Special points applicable to End Semester Examinations on Engineering Graphics:

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

22CAES105 **C PROGRAMMING** **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 - 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 declaration, function definition, 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 – Self referential structures – Dynamic memory allocation - Singly linked list – typedef – Union - Storage classes and Visibility.

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. Kernighan, B.W and Ritchie, D.M, "The C Programming language", 2nd Edition, Pearson Education, 2015.
2. ReemaTheraja "Fundamentals of Computing and Programming in C", 2nd Edition, Oxford University Press, 2016.
3. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2013.
4. Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighth edition, Pearson Education, 2018.
5. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 16th revised edition, 2020.

COURSE OUTCOMES:

Upon completion of this course, the students will 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.

22EEES106 **BASIC CIVIL AND MECHANICAL ENGINEERING** **SEMESTER I**

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 – Chain 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 and 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 Dams – Bridges and its components – Water supply – Sources and quality of water.

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: 0 Periods Total: 45 Periods

REFERENCES:

1. Ramamrutham S., “Basic Civil Engineering”, Dhanpat Rai Publishing Co.(P) Ltd. 2013.
2. Shanmugam.G, “Basic Mechanical Engineering” McGraw Hill Education (India) Pvt. Ltd, New Delhi, 4th Edition, 2013.
3. Kilbert C., “Sustainable Construction: Green building design and delivery”, John wiley & sons, 2005.
4. Jain R.K ,“Production Technology” Khanna Publishers, New Delhi, 2004.
5. Nagpal G.R, “Power Plant Engineering” Khanna Publishers, New Delhi, 2002.

COURSE OUTCOMES:

Upon on 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.

22CAHS109 **HERITAGE OF TAMILS** **SEMESTER I**

L	T	P	C
1	0	0	1

UNIT-I: LANGUAGE AND LITERATURE **3**

Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT-II: HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTU **3**

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT-III: FOLK AND MARTIAL ARTS **3**

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT-IV: THINAI CONCEPT OF TAMILS **3**

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT-V: CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE **3**

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL : 15 PERIODS

REFERENCES:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.

7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

22CAES106 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. I/O statements, operators, expressions
2. Decision-making constructs: if-else, goto, switch-case, break-continue
3. Loops: for, while, do-while
4. Arrays: 1D and 2D, Multi-dimensional arrays, traversal
5. Strings: operations
6. Functions: call, return, passing parameters by (value, reference), passing arrays to function.
7. Recursion
8. Pointers: Pointers to functions, Arrays, Strings, Pointers to Pointers, Array of Pointers
9. Structures: Nested Structures, Pointers to Structures, Arrays of Structures and Unions.
10. Files: reading and writing, File pointers, file operations, random access, processor directives.
11. Mini project

Contact Periods:

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

COURSE OUTCOMES:

Upon successful completion of the course, students should 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.

LIST OF EQUIPMENT'S AND COMPONENTS

- Software Required – Turbo C Compiler / GNU C Compiler / Equivalent
- Operating System – Windows 7 / 8.1 / 10 / Linux
- Computers Required – 30 Nos.

22CAES107 ENGINEERING PRACTICES LABORATORY SEMESTER I

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

The main learning objective of this course is to provide hands on training to the students in:

- Connecting various pipe fittings used in common household plumbing work, sawing, planning and making joints in wood materials used in common household wood work.
- Welding various joints in steel plates using arc welding work.
- Machining various simple processes like turning, drilling, and tapping in parts and making a tray out of metal sheet using sheet metal work.
- Wiring various electrical joints in common household electrical wire work
- Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & MECHANICAL)
PART I CIVIL ENGINEERING PRACTICES

PLUMBING WORK:

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

b) Preparing plumbing line sketches.

c) Laying pipe connection to the pump

d) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK:

a) Sawing,
b) Planning and
c) Making joints like T-Joint, Cross lap Joint and Dovetail joint.

Wood Work Study:

a) Studying joints in door panels and wooden furniture.
b) Studying common industrial trusses using models.

PART II MECHANICAL ENGINEERING PRACTICES

WELDING WORK:

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

b) Practicing gas welding.

BASIC MACHINING WORK:

a) Simple Turning.
b) Simple Drilling.

c) Simple Tapping.

SHEET METAL WORK:

a) Making of a square tray

FOUNDRY WORK:

a) Demonstrating basic foundry operations.

Contact Periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 24 Periods Total: 24 Periods

GROUP – B (ELECTRICAL & ELECTRONICS)

PART III ELECTRICAL ENGINEERING PRACTICES

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Measurement of voltage and current using solar panel
3. Stair case wiring
4. Assembling and Testing of Ceiling Fan
5. Study of lightning arrester

PART IV ELECTRONIC ENGINEERING PRACTICES

1. Study of Electronic components and equipments – Resistor, colour coding
2. Measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
3. Verification of logic gates AND, OR, EX-OR and NOT.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Assembling of 15 watts LED circuit

Contact Periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 21 Periods Total: 21 Periods

COURSE OUTCOMES:

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

CO1: Apply the knowledge of pipeline and connecting various pipe fittings used in common household plumbing work and Use tools and equipments used in Carpentry.

CO2: Perform the various welding joints in steel plates using arc welding work.

CO3: Perform operation in a lathe machine and also fabricate parts like tray in sheet metal.

CO4: Wire various electrical joints in common household electrical wire work.

CO5: Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

22CAHS201 **PROFESSIONAL ENGLISH - II** **SEMESTER II**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To engage learners in meaningful language activities to improve their LSRW skills.
- To enhance learners' awareness of general rules of writing for specific audiences.
- To help learners understand the purpose, audience, contexts of different types of writing.
- To develop analytical thinking skills for problem solving in communicative contexts.
- To demonstrate an understanding of job applications and interviews for internship and placements.

UNIT-I: MAKING COMPARISONS **9**

Listening - Listening to oral presentation- Listening and Gap filling
Speaking - Marketing a product, Mock interviews
Reading - Reading advertisements, Reading to identify stylistic features(syntax, lexis and sentence structures)
Writing - Compare and Contrast Essay, Review writing
Grammar - If conditions, Direct and indirect speech
Vocabulary - Verbal analogies

UNIT-II: EXPRESSING CASUAL RELATIONS IN SPEAKING AND WRITING **9**

Listening - Listening to longer technical, Listening technical information from podcasts
Speaking - Describing and discussing the reasons of accidents or disasters based on news Reports
Reading - Reading and understanding technical articles
Writing - Writing responses to complaints
Grammar - Active Passive Voice transformations, Infinitive and Gerund
Vocabulary - Technical Jargons

UNIT-III: PROBLEM SOVING **9**

Listening - Listening to video clips and answering the questions, listening to different view points on an issue
Speaking - Picture description
Reading - Case studies, excerpts from literary texts, news reports etc
Writing - Letter to the Editor, Checklists
Grammar - Error correction, Numerical adjectives
Vocabulary - Compound Words, Sentence Completion

UNIT-IV: REPORTING OF EVENTS AND RESEARCH **9**

Listening - Listening comprehension based on news reports and documentaries
Speaking - Interviewing, Presenting an oral report, Mini presentations on select topics
Reading - Newspaper articles
Writing - Delivering welcome address, Proposing Vote of thanks, Accident Report, Survey Report
Grammar - Phrases and its types
Vocabulary - Cliches, Redundancies

UNIT-V: THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY **9**

Listening - Listening to TED Talks, Job interviews(analysis of the interview performance)
Speaking - Participating in a Role play, virtual interviews, Making presentations with visual aids
Reading - Company profiles, Statement of Purpose(SOP), an excerpt of interview with Professionals
Writing - Internship application, Cover letter & Resume, Precise writing, Summarizing
Grammar - Subject- Verb agreement, Relative clauses
Vocabulary - Numerical Adjectives

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

REFERENCES:

1. Department of English, Anna University, "English for Engineers & Technologists", Orient Blackswan, 2020.
2. Krishna Mohan, Meera Bannerji, "Developing Communication Skills", Macmillan India Ltd, Delhi, 2020.
3. V. N. Arora and Laxmi Chandra, "Improve Your Writing", Oxford University Press, New Delhi, 2020.
4. J. Anbazhagan Vijay, "Communicative English", Global Publishers, Chennai, 2019.
5. Raman, Meenakshi, Sharma. Sangeeta, "Professional English", Oxford University Press, New Delhi, 2019.
6. Prof. R.C. Sharma & Krishna Mohan, "Business Correspondence and Report Writing", Tata McGraw Hall & Co. Ltd, New Delhi, 2019.

COURSE OUTCOMES:

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

CO1: Compare and contrast products and ideas in technical texts.
CO2: Identify cause and effects in events, industrial processes through technical texts
CO3: Analyze problems in order to arrive at feasible solutions and communicate them orally and in the written format.
CO4: Report events and the processes of technical and industrial nature.
CO5: Present their opinions in a planned and logical manner and draft effective resume in context of job search.

22CABS202 **ADVANCED CALCULUS AND ITS APPLICATIONS** **SEMESTER II**

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- 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 gain methods to solve differential equations with constant and variable coefficients.
- To introduce the basic concepts of PDE for solving standard partial differential equations

UNIT-I: 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 - Volume integral - Green's, Gauss divergence and Stoke' s theorems (Excluding Proofs).

UNIT-II: 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 ,$1/z$, z^2 - Bilinear transformation.

UNIT-III: 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-IV: ORDINARY 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.

UNIT-V: PARTIAL DIFFERENTIAL EQUATIONS **9+3**

Formation of partial differential equations - Singular integrals - Solutions of standard types of first order partial differential equations [$F(p,q) = 0$ and $z = px + qy + f(p,q)$] - Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of homogeneous types.

Contact Periods:

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

REFERENCES:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, New Delhi, 2018.
2. Kreyszig E., "Advanced Engineering Mathematics", John Wiley & Sons, 10th Edition, 2018.
3. Bali N.P. and Manish Goyal, "A Text book of Engineering Mathematics", Laxmi Publications Pvt. Ltd, New Delhi, 10th Edition, 2021.
4. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5th Edition, 2016.
5. Ramana B.V., "Higher Engineering Mathematics", Mc Graw Hill Education Pvt. Ltd, New Delhi, 11th Edition, 2018.
6. James G., "Advanced Modern Engineering Mathematics", Pearson Education, New Delhi, 4th Edition, 2016.

COURSE OUTCOMES:

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

CO1: Acquire knowledge in Gradient, divergence and curl of a vector point function and related identities.

CO2: Understand the properties and formation of analytic function, mappings of standard functions and Bilinear transformation.

CO3: Understand calculus of residues to evaluate contour integration.

CO4: Apply various techniques in solving differential equations.

CO5: Understand how to solve the given standard partial differential equations.

22CAES203 **PYTHON PROGRAMMING** **SEMESTER II**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures – lists, tuples, dictionaries.
- To do input/output with files in Python.
- To understand different Python packages and libraries.

UNIT-I: DATA, EXPRESSIONS, STATEMENTS **9**

Python interpreter and interactive mode; values and Numeric Data types, variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Object Oriented Features; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT-II: CONTROL FLOW, FUNCTIONS **9**

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

UNIT-III: LISTS, TUPLES, DICTIONARIES **9**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing – list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, quick sort.

UNIT-IV: FILES, MODULES, PACKAGES **9**

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

UNIT-V: DATA HANDLING AND DATA VISUALIZATION **9**

Data Handling using Pandas – Introduction to Python Libraries: Pandas, Matplotlib, Numpy – Pandas: Series and Data Frames – Descriptive Statistics – Data Frame Operations – Handling missing Values – Data Visualization – Creating Charts: Bar and Pie Charts –
Customizing Plots.

Contact Periods:

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

REFERENCES:

1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021.
4. Wes McKinney, "Python for Data Analysis", 2nd Edition, O'Reilly Publishers, 2017.
5. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.

COURSE OUTCOMES:

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

CO1: Write simple Python programs using conditionals and loops for solving problems.

CO2: Decompose a Python program into functions.

CO3: Represent compound data using Python lists, tuples, dictionaries etc.

CO4: Read and write data from/to files in Python programs.

CO5: Explore their knowledge in Python packages and libraries.

22EEPC204 ELECTRIC CIRCUIT ANALYSIS SEMESTER II

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To introduce electric circuits and its analysis
- To provide key concepts to analyze and understand electrical circuits
- To impart knowledge on solving circuit equations using network theorems
- To educate on obtaining the transient response of circuits.
- To introduce the phenomenon of resonance in coupled circuits.

UNIT I BASIC CIRCUITS ANALYSIS 9+3

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

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

Network reduction: voltage and current division, source transformation – star delta conversion. Theorems – Superposition, Thevenin's and Norton's Theorem – Maximum power transfer theorem – Reciprocity Theorem – Millman's theorem - Tellegen's Theorem-Statement, application to DC and AC Circuits.

UNIT II TRANSIENT RESPONSE ANALYSIS 9+3

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

UNIT IV RESONANCE AND COUPLED CIRCUITS 9+3

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

UNIT V THREE PHASE CIRCUITS AND TOPOLOGY 9+3

Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced and unbalanced – phasor diagram of voltages and currents – an introduction to Network Topology.

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", McGraw Hill publishers, 9th edition, New Delhi, 2020.
2. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, 2019.
3. Allan H. Robbins, Wilhelm C. Miller, "Circuit Analysis Theory and Practice", Cengage Learning India, 2013.

4. Chakrabarti A, “Circuits Theory (Analysis and synthesis), Dhanpat Rai& Sons, New Delhi, 2020.
5. Joseph A. Edminister, Mahmood Nahvi, “Electric circuits”, Schaum’s series, McGraw-Hill, First Edition, 2019.
6. M E Van Valkenburg, “Network Analysis”,Prentice-Hall of India Pvt Ltd, New Delhi, 2015.

COURSE OUTCOMES:

After completing this course, the students will be able to:

CO1: Explain circuit’s behavior using circuit laws.

CO2: Apply mesh analysis/ nodal analysis / network theorems to determine behavior of the given DC and AC circuit.

CO3: Compute the transient response of first order and second order systems to step and sinusoidal input.

CO4: Explain the frequency response of series, parallel RLC circuits and the behavior of magnetically coupled circuits.

CO5: Compute power, line/ phase voltage and currents of the given three phase circuit and network topology.

22CABS205 PHYSICS FOR ELECTRONICS ENGINEERING SEMESTER II

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To make the students to understand the basics of electromagnetism and its importance.
- To understand the properties of Laser including Einstein's theory, types and their applications.
- To instil knowledge on types of optical fibers and device applications.
- To establish a sound grasp of knowledge on conducting and semiconducting materials.
- To inculcate an idea of significance of magnetic and superconducting materials and their applications.

UNIT-I: ELECTROMAGNETISM 9

Physics of Divergence, Gradient and Curl, Qualitative understanding of surface and volume integral - Maxwell Equations (Qualitative) - Differential Form and Integral Form - Wave Equation – Derivation of Plane electromagnetic waves in vacuum and Homogeneous Isotropic Dielectric Medium - Electromagnetic Waves - Refractive index - Phase velocity - Group velocity, Group index, Wave guide (Qualitative) - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources.

UNIT-II: LASER 9

Properties of laser beams – monochromaticity - coherence - directionality and brightness - Einstein's theory of radiation and determination of A and B coefficients - amplification of light by population inversion - types of lasers - Gas laser: CO_2 - Solid state laser: Nd-YAG laser - dye laser
- Applications of lasers in cutting, welding and materials processing.

UNIT-III: 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.

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: MAGNETIC AND SUPERCONDUCTING MATERIALS 9

Origin of magnetic moment - Bohr magneton - Dia, Para, and Ferro magnetic materials - Domain Theory of ferromagnetism - Hysteresis - Hard and Soft magnetic materials. Superconductivity - properties - Meissner effect, effect of magnetic field and heavy current- Types of superconductors - BCS theory of superconductivity (qualitative) - Applications of superconductors: Cryotron and Magnetic levitation.

Contact Periods:

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

REFERENCES:

1. David Griffith, "Introduction to Electrodynamics", 4thEdition, 2013, Pearson Education.
2. S.O. Kasap, Principles of Electronic Materials and Devices, McGraw Hill Education (Indian Edition), 2020.
3. D.Halliday, R.Resnick and J.Walker, Principles of Physics, Wiley (Indian Edition), 2015.
4. G.W.Hanson, Fundamentals of Nanoelectronics, Pearson Education (Indian Edition), 2009.
5. Jasprit Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Education (Indian Edition), 2019.
6. Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019.

COURSE OUTCOMES:

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

CO1: Acquire knowledge in basics of Electromagnetism and its importance.

CO2: Gain knowledge on the properties, types and applications of Laser in industries.

CO3: Understand clearly of optical fibers classification and their applications.

CO4: Understand the properties of conducting and semiconducting materials and their carrier concentration.

CO5: Appreciate the importance of magnetic and superconducting materials for device applications.

22CABS104 ENGINEERING CHEMISTRY SEMESTER II

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on engineering applications of polymers.
- To understand the principles of electrochemistry, electrochemical cells, emf and applications of emf measurements.
- To acquire knowledge about principles of corrosion and corrosion control techniques.
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

UNIT-I: WATER AND ITS TREATMENT 9

Water quality parameters: Significance - Alkalinity, TDS, COD and BOD (definition and significance only). Hardness- types, estimation of hardness by EDTA method - Boiler feed water troubles - Scale and sludge - Priming and foaming - Caustic embrittlement - Boiler corrosion. Softening of boiler feed water - Internal softening (colloidal, phosphate, sodium aluminate and calgon conditioning) - External softening – demineralization process - Desalination of brackish water – Electrodialysis and Reverse Osmosis. Municipal water treatment - primary treatment and disinfection (UV, Ozonation, break-point chlorination).

UNIT-II: POLYMER CHEMISTRY 9

Introduction: Classification of polymers – Functionality – Degree of polymerization. Types of polymerization: Addition, condensation and copolymerization. Thermal Properties of polymers: Thermoplastic and Thermosetting - Glass Transition temperature (Tg) – significance - factors affecting Tg, Molecular weight – weight average, number average and polydispersity index. Preparation, properties and uses of PVC, Bakelite and Epoxy resin. Conducting polymers- mechanism – application of OLED.

UNIT-III: ELECTROCHEMISTRY 9

Electrode potential - Electrochemical cells – reversible and irreversible cells – EMF – measurement of emf. Emf series and its applications. Nernst equation (problems). Reference electrodes – Standard Hydrogen electrode – Calomel electrode, Ion selective electrode – glass electrode and measurement of pH. Potentiometric redox titration (Estimation of ferrous ion) – conductometric titration (Strong acid Vs Strong base).

UNIT-IV: CORROSION AND ITS CONTROL 9

Corrosion - chemical corrosion - mechanism, nature of oxides – Pilling - Bedworth rule. Electrochemical corrosion – mechanism. Galvanic series and importance. Factors influencing corrosion. Prevention methods - design of materials, cathodic protection techniques - sacrificial anode and impressed current method. Protective coatings – electroplating - Cr, Ni and galvanizing. Anodising of aluminium.

UNIT-V: ENERGY SOURCES AND STORAGE DEVICES **9**

Nuclear energy: light water nuclear power plant - breeder reactor. Solar energy conversion - working principles of photovoltaic cell, organic and dye sensitized solar cell. Batteries - Types of batteries. Primary battery – Leclanche cell. Secondary battery - lead acid battery – nickel metal hydride and Li-ion battery. Fuel cells: proton exchange membrane and solid oxide fuel cell. Supercapacitors: working principles.

Contact Periods:

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

REFERENCES:

1. P. C. Jain and Monica Jain, "Engineering Chemistry, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 17th Edition, 2018.
2. V. R. Gowariker, N. V. Viswanathan and Jayadev Sreedhar, Polymer Science, New Age International Publishers, 6th Edition, 2019.
3. Sivasankar B. "Engineering Chemistry, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
4. S.S. Dara, "A Text book of Engineering Chemistry. S. Chand Publishing, 12th Edition, 2018.
5. O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013.

COURSE OUTCOMES:

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

CO1: Understand the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.

CO2: Acquire the basic knowledge of polymers and apply in engineering.

CO3: Understand the basic principles of electrochemistry and its applications.

CO4: Know the principles, various types of corrosion and corrosion control techniques.

CO5: Identify different forms of energy resources and apply them for suitable applications in energy sectors.

22CAHS202 TAMILS AND TECHNOLOGY SEMESTER II

L	T	P	C
1	0	0	1

UNIT-I: WEAVING AND CERAMIC TECHNOLOGY 3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT -II: DESIGN AND CONSTRUCTION TECHNOLOGY 3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT-III: MANUFACTURING TECHNOLOGY 3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and goldCoins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT-IV: AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT-V: SCIENTIFIC TAMIL & TAMIL COMPUTING 3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

TOTAL : 15 PERIODS

REFERENCES:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.

7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

22CABS107 PHYSICS AND CHEMISTRY LABORATORY SEMESTER II

L	T	P	C
0	0	3	1.5

PHYSICS LABORATORY:

COURSE OBJECTIVES:

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

LIST OF EXPERIMENTS:

1. Cantilever bending – Determination of Young's modulus.
2. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia.
3. Non-uniform bending - Determination of Young's modulus.
4. Laser- a) Determination of the wave length of the laser using grating.
   b) Determination of Numerical Aperture and acceptance angle using optical fiber.
5. Air wedge - Determination of thickness of a thin sheet/wire.
6. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids.

Contact Periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 24 Periods Total: 24 Periods

COURSE OUTCOMES:

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

CO1: Understand the functioning of various physics laboratory equipment.
CO2: Use experimental models to analyze laboratory data.
CO3: Use mathematical models as a medium for quantitative reasoning and describing physical reality.
CO4: Access, process and analyze scientific information.
CO5: Solve problems individually and collaboratively.

CHEMISTRY LABORATORY:

COURSE OBJECTIVES:

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric analysis.
- To inculcate experimental skills to understanding of water quality parameters, such as hardness, alkalinity and dissolved oxygen.
- To induce the students to familiarize with electroanalytical techniques such as conductometry and potentiometry.
- To demonstrate the analysis of strong acid and strong base by conductometry.
- To equip the students for determination of hydrochloric acid by pH measurement.

LIST OF EXPERIMENTS:

1. Estimation of hardness by EDTA method.
2. Determination of types and amount of alkalinity in water sample.
3. Estimation of Dissolved Oxygen by Iodometry.
4. Determination of HCl by pH titration.
5. Conductometric titration of strong acid and strong base.
6. Estimation of iron content of the given solution using potentiometer.

Contact Periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 21 Periods Total: 21 Periods

REFERENCE:

1. J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas and B. Sivasankar, Vogel's Textbook of Qualitative Chemical Analysis, 2009.

COURSE OUTCOMES:

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

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

CO2: Quantify the type and amount of alkalinity in water sample.

CO3: Equip with the methods and techniques involved in pH metry.

CO4: Apply the conductometric measurements in quantitative analysis of chemical substances.

CO5: Estimate the amount of ferrous ion present in solution by potentiometric titration.

22CAES206 PYTHON PROGRAMMING LABORATORY SEMESTER II

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To practice various computing strategies for Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To develop applications using python packages and libraries.

LIST OF EXPERIMENTS:

1. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
2. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
3. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Retail Store –operations of list & tuples)
4. Implementing real-time/technical applications using Sets, Dictionaries. (Student Enrolment and Mark sheet - operations of Sets & Dictionaries)
5. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
6. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
7. Implementing programs using Python Standard Libraries (pandas, numpy, Matplotlib)
8. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
9. Create a data frame based on E Commerce data and generate descriptive statistics (Mean, Median, Mode and Variance).
10. Consider Data of your interest from an Open Source (Eg. Data.gov.in) aggregate and summarize. Then plot it using different plotting functions of Matplotlib Library.
11. Mini Project.

Contact Periods:

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

COURSE OUTCOMES:

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

CO1: Implement programs in Python using conditionals and loops for solving problems.

CO2: Deploy functions to decompose a Python program.

CO3: Utilize Python packages and libraries in developing software applications.

LIST OF EQUIPMENT'S AND COMPONENTS

- Software Required – Python 3 Interpreter
- Operating System – Windows 7 / 8.1 / 10 / Linux
- Computers Required – 30 Nos.

22CABS301 **TRANSFORM TECHNIQUES AND ITS APPLICATIONS** **SEMESTER III**

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- 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 be familiar with techniques of laplace and Inverse laplace transformations.
- 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: FOURIER SERIES **9+3**

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

UNIT-II: APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **9+3**

Classification of PDE – 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-III: LAPLACE TRANSFORMS **9+3**

Existence conditions – Transforms of elementary functions – Basic properties – 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.

UNIT-IV: FOURIER TRANSFORMS **9+3**

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

UNIT-V: Z -TRANSFORMS AND DIFFERENCE EQUATIONS **9+3**

Z-transforms – Elementary properties – 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:** 15**Periods** **Practical:** 0 **Periods** **Total:** 60**Periods**

REFERENCES:

1. Grewal B. S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.

2. Kreyszig E., “Advanced Engineering Mathematics”, John Wiley & Sons, 10th Edition, 2018.
3. Ramana B.V., “Higher Engineering Mathematics”, Mc Graw Hill Education Pvt. Ltd, New Delhi, 11th Edition, 2018.
4. Andrews L. C and Shivamoggi B, "Integral Transforms for Engineers" SPIE Press, 1999.
5. Bali N.P. and Manish Goyal, “A Text book of Engineering Mathematics”, Laxmi Publications Pvt. Ltd, New Delhi, 10th Edition, 2021.
6. James G., "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, New Delhi, 2016.

COURSE OUTCOMES:

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

CO1: Solve differential equations using Fourier series analysis which plays a vital role in Engineering applications.

CO2: Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.

CO3: Understand Laplace transform and inverse transform of simple functions, various related theorems and application to differential equations with constant coefficients.

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.

22EEPC302 **ELECTROMAGNETIC FIELDS** **SEMESTER III**

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To understand the concepts of basic mathematical concepts related to electromagnetic vector fields
- To understand the concepts of electrostatic fields, electric potential, energy density and their applications.
- To acquire knowledge of Magneto static fields, magnetic flux density, vector potential and its applications.
- To acquire knowledge about the relation between the fields under time varying situations.
- To impart knowledge on the concepts of electromagnetic waves and characterizing parameters

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 equations, 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 magnetic 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 – Conduction current density - Displacement current density – 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: Visualize and explain Gradient, Divergence, and Curl operations on electromagnetic vector fieldsand identify the electromagnetic sources and their effects.

CO2: Compute and analyse electrostatic fields, electric potential, energy density along with their applications.

CO3: Compute and analyse magneto static fields, magnetic flux density, vector potential along with their applications.

CO4: Explain different methods of emf generation and Maxwell's equations.

CO5: Explain the concept of electromagnetic waves and characterizing parameters

22EEPC303 **DIGITAL LOGIC CIRCUITS** **SEMESTER III**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study various number systems, simplify the logical expressions using Boolean functions.
- To study 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(TTL,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 – Asynchronous circuits – Analysis procedure– Hazards & error in digital circuits.

UNIT-IV: REGISTERS, COUNTERS AND MEMORY **9**

Registers, shift registers, ripple counters, synchronous counters – Modulo counters – Random access memory – 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. Gate level description of multiplexers (2:1,4:1,8:1) and de-multiplexers – Encoders (8 to 3), decoders (2 to 4).

Contact Periods:

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

REFERENCES:

1. Morris ManoM., "Digital Design", Pearson Education, New Delhi, 6thEdition, 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. Tocci R.J., Neal S. Widmer, 'Digital Systems: Principles and Applications', Pearson

Education Asia, 12th Edition, 2017.
5. Floyd and Floyd Thomas L., "Digital fundamentals", Pearson Education, New Delhi 11th Edition,2014.
6. Donald P Leach, Albert Paul Malvino, Goutam Sha, 'Digital Principles and Applications', Tata McGraw Hill, 7th Edition, 2010.

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.

22EEPC304 ELECTRON DEVICES AND CIRCUITS SEMESTER III

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the structure of basic electronic devices.
- To be exposed to active and passive circuit elements.
- To familiarize the operation and applications of transistor like BJT and FET.
- To explore the characteristics of amplifier gain and frequency response.
- To learn the required functionality of positive and negative feedback systems.

UNIT-I: PN JUNCTION DEVICES 9

PN junction diode –structure, operation and V-I characteristics, diffusion and transition capacitance –Clipping & Clamping circuits - Rectifiers – Half Wave and Full Wave Rectifier– Display devices- LED, Laser diodes, Zener diode characteristics- Avalanche and Zener Breakdown - Zener diode as regulator.

UNIT-II: TRANSISTORS AND THYRISTOR 9

BJT, JFET, MOSFET- structure, operation, characteristics and Biasing - UJT, Thyristors and IGBT - Structure and characteristics

UNIT-III: AMPLIFIERS 9

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 analysis..

UNIT-IV: MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER 9

BIMOS 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

Advantages of negative feedback – voltage / current, series, Shunt feedback –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: Explain the structure and operation of PN junction devices and Design clipper, clamper, half wave and full wave rectifier, regulator circuits using PN junction diodes

CO2: Analyze the characteristics of the various electronic devices.

CO3: Analyze the performance of various configurations of BJT and MOSFET based amplifier

CO4: Explain the characteristics of MOS based cascade and differential amplifier

CO5: Explain the operation of various feedback amplifiers and oscillators

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

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

UNIT-I: ELECTROMECHANICAL ENERGY CONVERSION **9**

Fundamentals of magnetic circuit - 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.Introduction to Indian Standard Specifications (ISS) - Role and significance in testing.

UNIT-II: DC GENERATORS **9**

Principle of operation and Constructional details – 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**

Principle of operation and Constructional details - 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. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 5th Edition, 2017.

2. P. S. Bimbhra, “Electric Machinery”, Khanna Publishers, 2nd Edition, 2021.
3. Fitzgerald A. E., C. Kingsley and S. Umans, “Electric Machinery”, Mc Graw Hill, 2017.
4. Jacek F. Gieras, “Electrical Machines: Fundamentals of Electromechanical Energy Conversion”, CRC press,2016
5. Abhijith Chakrabarti, 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 concepts of electro mechanical energy conversion
CO2: Explain the knowledge in working principle and performance of DC generators
CO3: Describe the knowledge in working principle and performance of DC motors
CO4: Show the knowledge in construction details and performance of transfromers
CO5: Perform the testing of DC machines and transformers

22CAHS306 **ENVIRONMENTAL SCIENCE AND ENGINEERING** **SEMESTER III**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn about natural resources, exploitation and its conservation.
- To understand the concept of ecosystem and preservation of biodiversity.
- To acquire knowledge about the role of a human being in maintaining a clean and useful environment for the future generation.
- To impart awareness of various social issues affecting the environment.
- To know about population explosion in the environment.

UNIT-I: ENVIRONMENT AND NATURAL RESOURCES **10**

Definition, scope and importance of environment – Forest resources: Use and over exploitation – Deforestation – Dams and their effects on forests and tribal people – Water resources: Use and over utilization of surface and ground water – Mineral resources: Use and over exploitation – Environmental effects of extracting and using mineral resources – Food resources : changes caused by agriculture – Effects of modern agriculture – fertilizer – pesticide problems, water logging, salinity – Energy resources: Growing energy needs, renewable and non-renewable energy sources, Use of alternate energy sources – Role of an individual in conservation of natural resources.

UNIT-II: ECOSYSTEMS AND BIODIVERSITY **10**

Concept of an ecosystem – Structure and function of an ecosystem – Energy flow in the ecosystem – Ecological succession – Food chains, food webs – Forest ecosystem – Introduction to biodiversity – Genetic, species and ecosystem diversity – Value of biodiversity – India as a mega – diversity nation – Hot-spots of biodiversity – Threats to biodiversity – Endangered and endemic species – Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT-III: POLLUTION AND SOLID WASTE MANAGEMENT **10**

Definition – Causes, effects and control measures of – Air pollution, Water pollution, Soil pollution, Marine pollution and Noise pollution – Solid waste management: Causes, Effects and Control measures of municipal solid wastes – Role of an individual in prevention of pollution – Disaster management: Floods, Earthquake, Cyclone and Landslides.

UNIT-IV: SOCIAL ISSUES AND THE ENVIRONMENT **8**

From unsustainable to sustainable development – Urban problems related to energy – Water conservation – Rain water harvesting – Watershed management – Resettlement and rehabilitation of people – Climate change – Global warming – Acid rain – Ozone layer depletion, Nuclear accidents and holocaust – Consumerism and waste products – 12 principles of green chemistry – Environment protection act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Forest conservation act.

UNIT-V: HUMAN POPULATION AND THE ENVIRONMENT **7**

Population growth, variation among nations – Population explosion – Family welfare programme – Environment and human health – Human rights – Value education – HIV / AIDS

– Women and child welfare – Environmental impact assessment (EIA) – GIS – Remote sensing – Role of information technology in environment protection and human health.

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

REFERENCES:

1. Deswal.S and Deswal.A, "A Basic Course in Environmental Studies", Dhanpat Rai & Co (P) Ltd, New Delhi, 2021.
2. Anubha Kaushik and C.P.Kaushik, "Perspectives in Environmental Studies", Sixth edition, New Age International Publishers, New Delhi, 2019.
3. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2016.
4. Erach Bharucha, "Textbook of Environmental Studies", Universities Press (I) Pvt. Ltd., Hyderabad, 2015
5. Tyler. G Miller and Scott E. Spoolman, Environmental Science, Cengage Learning India PVT, LTD, Delhi, 2014.
6. Gilbert M. Masters and Wendell P.Ela "Introduction to Environmental Engineering and Science", Third Edition, Pearson Education, 2013.

COURSE OUTCOMES:

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

CO1: Develop an understanding of different types of natural resources
CO2: Realise the importance of ecosystem and biodiversity for maintaining ecological balance.
CO3: Create awareness about environmental pollution and role of human being in environmental protection.
CO4: Gain adequate knowledge about the social issues of the environment and solutions to solve the issues.
CO5: Understand the population explosion and current technology to protect the environment and human health

22EEPC307	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. Characteristics of Single Phase full wave Rectifier
7. Zener diode characteristics
8. Transistor characteristics – Common emitter mode
9. Transistor characteristics – Common base mode
10. Transistor characteristics – Common collector mode
11. Characteristics of UJT
12. 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: Measure the real and reactive power in three phase network.
CO3: Infer the characteristics of basic semiconductor devices.
CO4: Determine the characteristics of transistor BJT.
CO5: Determine the characteristics of UJT and FET.

22EEPC308 ELECTRICAL MACHINES – I LABORATORY SEMESTER III

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To expose the students to determine the characteristics of DC machines and transformers by performing experiments on these machines.
- To provide hands on experience to evaluate the performance parameters of DC machines and transformer by conducting suitable tests.

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 no load losses in single phase 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: Acquire knowledge on separation of losses.

22CABS402 **NUMERICAL METHODS** **SEMESTER IV**

L	T	P	C
3	1	0	4

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+3

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.

UNIT-II: INTERPOLATION AND APPROXIMATION 9+3

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

UNIT-III: NUMERICAL DIFFERENTIATION AND INTEGRATION 9+3

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+3

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

UNIT-V: BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 9+3

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

Contact Periods:

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

REFERENCES:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 10th Edition, Cengage Learning, 2016.
2. Grewal, B.S., and Grewal, J.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, 7th Edition, New Delhi, 2007.
5. Mathews, J.H. "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition Prentice Hall, 1992.
6. Steven C.Chapra and Raymond P.Canale, "Numerical Methods for Engineers" 7th Edition, McGraw – Hill Education, 2015.

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.

22EEPC401 TRANSMISSION AND DISTRIBUTION SEMESTER IV

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge about the configuration of the electrical power systems.
- To study the line parameters and interference with neighbouring circuits.
- To understand the mechanical design and performance analysis of transmission lines.
- To learn about different insulators and underground cables.
- To understand and analyze the distribution system.

UNIT-I: TRANSMISSION LINE PARAMETERS 9

Structure of electric 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 - Typical configuration, conductor types - Symmetrical and unsymmetrical spacing and transposition – application of self and mutual GMD; skin and proximity effects - Effects of earth on the capacitance of the transmission line.

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 –Ferranti effect – Formation of Corona – Critical Voltages – Effect on line Performance.

UNIT-III: SAG CALCULATION AND LINE SUPPORTS 9

Mechanical design of overhead lines – Line Supports –Types of towers – Tension and Sag Calculation for different weather conditions – Methods of grounding - Insulators: Types, voltage distribution in insulator string, improvement of string efficiency, testing of insulators.

UNIT-IV: UNDERGROUND CABLES 9

Underground cables – Types of cables – Construction of single-core and 3-core belted cables – Insulation Resistance – Potential Gradient – Capacitance of single-core and 3-core belted 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 – Concentrated and Distributed loading- Techniques of Voltage Control and Power factor improvement – Distribution Loss –Types of Substations – 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. KothariDP, Nagarath, IJ, 'Power System Engineering', Mc Graw-Hill Publishing Companylimited, New Delhi, Third Edition, 2019.
2. Wadhwa C L, 'Electrical Power Systems', New Age International Ltd, seventh edition 2022.

3. Singh S N, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of IndiaPvt. Ltd, New Delhi, Second Edition, 2008.
4. Gupta B R, 'Power System Analysis and Design' S. Chand, New Delhi, Sixth Edition, 2011.
5. Luces M.Fualken berry, Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 2007.
6. Mehta V K, Rohit Mehta, 'Principles of power system', S. Chand & Company Ltd, New Delhi,2013.

COURSE OUTCOMES:

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

CO1: Understand the structure of power system, computation of transmission line parameters for different configurations.

CO2: Model the transmission lines to determine the line performance and to understand the impact of Ferranti effect and corona on line performance.

CO3: Do Mechanical design of transmission lines, grounding and to understand about the insulators in transmission system.

CO4: Design the underground cables and understand the performance analysis of underground cable.

CO5: Understand the modelling, performance analysis and modern trends in distribution system.

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To educate the fundamental concepts and characteristics of measurement and errors
- To impart the knowledge on the functional aspects of measuring instruments
- To infer the importance of various bridge circuits used with measuring instruments.
- To educate the fundamental working of sensors and transducers and their applications
- To summarize the overall measurement and instrumentation with the knowledge on digital instrumentation principles.

UNIT-I: CONCEPTS OF MEASUREMENTS **9**

Instruments: classification, applications – Elements of a generalized measurement system - Static and dynamic characteristics - Errors in measurement -Statistical evaluation of measurement data.

UNIT-II: MEASUREMENT OF PARAMETERS IN ELECTRICAL SYSTEMS **9**

Classification of instruments – moving coil and moving iron meters – Induction type, dynamometer type watt meters – Energy meter – Megger – Instrument transformers (CT & PT).

UNIT-III: AC/DC BRIDGES **9**

Wheatstone bridge, Kelvin double bridge - Maxwell, Hay, Wien and Schering bridges – Errors and compensation in A.C. bridges.

UNIT-IV: TRANSDUCERS FOR MEASUREMENT OF NON- ELECTRICAL SYSTEMS **9**

Classification of transducers – Measurement of pressure, temperature, displacement, flow, angular velocity – Digital transducers – Smart Sensors.

UNIT-V: DIGITAL INSTRUMENTATION **9**

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

Contact Periods:

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

REFERENCES:

1. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, New Delhi, Edition 2011.
2. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010
3. W.Bolton, Programmable Logic Controllers, 6th Edition, Elseiver, 2015.
4. R.B. Northrop, 'Introduction to Instrumentation and Measurements', Taylor & Francis, New Delhi, 3rd Edition 2014.
5. E. O. Doebelin and D. N. Manik, "Measurement Systems – Application and Design", Tata McGraw-Hill, New Delhi, 6th Edition 2017.
6. R. K. Rajput, "Electrical and Electronics Measurements and Instrumentation", Chand Pub, 2016

COURSE OUTCOMES:

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

CO1: Understand the fundamental art of measurement in engineering.

CO2: Understand the structural elements of various instruments.

CO3: Understand the importance of bridge circuits.

CO4: Understand about various transducers and their characteristics by experiments.

CO5: Understand the concept of digital instrumentation and virtual instrumentation by experiments.

22EEPC404 **ELECTRICAL MACHINES - II** **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 familiarize 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 – EMF equation – Synchronous reactance – Armature reaction – Voltage regulation – EMF, MMF, ZPF and ASA methods – Synchronizing and parallel operation – Synchronizing torque - Change of excitation and mechanical input - Operating characteristics – Capability curves.

Salient pole machines: Two reaction theory – Determination of direct and quadrature axis synchronous reactance using slip test – phasor diagram using Xd and Xq.

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 – Synchronous condenser.

UNIT-III: THREE PHASE INDUCTION MOTOR 9

Constructional details – Types of rotors –Principle of operation – Slip –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 – Cogging and Crawling- 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 **–** BLDC Motor – SRM Motor - AC series motor - Servo motors - Stepper motors.

Contact Periods:

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

REFERENCES:

1. Kothari D. P. and Nagrath I. J "Electric Machines" Tata McGraw Hill, 5th Ed., 2017.
2. Fitzgerald A.E., Charles Kingsly C. Stephen D. Umans "Electric Machinery" Tata McGraw Hill, 6th Ed., 2017.
3. Stephen J. Chapman, 'Electric Machinery Fundamentals'4th edition, McGraw Hill Education Pvt. Ltd, 4th Edition 2017.
4. P. S. Bimbhra, "Electric Machinery", Khanna Publishers, 7th Revised Edition, 2021.
5. Sen. S. K, "Electric Machinery", Khanna Publishers, New Delhi, 2008
6. Janardanan E.G., "Special Electrical machines", PHI Learning Pvt. Ltd, Delhi, 2014.

COURSE OUTCOMES:

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

CO1: Explain the construction working principles and performace of sysnchronous generator.
CO2: Show the knowledge of operation and performance of synchronous motor.
CO3: Illustrate the working principle and performance of three phase induction machine.
CO4: Execute speed control and starting methods for various AC motors.
CO5: Familiarize the single phase induction motor, special electrical machines and their applications.

22EEPC405 LINEAR INTEGRATED CIRCUITS SEMESTER IV

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. Realisation of monolithic ICs and packaging. Fabrication of diodes, capacitance, resistance, FETs and PV Cell.

UNIT-II: CHARACTERISTICS OF OP-AMP **9**

Ideal OP-AMP characteristics, DC characteristics, AC characteristics, differential amplifier; frequency response of OP-AMP; Voltage-shunt feedback and inverting amplifier - Voltage series feedback: and Non-Inverting Amplifier - Basic applications of op-amp –, summer, differentiator and Integrator-V/I & I/V converters.

UNIT-III: APPLICATIONS OF OP-AMP **9**

Instrumentation amplifier and its applications for transducer Bridge, Log and Antilog Amplifiers- Analog multiplier & Divider, first and second order active filters, comparators, multi vibrators, waveform generators, clippers, clampers, peak detector, S/H circuit, D/A converter (R- 2R ladder and weighted resistor types), A/D converters using OP-AMPs.

UNIT-IV: SPECIAL ICs **9**

Functional block, characteristics of 555 Timer and its PWM application - IC-566 voltage controlled oscillator IC; 565-phase locked loop IC, AD633 Analog multiplier ICs.

UNIT-V: APPLICATION ICs **9**

AD623 Instrumentation Amplifier and its application as load cell weight measurement - IC voltage regulators –LM78XX, LM79XX; Fixed voltage regulators its application as Linear power supply - LM317, 723 Variability voltage regulators, switching regulator- SMPS - ICL 8038 function generator IC.

Contact Periods:

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

REFERENCES:

1. David A. Bell, ‘Op-amp & Linear ICs’, Oxford, Third Edition, 2011
2. D. Roy Choudhary, Sheil B. Jani, ‘Linear Integrated Circuits’, , New Age, Fourth Edition, 2018.
3. Ramakant A.Gayakward, ‘Op-amps and Linear Integrated Circuits’, 4th edition, Pearson Education, PHI 2021.
4. Fiore,”Opamps& Linear Integrated Circuits Concepts & applications”, Cengage, 2010.
5. Floyd ,Buchla,”Fundamentals of Analog Circuits, Pearson, 2013.
6. Jacob Millman, Christos C.Halkias, ‘Integrated Electronics - Analog and Digital circuits system’, McGraw Hill, 2nd Edition, 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.

22EEPC406 MICROPROCESSOR AND MICROCONTROLLER SEMESTER IV

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the architecture, addressing modes and instruction set of 8085 microprocessor.
- To develop skills in simple program writing in assembly languages.
- To introduce commonly used peripheral/interfacing ICs.
- To study the architecture, addressing modes and instruction set of 8051 microcontroller.
- To develop the microprocessor and microcontroller based applications.

UNIT-I: INTRODUCTION TO 8085 ARCHITECTURE **9**

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

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

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

UNIT-III: INTERFACING BASICS AND ICs **9**

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

UNIT-IV: INTRODUCTION TO 8051 MICROCONTROLLER **9**

Functional block diagram, pinouts - Memory organization - Instruction format and addressing modes – Interrupt structure – Timer – I/O ports – Serial communication.

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

Simple programming exercises – Key board and display interface – Temperature control system -Control of servo motor – Stepper motor control.

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, 2011
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 Architecture and Interrupt structure of 8085 microprocessor.
CO2: Write assembly language program for 8085 microprocessor.
CO3: Design and implement interfacing of peripheral with microprocessor and microcontroller
CO4: Acquire knowledge in architecture and write assembly language program of 8051 microcontroller.
CO5: Design the microprocessor and microcontroller based systems used for control and monitoring..

22EEPC407 ELECTRICAL MACHINES- II LABORATORY SEMESTER IV

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To expose the students to analyze the characteristics of EMF, MMF and ZPF methods
- To expose the students to conducting various tests on alternators and obtaining their performance indices using standard analytical as well as graphical methods
- To observe and conduct various tests on induction motors and synchronous motor to obtain their performance Characteristics
- To expose the students to conduct and analyze various tests on induction motors to obtain their performance indices.
- To grasp the knowledge on AC motor starters

LIST OF EXPERIMENTS

1. Regulation of three phase alternator by EMF and MMF methods
2. Regulation of three phase alternator by ZPF method
3. Load test on three phase Alternator.
4. Regulation of three phase salient pole alternator by slip test
5. Load test on single phase induction 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. No load and blocked rotor test on single phase induction motor
10. Separation of no load losses of three phase induction motor
11. V and Inverted V curves of three phase synchronous 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 EMF, MMF and ZPF methods

CO2: Analyze the characteristics of alternator

CO3: Acquire hands on experience of conducting various tests on induction motors and synchronous motor to obtaining the performance Characteristics

CO4: Acquire hands on experience of conducting various tests on induction motors and obtaining their performance indices.

CO5: Acquire knowledge on AC motor starters

22EEPC408 LINEAR AND DIGITAL CIRCUITS LABORATORY SEMESTER IV

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To known about internal circuitry and logic for digital circuits.
- To fabricate electronic circuit depends on applications.
- To understand various waveform generation circuits using opamps, comparators and IC's.
- To grasp knowledge on various combinational logic circuits.
- To grasp knowledge on various sequential logic circuits.

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 Arithmetic Circuits-Adder, Subtractor
7. Registers
8. Design of Counters
9. Encoder and Decoder
10. Multiplexer and Demultiplexer

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: 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.

22EEPC409 MICROPROCESSOR AND MICROCONTROLLER LABORATORY SEMESTER IV

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To perform simple arithmetic operations using assembly language program and study the addressing modes & instruction set of 8085 & 8051
- To develop skills in simple program writing in assembly languages
- To write an assembly language program to convert Analog input to Digital output and Digital input to Analog output.
- To perform interfacing experiments with 8085
- To perform interfacing experiments with 8051.

LIST OF EXPERIMENTS

1. Simple arithmetic operations: addition / subtraction / multiplication / division
2. Programming with control instructions:
   (i) Ascending / Descending order
   (ii) Programs using Rotate instructions
   (iii) Hex / 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.

22EEPC501 POWER SYSTEM ANALYSIS SEMESTER V

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impact knowledge on need for operational studies, and to model the power system under steady state operating condition.
- To understand and apply iterative techniques for power flow analysis.
- To model or carry out short circuit studies for power system during symmetrical fault.
- To model or carry out short circuit studies for power system during unsymmetrical fault.
- To study the various methods for analysing power system stability.

UNIT-I: POWER SYSTEM **9**

Need for system planning and operational studies - Power scenario in India - Power system components, Representation - Single line diagram - per unit quantities - p.u. impedance diagram - p.u. reactance diagram, Network graph Theory - Bus incidence matrices, Primitive parameters, Formation of bus admittance matrix – Direct inspection method – Singular Transformation method.

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

Bus classification - Formulation of Power Flow problem in polar coordinates - Power flow solution using Gauss Seidel method - Handling of Voltage controlled buses - Power Flow Solution by Newton Raphson method – Flow charts – Comparison of methods.

UNIT-III: SYMMETRICAL FAULT ANALYSIS **9**

Assumptions in short circuit analysis - Symmetrical short circuit analysis using Thevenin's theorem - Bus Impedance matrix building algorithm (without mutual coupling) - Symmetrical fault analysis through bus impedance matrix - Post fault bus voltages - Fault level - Current limiting reactors.

UNIT-IV: UNSYMMETRICAL FAULT ANALYSIS **9**

Symmetrical components - Sequence impedances - Sequence networks - Analysis of unsymmetrical faults at generator terminals: LG, LL and LLG - unsymmetrical fault occurring at any point in a power system.

UNIT-V: STABILITY ANALYSIS **9**

Classification of power system stability – Rotor angle stability - Power-Angle equation – Steady state stability - Swing equation – Solution of swing equation by step by step method - Swing curve, Equal area criterion - Critical clearing angle and time, Multi-machine stability analysis – modified Euler method.

Contact Periods:

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

REFERENCES:

1. John J. Grainger, William D. Stevenson, Jr, 'Power System Analysis', Mc Graw Hill Education (India) Private Limited, New Delhi, 2017.
2. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw-Hill Education, Third Edition 2019.
3. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.

4. Pai M A, 'Computer Techniques in Power System Analysis', Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.
5. J. Duncan Glover, Mulukutla S.Sarma, Thomas J. Overbye, 'Power System Analysis & Design', Cengage Learning, Fifth Edition, 2012.
6. P. Venkatesh, B. V. Manikandan, A. Srinivasan, S. Charles Raja, "Electrical Power Systems: Analysis, Security and Deregulation", Prentice Hall India (PHI), second edition, 2017

COURSE OUTCOMES:

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

CO1: Model the power system under steady state operating condition.
CO2: Carry out power flow analysis using iterative techniques.
CO3: Infer the significance of short circuit studies in designing circuit breakers.
CO4: Analyse the state of the power system for various unsymmetrical faults.
CO5: Analyse the stability of power system using different methods.

22EEPC502 **CONTROL SYSTEMS** **SEMESTER V**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

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

UNIT-I: MODELING OF LINEAR TIME INVARIANT SYSTEM (LTIV) 9

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

UNIT-II: TIME DOMAIN ANALYSIS 9

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

UNIT-III: FREQUENCY DOMAIN ANALYSIS 9

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

UNIT-IV: STATE VARIABLE ANALYSIS 9

State variable formulation – State space model – Canonical state model – State transition matrix - Decomposition of transfer function – Transfer function from state model – Concept of controllability and observability.

UNIT-V: DESIGN OF FEED BACK CONTROL SYSTEM 9

Design specifications – Lead, Lag and Lag-lead compensators using Bode plot techniques – Effect of adding lag and lead compensators - PID controller - Analytical design for PI, PD, PID control systems.

Contact Periods:

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

REFERENCES:

1. Benjamin C. Kuo, "Automatic Control Systems", 7th Edition PHI Learning Private Ltd, 2010.
2. Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New Age International Publishers 2010.
3. Katsuhiko Ogata, "Modern Control Engineering", PHI Learning Private Ltd, 5th Edition, 2010
4. John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Taylor& Francis Reprint 2009.
5. Richard C. Dorf and Bishop, R.H., "Modern Control Systems", Education Pearson,3 Impression 2009.
6. NPTEL Video Lecture Notes on "Control Engineering" by Prof.S.D.Agashe, IIT Bombay.

COURSE OUTCOMES:

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

CO1: Represent simple systems in transfer function forms
CO2: Analyze simple systems in time domain.
CO3: Analyze simple systems in frequency domain.
CO4: Represent simple systems in state variable forms
CO5: Infer the stability of systems in time and frequency domain.

22EEES503 DATA STRUCTURES AND ALGORITHMS SEMESTER V

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the concepts of ADTs and linear data structures.
- To introduce the linear data structures Stack and Queue.
- To know the concepts of tree non-linear data structure.
- To learn to represent data using graph data structure.
- To familiarize the concepts of sorting, searching and hashing techniques.

UNIT I: INTRODUCTION **9**

Abstract Data Types (ADT) – List ADT: Array implementation, Linked list implementation (Singly, Doubly & Circular)–Applications: Polynomial Evaluation.

UNIT II: STACKS AND QUEUES **9**

Stack ADT: Array and Linked Stacks, Applications: Arithmetic expression conversion - Postfix evaluation – Queue ADT: Array and Linked Queue, Circular Queue – Applications.

UNIT III: TREES **9**

Tree Terminologies – tree traversal - Binary Tree –Threaded Binary Trees - Binary Search Trees – AVL Trees – B-Tree - Heap – Applications.

UNIT IV: GRAPHS **9**

Representation of Graph - Types of graph –Graph traversal – - Shortest path algorithms: Dijkstra‘s algorithm - Minimum Spanning Tree: Prim's and Kruskal's algorithms – Topological Sort –Real world applications.

UNIT V: SEARCHING, SORTING AND HASHING **9**

Searching: Linear and Binary Search – Sorting: Bubble sort – Insertion sort – Quick sort - Merge sort – Hashing: Hash Functions – Collision Avoidance Techniques: Separate chaining – Open Addressing – Linear probing, Quadratic probing, Double hashing – Rehashing – Applications.

Contact Periods:

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

REFRENCES:

1. Mark A.Weiss., “Data Structures and Algorithm Analysis in C”, Second Edition, Pearson Education, 2010.
2. Reema Thareja, “Data Structures using C”, 2nd Edition, Oxford University Press, 2011.
3. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education,1983.
4. Ellis Horowitz, SartajSahni and Susan Anderson, “Fundamentals of Data Structures”, Galgotia, 2008.
5. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, “Fundamentals of Computer Algorithms” University Press, Second Edition, 2011.
6. Brian W. Kernighan, Rob Pike, “The Practice of Programming”, Pearson Education, 2012.

COURSE OUTCOMES:

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

CO1: Analyse the representation and manipulation of linear data structures in memory.

CO2: Use appropriate non-linear data structure to solve various applications.

CO3: Apply the tree concepts for efficient storage and retrieval of data.
CO4: Apply the graph algorithms to solve real-world challenges.
CO5: Choose the optimal searching, sorting and hashing techniques to solve real- time applications.

22EEPC504 CONTROL AND INSTRUMENTATION LABORATORY **SEMESTER V**

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To make the students familiarize in measurements and instrumentation.

- To understand signal conditioning circuits and various types of converters.
- To make the students analyze the stability of linear systems in the time domain and frequency domain.
- To design a suitable controller for closed loop operation of second order systems.
- To make the students design compensator based on the time and frequency domain Specifications.

LIST OF EXPERIMENTS

1. Measurement of resistance, inductance and capacitance using bridge circuits
2. Dynamics of displacement transducer
3. Dynamics of flow sensor
4. Analog to digital converters
5. Digital to analog converters
6. Mathematical modeling and simulation of physical systems in two fields.
   i. Mechanical
   ii. Electrical
7. Stability analysis using bode plot in simulation platform
8. Root locus based analysis in simulation platform.
9. Stability analysis using nyquist plot in simulation platform
10. Design and simulation of PID controllers for a second order system
11. Test of controllability and observability in continuous and discrete domain in simulation platform
12. Design of lag, lead compensators and evaluation of closed loop performance

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: Experiment the various measuring techniques for electrical quantity
CO2: Acquire knowledge on signal conditioning circuits and various types of converters.
CO3: Analyze the stability of a physical system in both continuous and discrete domains
CO4: Design suitable controllers for closed loop operation of second order systems.
CO5: Design suitable compensator for closed loop systems.

22EEES505 DATA STRUCTURES AND ALGORITHMS LABORATORY **SEMESTER V**

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To implement linear and non-linear data structures

- To understand the different operations of search trees
- To implement graph traversal algorithms
- To get familiarized to sorting and searching algorithms
- To get familiarized in collision techniques

LIST OF EXPERIMENTS

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

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: Write functions to implement linear and non-linear data structure operations
CO2: Suggest appropriate linear / non-linear data structure operations for solving a given problem
CO3: Appropriately use the linear / non-linear data structure operations for a given problem
CO4: Apply appropriate searching and sorting algorithm to linear and non-linear data structure operations
CO5: Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval

22EEPC601 RENEWABLE ENERGY SYSTEMS SEMESTER VI

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Understand the various types of renewable energy sources.
- 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.
- Study the various types of other energy sources

UNIT-I: RENEWABLE ENERGY SOURCES **9**

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

UNIT-II: WIND ENERGY **9**

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

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.

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.

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.

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: 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.

22EEPC602 **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 – SCR – GTO –Triac- MOSFET and IGBT – di/dt and dv/dt protection- Introduction of IGCT.

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 – 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.

UNIT-III: CHOPPER **9**

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

UNIT-IV: INVERTERS **9**

Single phase half bridge and full bridge inverters - VSI :(1phase and three phase inverters square wave operation) - Voltage control of inverters single, multi pulse, sinusoidal, – CSI.

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

TRIAC based phase controllers - various configurations for SCR based single and three phase controllers – cyclo converters.

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, 2017.
2. P.S.Bimbhra, Power Electronics, Khanna Publishers, Edition-7 2022.
3. Philip T.Krein, Elements of Power Electronics, Oxford University Press, 2013.
4. Ned Mohan, T.M.Undeland, W.P.Robbins, "Power Electronics: Converters, applications and design", John Wiley and Sons, 3rd Edition (reprint), 2009.
5. Singh M. D and Khanchandani K.B.,"Power Electronics", Tata McGraw Hill Publishing Co. Ltd,New Delhi- 3rd Reprint 2012.
6. Cyril. W.Lander, Power Electronics, McGraw Hill International, Third Edition, 1993.

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.

22EEPC603 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 converter
7. Boost converter
8. Single phase PWM inverter
9. Single phase voltage control using SCR and TRIAC
10. Three phase PWM Inverter
11. Characteristics of PMBLDC Motor
12. Study of switched mode power converter

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: 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: Evaluate the characteristics of PMBLDC motor

22EEPC604 POWER SYSTEM & RENEWABLE ENERGY LABORATORY SEMESTER VII

L	T	P	C
0	0	3	1.5

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 this course, the students 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.

22CAHS108 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 this course, the students 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.

22EEPE501 COMPUTER SYSTEM ARCHITECTURE SEMESTER V

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 knowledge 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. 116

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.

22EEPE502 EMBEDDED C- PROGRAMMING SEMESTER V

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To expose the students to the fundamentals of embedded programming
- To introduce the GNU C Programming tool Chain.
- To study the basic concepts of embedded C.
- To teach the basics of 8051 Programming
- To involve discussions/ practice/exercise in revising & familiarizing the concepts acquired over the 5 units of the subject for improved employability skills.

UNIT-I: BASIC C PROGRAMMING **9**

Typical C Program Development Environment - Introduction to C Programming – Structured Program Development in C - Data Types and Operators - C Program Control - C Functions - Introduction to Arrays.

UNIT-II: II EMBEDDED C **9**

Adding Structure to 'C' Code: Object-oriented programming with C, Header files for Project and Port, Examples. Meeting Real-time constraints: Creating hardware delays - Need for timeout mechanism - Creating loop timeouts - Creating hardware timeouts.

UNIT-III: 8051 PROGRAMMING IN C **9**

Data types and time delay in 8051, I/O programming in 8051, Logic operations in 8051, Data conversion program in 8051 Accessing code ROM space in 8051, Data serialization using 8051.

UNIT-IV: 8051 SERIAL PORT AND INTERRUPT PROGRAMMING IN C **9**

Basics of serial communication, 8051 interface to RS232- serial port programming in 8051. 8051 interrupts and programming, Programming for timer configuration.

UNIT-V: 8051 INTERFACING **9**

8051: ADC interfacing , DAC interfacing, Sensor interfacing, LCD interfacing, Stepper motor interfacing.

Contact Periods:

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

REFERENCES:

1. Paul Deitel and Harvey Deitel, "C How to Program", 9th Edition, Pearson Education Limited, 2022, 1st edition.
2. Michael J Pont, "Embedded C", Addison-Wesley, An imprint of Pearson Education, 2002.
3. William von Hagen, "The Definitive Guide to GCC", 2nd Edition, Apress Inc., 2006.
4. Gowrishankar S and Veena A, "Introduction to Python Programming", CRC Press, Taylor & Francis Group, 2019.
5. Noel Kalicharan, "Learn to Program with C", Apress Inc., 2015, 1st edition.
6. Steve Oualline, "Practical C programming", O'Reilly Media, 1997, 3rd edition.

COURSE OUTCOMES:

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

CO1: Deliver insight into embedded C programming and its salient features for embedded systems.

CO2: Illustrate the software and hardware architecture for distributed computing in embedded systems

CO3: Develop a solution for problems by using the concept learned in programming using the embedded controllers

CO4: Develop simple applications with 8051 by using its various features and interfacing with various external hardware.

CO5: Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded programming skills.

22EEPE503 **VLSI DESIGN** **SEMESTER V**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To explain the basic concepts of CMOS.
- To know the CMOS IC fabrication methods.
- To introduce the programable logic devices and reconfigurable processor technologies.
- To understand the architecture of FPGA and FPAA.
- To learn about the programming of programmable device using hardware description.

UNIT-I: CMOS BASICS **9**

Enhancement mode & Depletion mode – MOSFET Scaling - CMOS logic design- Dynamic CMOS –Transmission Gates- BiCMOS.

UNIT-II: IC FABRICATION **9**

CMOS IC Fabrications: P well, N Well and Twin Tub process, soi – Sub micron technology - Design Rules and Layout.

UNIT-III: PROGRAMABLE LOGIC DEVICES **9**

Read Only Memory (ROM)- PLA, PAL- Complex Programmable Logic Devices (CPLD)- architecture and application.

UNIT-IV: RECONFIGURABLE PROCESSOR **9**

Field Programmable Logic Devices - FPGA- Architecture : CLB,I/O Blocks,– FPGA Design Flow - Introduction to FPAA.

UNIT-V: HDL PROGRAMMING **9**

Verilog HDL- Overview - structural and behavioural modeling concepts-Design examples- Carry Look ahead adders, ALU, Shift Registers.

Contact Periods:

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

REFERENCES:

1. M.J.S Smith, "Application Specific integrated circuits", Addition Wesley Longman Inc. 1st Edition 2010.
2. Kamran Eshraghian, Douglas A.pucknell and Sholeh Eshraghian,"Essentials of VLSI circuits and system", Prentice Hall India,2005, 1st Edition.
3. Donald G. Givone, "Digital principles and Design", Tata McGraw Hill 2002, 1st Edition.
4. Charles H. Roth Jr., "Fundamentals of Logic design", Thomson Learning, 7th Edition 2013.
5. Nurmi, Jari (Ed.) "Processor Design System-On-Chip Computing for ASICs and FPGAs" Springer, 2007, 1st Edition.
6. Joao Cardoso, Michael Hübner, "Reconfigurable Computing: From FPGAs to Hardware/Software Codesign" Springer, 2011, 1st Edition.

COURSE OUTCOMES:

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

CO1: Develop CMOS design techniques
CO2: Learn and build IC fabrication
CO3: Explain the need of reconfigurable computing with PLDs.
CO4: Design and development of reprogrammable FPGA.

CO5: Illustrate and develop HDL computational processes with improved design strategies.

22EEPE504	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 Ltd, 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. 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.

22EEPE505 COMPUTER CONTROL OF PROCESSES SEMESTER V

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To represent the linear time invariant system in discrete state space form.
- To analyze the controllability, observability and stability of a discrete time system.
- To estimate model parameters from input/output measurements.

- To design digital controllers.
- To design multi-loop and multivariable controllers for multivariable system.

UNIT I DISCRETE STATE-VARIABLE TECHNIQUE 9

State equation of discrete data system with sample and hold – State transition equation – Methods of computing the state transition matrix – Decomposition of discrete data transfer functions – State diagrams of discrete data systems – System with zero-order hold – Controllability and observability of linear time invariant discrete data system–Stability tests of discrete-data system.

UNIT II SYSTEM IDENTIFICATION 9

Identification of Non-Parametric Input-Output Models: -Transient analysis–Frequency analysis–Correlation analysis– Spectral analysis – Identification of Parametric Input-Output Models: -Least Squares Method – Recursive Least Square Method.

UNIT III DIGITAL CONTROLLER DESIGN 9

Review of z-transform – Modified of z-transform – Pulse transfer function – Digital PID controller– Dead-beat controller and Dahlin's controller – Kalman's algorithm, Pole Placement Controller.

UNIT IV MULTI-LOOP REGULATORY CONTROL 9

Multi-loop Control - Introduction – Process Interaction – Pairing of Inputs and Outputs -The Relative Gain Array (RGA) – Properties and Application of RGA - Multi-loop PID Controller –Biggest Log Modulus Tuning Method – De-coupler.

UNIT V MULTIVARIABLE REGULATORY CONTROL 9

Introduction to Multivariable control –Multivariable PID Controller – Multivariable Dynamic Matrix Controller – Case Studies: - Distillation Column, CSTR and Four-tank system.

Contact Periods:

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

REFERENCES:

1. Thomas E. Marlin, Process Control – Designing Processes and Control systems for Dynamic Performance, Mc-Graw-Hill,2000, 2nd Edition.
2. Gopal, M., "Digital Control and State Variable Methods", Tata Mc Graw Hill, 4th Edition, 2017.
3. P. Albertos and A. Sala, "Multivariable Control Systems an Engineering Approach", SpringerVerlag, 1st Edition, 2004.
4. Bequette, B.W., "Process Control Modeling, Design and Simulation", Prentice Hall of India,1st Edition, 2003.
5. Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, "Process Dynamics and Control",Wiley John and Sons, 4th Edition, 2016.
6. Stephanopoulos, G., "Chemical Process Control -An Introduction to Theory and Practice", Prentice Hall of India, 1st Edition, 2015.

COURSE OUTCOMES:

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

CO1: Develop mathematical models for discrete time systems using state variable techniques and analyze the stability of the systems.

CO2: Construct models from input-output data by least square and recursive least square method.

CO3: Ability and design different digital controllers to satisfy the required criterion.

CO4: Design a multi-loop controller and multivariable controller for multi-variable systems.

CO5: Ability and design multivariable dynamic matrix controller for industrial processes.

22EEPE601 MULTILEVEL POWER CONVERTERS SEMESTER VI

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn multilevel topology (Symmetry & Asymmetry) with common DC bus link.
- To study the working of cascaded H Bridge, Diode Clamped and Flying Capacitor MLI
- To study the working of MLI with reduced switch count

- To learn three level diode clamped MLI and three level flying capacitor based MLI with resistive and reactive load
- To study the MLI with reduced switch count.

UNIT-I: MULTILEVEL TOPOLOGIES **9**

Introduction – Generalized Topology with a Common DC bus – Converters derived from the generalized topology – symmetric topology without a common DC link – Asymmetric topology.

UNIT-II: CASCADED H-BRIDGE MULTILEVEL INVERTERS **9**

Introduction -H-Bridge Inverter, Bipolar Pulse Width Modulation, Unipolar Pulse Width Modulation. Multilevel Inverter Topologies, CHB Inverter with Equal DC Voltage, H-Bridges with Unequal DC Voltages – PWM, Carrier-Based PWM Schemes, Phase-Shifted Multicarrier Modulation, Level Shifted Multicarrier Modulation, Comparison Between Phase- and Level-Shifted PWM Schemes- Staircase Modulation.

UNIT-III: DIODE CLAMPED MULTILEVEL CONVERTER **9**

Introduction – Converter structure and Functional Description – Modulation of Multilevel converters – Voltage balance Control – Effectiveness Boundary of voltage balancing in DCMC converters – Performance results.

UNIT-IV: FLYING CAPACITOR MULTILEVEL CONVERTER **9**

Introduction – Flying Capacitor topology – Modulation scheme for the FCMC – Dynamic voltage balance of FCMC.

UNIT-V: MULTILEVEL CONVERTER WITH REDUCED SWITCH COUNT **9**

Multilevel inverter with reduced switch count-structures, working principles and pulse generation methods.

Contact Periods:

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

REFERENCES:

1. Rashid M.H,"Power Electronics Circuits, Devices and Applications", Prentice Hall India, Third Edition, New Delhi, 2014 Pearson 4th edition.
2. Sergio Alberto Gonzalez, Santiago Andres Verne, Maria Ines Valla,"Multilevel Converters for Industrial Applications", CRC Press, 22-Jul-2013, 2017 1st Edition.
3. BinWu, Mehdi Narimani,High Power Converters and AC drives by IEEE press 2017, 2nd Edition.
4. Iftekhar Maswood, Dehghani Tafti,Advanced Multilevel Converters and Applications in Grid Integration, Wiley, 2018, 1st Edition.
5. Ersan Kabalcı, Multilevel Inverters Introduction and Emergent Topologies, Academic Press Inc,2021, 1st Edition.
6. Hani Vahedi, Mohamed Trabelsi, Single-DC-Source Multilevel Inverters, Springer, 2019, 1st Edition.

COURSE OUTCOMES:

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

CO1: Examine the different topologies of multilevel inverters (MLIs) with and without DC link capacitor.
CO2: Demonstrate the working principles of Cascaded H-Bridge MLI, diode clamped MLI, flying capacitor MLI and MLI with reduced switch count.
CO3: Analyze the voltage balancing performance in Diode clamped MLI.
CO4: Analyze three level, capacitor clamed and diode clamped MLI with R and RL load.
CO5: Examine MLI with reduced switch configuration using fundamental switching scheme

22EEPE602 DIGITAL SIGNAL PROCESSING SYSTEM SEMESTER VI

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the concept of analyzing discrete time signals & systems in the time and frequency domain through mathematical representation.
- To study the various time to frequency domain transformation techniques.
- To understand the computation algorithmic steps for Fourier Transform.
- To study about filters and their design for digital implementation.

- To introduce the programmable digital signal processor & its application.

UNIT-I: INTRODUCTION **9**

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

UNIT-II: DISCRETE TIME SYSTEM ANALYSIS **9**

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

UNIT-III: DISCRETE FOURIER TRANSFORM & COMPUTATION **9**

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

UNIT-IV: DESIGN OF DIGITAL FILTERS **9**

FIR & IIR filter realization – Parallel & cascade forms. FIR design: Windowing Techniques – Need and choice of windows – Linear phase characteristics. IIR design: Analog filter design – Butterworth and Chebyshev approximations; digital design using impulse invariant and bilinear transformation - Warping, prewarping -Frequency transformation.

UNIT-V: DIGITAL SIGNAL PROCESSORS **9**

Introduction – Architecture of one DSP processor for motor control – Features – Addressing Formats– Functional modes - Introduction to Commercial Processors

Contact Periods:

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

REFERENCES:

1. J.G. Proakis and D.G. Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", Pearson Education, New Delhi, 4th Edition 2007.
2. Robert J.Schilling & Sandra L.Harris, "Introduction to Digital Signal Processing using MATLAB", Cengage Learning, 2nd Edition 2013.
3. Emmanuel C I feachor and Barrie W Jervis, "Digital Signal Processing – A Practical approach", Pearson Education, 2nd Edition, 2002.
4. Alan V. Oppenheim, Ronald W. Schafer and John R. Buck, "Discrete – Time Signal Processing", Pearson Education, New Delhi, 2nd Edition 2012.
5. SenM.kuo, Woonsen. s.gan, "Digital Signal Processors, Architecture, Implementations & Applications", Pearson, 1st Edition 2004.
6. S.K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata McGraw Hill, New Delhi, 4th Edition 2013.

COURSE OUTCOMES:

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

CO1: Explain the concepts of digital signal processing

CO2: Illustrate the system representation using transforms
CO3: Learn the transformation techniques for time to frequency conversion
CO4: Design suitable digital FIR, IIR algorithm for the given specification
CO5: Use digital signal processor for application development

22EEPE603 **NON LINEAR CONTROL** **SEMESTER VI**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide knowledge on design in state variable form
- To provide knowledge in phase plane analysis
- To give basic knowledge in describing function analysis
- To study the design of optimal controller
- To study the design of optimal estimate or including Kalman Filter

UNIT-I: STATE VARIABLE DESIGN **9**

Introduction to state model – effect of state feedback – necessary and sufficient condition for arbitrary pole-placement – pole placement design – design of state observers – separation principle – servo design – state feedback with integral control

UNIT-II: PHASE PLANE ANALYSIS **9**

Features of linear and non-linear systems – common physical non-linearities – methods of linearization concept of phase portraits – singular points – limit cycles – construction of phase portraits – phase plane analysis of linear and non-linear systems – iso cline method.

UNIT-III: DESCRIBING FUNCTION ANALYSIS **9**

Basic concepts, derivation of describing functions for common non-linearities – describing function analysis of non-linear systems – limit cycles – stability of oscillations.

UNIT-IV: OPTIMAL CONTROL **9**

Introduction – time varying optimal control – LQR steady state optimal control – solution of ricatti's equation – application examples.

UNIT-V: OPTIMAL ESTIMATION **9**

Optimal estimation – kalman bucy filter – solution by duality principle – discrete systems – kalman filter – application examples.

Contact Periods:

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

REFERENCES:

1. G. J. Thaler, "Automatic Control Systems", Jaico Publishing House 1993
2. M.Gopal, Modern Control System Theory, New Age International Publishers, 2024, 5th Edition
3. K.Ogata,"Modern Control Engineering",5th Edition,PHI,NewDelhi,2009.
4. T.Gladand L.Ljung,,"Control Theory–Multi variable and Non-Linear Methods",Taylor & Francis, 2002, 1st Edition.
5. D.S.Naidu, "Optimal Control Systems", First Indian Reprint, CRC Press, 2009,1st Edition.
6. William S Levine, "Control System Fundamentals", The Control Handbook, CRC Press, Tayler and Francies Group, 2011, 2nd Edition.

COURSE OUTCOMES:

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

CO1: Knowledge gained on state feedback control and nonlinear control.
CO2: Analysis for common nonlinearities in a system.
CO3: Apply advanced control theory to practical engineering problems.
CO4: Design optimal controller.
CO5: Understand the basics and Importance of Kalman filter.

22EEPE604 CONTROL OF POWER ELECTRONICS CIRCUITS **SEMESTER VI**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn the basics of control system simulation.
- To do symbolic calculation.
- To study the principles of sliding mode control and the way of apply smc for buck Converter.

- To learn the concept of power factor correction.
- To design simulate smc for buck converter and power factor correction circuit with Controller.

UNIT-I: SIMULATION BASICS IN CONTROL SYSTEMS **9**

Transfer Function-How to build transfer function, identify Poles, zeros, draw time response plots, bode plot (Bode Plots for Multiplication Factors, Constant, Single and Double Integration Functions, Single and Double Differentiation Functions, Single Pole and Single Zero Functions, RHP Pole and RHP Zero Functions), state space modelling-transfer function from state space Model.

UNIT-II: SYMBOLIC CALCULATIONS **9**

Symbolic Variables - Symbolic Vector Variables, Commands for Handling Polynomial Expressions - Extracting Parts of a Polynomial - Factorization and Roots of Polynomials, Symbolic Matrix Algebra - Operations with Symbolic Matrices - Other Symbolic Matrix Operations.

UNIT-III: SLIDING MODE CONTROL BASICS **9**

Introduction - Introduction to Sliding-Mode Control - Basics of Sliding-Mode Theory - Application of Sliding-Mode Control to DC-DC Converters – Principle - Sliding mode control of buck converter.

UNIT-IV: POWER FACTOR CORRECTION CIRCUITS **9**

Introduction, Operating Principle of Single-Phase PFCs, Control of boost converter based PFCs, Designing the Inner Average-Current-Control Loop, Designing the Outer Voltage-Control Loop, Example of Single-Phase PFC Systems.

UNIT-V: CONTROLLER DESIGN FOR PFC CIRCUITS **9**

Power factor correction circuit using other SMPS topologies: Cuk and SEPIC converter - PFC circuits employing bridgeless topologies.

Contact Periods:

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

REFERENCES:

1. Feedback Control problems using MATLAB and the Control system tool box By Dean Frederick and Joe Chow, 2000, 1st Edition, Cengage Learning.
2. Ned Mohan, "Power Electronics: A First Course", Johnwiley, 2013, 1st Edition.
3. Marian K. Kazimierczuk and AgasthyaAyachit, "Laboratory Manual for Pulse-Width Modulated DC-DC Power Converters", Wiley 2016, 1st Edition.
4. Power Electronics handbook, Industrial Electronics series, S.K.Varenina, CRC press, 2002, 1st Edition.
5. Sliding mode control for Switching Power Converters:, Techniques and Implementation, Slew-Chong Tan, Yuk Ming Lai Chi-Kong Tse, 1st Edition, CRC Press, 2011.
6. Andre Kislovski, "Dynamic Analysis of Switching-Mode DC/DC Converters", Springer 1991.

COURSE OUTCOMES:

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

CO1: Calculate transfer function for constant, differential, integral, First order and Second order factors.

CO2: Illustrate the effect of poles and zero's in the 's' plane.

CO3: Select Symbolic equations for solving problems related with Matrices, Polynomial and vectors.

CO4: Compute the control expression for DC – DC buck converter using sliding mode control theory.

CO5: Determine the controller expression for power factor correction circuits

22EEPE605 PROCESS MODELING AND SIMULATION SEMESTER VI

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the important of mathematical models for Industrial processes.
- To acquaint students with different forms of mathematical models.
- To develop and simulate mathematical models for different Industrial processes.
- To apply mathematical tools while developing mathematical models.
- To analyze the graphical response of developed mathematical models.

UNIT I GENERAL PRINCIPLES OF MODELLING **9**

Introduction to mathematical modeling; Advantages and limitations of models and applications of process models of stand-alone unit operations and unit processes; Classification of models: Linear vs Nonlinear, Lumped parameter vs. Distributed parameter; Static vs. Dynamic, Continuous vs. Discrete; Numerical Methods: Iterative convergence methods, Numerical integration of ODE- IVP and ODEBVP.

UNIT II MODELLING OF DISTRIBUTED PROCESSES **9**

Steady state models giving rise to differential algebraic equation (DAE) systems; Rate based Approaches for staged processes; Modeling of differential contactors – distributed parameter models of packed beds; Packed bed reactors; Modeling of reactive separation processes; Review of solution strategies for Differential Algebraic Equations (DAEs), Partial Differential Equations (PDEs), and available numerical software libraries.

UNIT III INTRODUCTION TO PROCESS MODELLING **9**

Concept of degree of freedom analysis: System and its subsystem, System interaction, Degree of free domin a system e.g. Heat exchanger, Equilibrium still, Reversal of information flow, Design variable selection algorithm, Information flow through subsystems, Structural effects of design variable selection, Persistent Recycle.

UNIT IV MODELLING OF INDUSTRIAL PROCESSES **9**

Simple examples of process models; Models giving rise to nonlinear algebraic equation (NAE) systems, -steady state models of flash vessels, equilibrium staged processes distillation columns, absorbers, strippers, CSTR, heat exchangers, etc.; Review of solution procedures and available numerical software libraries.

UNIT V SIMULATION OF MATHEMATICAL MODELLING **9**

Simulation and their approaches, Modular, Sequential, Simultaneous and Equation solving approach, Simulation software's and their applications, Review of solution techniques and available numerical software libraries.- Case Studies.

Contact Periods:

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

REFERENCES:

1. Luyben W.L., "Process Modeling, Simulation, and Control for Chemical Engineering", McGraw Hill, 2nd Edition, 1990
2. D. F. Rudd and C. C. Watson, "Strategy of Process Engineering", Wiley international, 1st Edition, 1968.
3. M.M. Denn, "Process Modeling", Wiley, New York, 1st Edition, 1986.
4. A. K. Jana, "Chemical Process Modeling and Computer Simulation", PHI,3rd Edition, 2018
5. C.D. Holland, "Fundamentals of Modeling Separation Processes", Prentice Hall, 1st Edition, 1975.
6. Hussain Asghar, "Chemical Process Simulation", Wiley Eastern Ltd., New Delhi, 1st Edition, 1986.

COURSE OUTCOMES:

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

CO1: Understand different methods of developing models for industrial processes.

CO2: Build mathematical models by applying relevant mathematics.

CO3: Implement mathematical models using relevant software.

CO4: Effectively perform analysis and subsequent conclusion for the developed mathematical models.

CO5: Interpret the results obtained from the mathematical model in terms of originalreal world problem.

22EEPE606	**EMBEDDED PROCESSORS**	**SEMESTER VI**

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To introduce the architecture of the ARM processor.
- To train students in ARM programming.
- To discuss memory management, append location development with an ARM processor.
- To involve discussions/ practice/exercise in revising & familiarizing the concepts
- To impart the knowledge on single board embedded processors

UNIT-I: ARM ARCHITECTURE **9**

Architecture – Memory Organization – addressing modes -Registers – Pipeline - Interrupts - Coprocessors – Interrupt Structure.

UNIT-II: ARM MICROCONTROLLER PROGRAMMING **9**

ARM general Instruction set – Thumb instruction set –Introduction to DSP on ARM- basic programming.

UNIT-III: PERIPHERALS OF ARM **9**

ARM: I/O Memory – EEPROM – I/O Ports – SRAM –Timer –UART - Serial Communication with PC – ADC/DAC Interfacing-stepper motor interfacing.

UNIT-IV: ARM COMMUNICATION **9**

Introduction to ARM communication, ARM With CAN, I2C, and SPI protocols.

UNIT-V: INTRODUCTION TO SINGLE BOARD EMBEDDED PROCESSOR **9**

Raspberry Pi Architecture - Booting Up RPi- Operating System and Linux Commands – Working with RPi using Python and Sensing Data using Python - programming - GPIO and interfacing peripherals With Raspberry Pi.

Contact Periods:

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

REFERENCES:

1. Steve Furber, "ARM system on chip architecture", Addisonn Wesley,2nd Edition,2015.
2. Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield's, A"RM System Developer's Guide Designing and Optimizing System Software", Elsevier 2004, 1st Edition.
3. William Hohl, "ARM Assembly Language Fundamentals and Techniques", CRC Press, 2nd Edition 2014.
4. Rajkamal, "Microcontrollers Architecture, Programming, Interfacing, & System Design", Pearson,2012, 2nd Edition.
5. ARM Architecture Reference Manual, LPC214x User Manual www.Nuvoton .com/websites on Advanced ARM Cortex Processors
6. ARM System Developer's Guide: Designing and Optimizing System Software 1st Edition (Designing and Optimizing System Software) Publisher: Morgan Kaufmann Publishers, 2011

COURSE OUTCOMES:

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

CO1: Interpret the basics and functionality of processor functional blocks.
CO2: Observe the specialty of RISC processor architecture.
CO3: Incorporate the I/O hardware interface of processor with peripherals.
CO4: Emphasis the communication features of the processor.
CO5: Improved employability and entrepreneurship capacity due to knowledge up gradation on embedded processors.

22EEPE607 **POWER SYSTEM TRANSIENT** **SEMESTER VI**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the generation of switching transients and their control using circuit-theoretical concept
- To study the mechanism of lighting strokes and the protection 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**

Sources of different types of transients - RL circuit transient with sine wave excitation – double frequency transients - basic transforms of the RLC circuit transients - study of transients in system planning - Importance of grounding.

UNIT-II: SWITCHING TRANSIENTS **9**

Basic concept of switching transients - resistance switching and 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 with a restrike, with multiple restrikes - ferro resonance.

UNIT-III: LIGHTNING TRANSIENTS **9**

Theories of cloud formation - 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: TRAVELLING 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 - overvoltage 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. M.S.Naidu and V.Kamaraju, "High Voltage Engineering", Tata McGraw Hill, 5th Edition, 2013.
2. R.D. Begamudre, "Extra High Voltage AC Transmission Engineering", Wiley Eastern Limited,1986.
3. Y.Hase, "Handbook of Power System Engineering", Wiley India, 2012.
4. J.L.Kirtley, "Electric Power Principles, Sources, Conversion, Distribution and use", Wiley, 2012.
5. Allan Greenwood, "Electrical Transients in Power Systems", Wiley Inter Science, New York, 2nd Edition, 1991.
6. Pritindra Chowdhari, "Electromagnetic transients in Power System", John Wiley and Sons Inc., 2nd Edition, 2009.

COURSE OUTCOMES:

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

CO1: Explain the principles of transients and its concepts.
CO2: Know the different types of switching transients and the way to draw the necessary equivalent circuit.
CO3: Explain the concepts behind lighting and the way to protect the same.
CO4: Compute the transient behaviour in transmission line.
CO5: Explain the behaviour of the Circuit during switching and to learn the simulation tool.

22EEPE608 **HVDC AND FACTS** **SEMESTER VI**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the problems in AC transmission systems and DC transmission systems.
- The operation and control of SVC and TCSC.
- The concepts of IGBT based FACTS Controllers.
- The basic operation Line Commutated Converter (LCC) based HVDC links.
- The features of voltage source converter based HVDC link.

UNIT-I: ITRODUCTION **9**

Reactive power control in electrical power transmission lines–load & system compensation, Uncompensated transmission line–shunt and series compensation. Need for HVDC

Transmission, Comparison between AC & DC Transmission, Types of HVDC transmission System.

UNIT-II: STATIC VAR COMPENSATOR (SVC) AND THYRISTOR CONTROLLED SERIES COMPENSATOR (TCSC) **9**

VI characteristics of FC+TSR, TSC+TSR, Voltage control by SVC – Advantages of slope in dynamic characteristics – Influence of SVC on system voltage – Design of SVC voltage regulator, Thyristor Controlled Series Compensator (TCSC), Concept of TCSC, Operation of the TCSC – Different modes of operation, Applications:

UNIT-III: VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS **9**

Static Synchronous Compensator (STATCOM) – Principle of operation – V-I Characteristics. Applications: Steady state power transfer - enhancement of transient stability - prevention of voltage instability. SSSC - operation of SSSC VI characteristics, Enhancement in Power transfer capability – UPSC – Operation principle applications.

UNIT-IV: LINE COMMUTATED HVDC TRASMISSION **9**

Operation of Gratz bridge - Effect of delay in Firing Angle – Effect of commutation overlap - Equivalent circuit, Basic concept of HVDC transmission. Model of operations and control of power flow CC and CIA mode of operation

UNIT-V: VSC BASED HVDC TRANSMISSION **9**

Basic 2 level IGBT inverter operation - 4 Quadrant operation - phase angle control - dq control-Control of power flow in VSC based HVDC Transmission, Topologies of MTDC system.

Contact Periods:

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

REFERENCES:

1. K. R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Limited, Publishers, New Delhi, 2008
2. A.T. John," Flexible A.C. Transmission Systems", Institution of Electrical and Electronic Engineers(IEEE), 1999.
3. V. K. Sood, HVDC and FACTS controllers–Applications of Static Converters in Power System, APRIL 2004, Kluwer Academic Publishers, 2004
4. R. Mohan Mathur, Rajiv K.Varma, "Thyristor–Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons,Inc,2002.
5. Narain G. Hingorani, "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors, Delhi-110006,2011.

COURSE OUTCOMES:

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

CO1: Identify and understand the problems in AC transmission systems and understand the need for Flexible AC transmission systems and HVDC transmission.

CO2: Understand the operation and control of SVC and TCSC and its applications to enhance the stability and damping.

CO3: Analyze basic operation and control of voltage source converter based FACTS controllers.

CO4: Demonstrate basic operation and control of Line Commutated HVDC Transmission.
CO5: Explain the d-q control based operation of VSC based HVDC Transmission.

22EEPE609 **OPTIMAL CONTROL** **SEMESTER VI**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide an exposure to different type of optimal control problems such as time-optimal, fuel optimal, energy optimal control problems.
- To impart knowledge and skills needed to design Linear Quadratic Regulator for Time-invariant and Time-varying Linear system (Continuous time and Discrete-time systems).
- To introduce concepts needed to design optimal controller using Dynamic Programming Approach and H-J-B equation.
- To provide an exposure to various types of fault tolerant control schemes such as passive and active approaches.
- To introduce concepts needed to design optimal controller in the presence of state constraints and time optimal controller.

UNIT-I: CALCULUS OF VARIATIONS AND OPTIMAL CONTROL **9**

Introduction – Performance Index-Constraints – Formal statement of optimal control system – Calculus of variations – Function, Functional, Increment, Differential and variation and optimum of function and functional – The basic variation problem Extrema of functions and functional with conditions – variational approach to optimal control system

UNIT-II: LINEAR QUADRATIC OPTIMAL CONTROL SYSTEM **9**

Problem formulation – Finite time Linear Quadratic regulator – Infinite time LQR system: Time Varying case- Time-invariant case – Stability issues of Time-invariant regulator – Linear Quadratic Tracking system: Fine time case and Infinite time case

UNIT-III: DISCRETE TIME OPTIMAL CONTROL SYSTEMS **9**

Variational calculus for Discrete time systems – Discrete time optimal control systems: Fixed final state and open-loop optimal control and Free-final state and open-loop optimal control - Discrete time linear state regulator system - Steady state regulator system

UNIT-IV: PONTRYAGIN MINIMUM PRINCIPLE **9**

Pontryagin Minimum Principle – Dynamic Programming:- Principle of optimality, optimal control using Dynamic Programming – Optimal Control of Continuous time and Discrete-time systems–Hamilton-Jacobi-Bellman Equation–LQR system using H-J-B equation

UNIT-V: CONSTRAINED OPTIMAL CONTROL SYSTEMS **9**

Time optimal control systems – Fuel Optimal Control Systems - Energy Optimal Control Systems–Optimal Control Systems with State Constraints.

Contact Periods:

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

REFERENCES:

1. D. Subbaram Naidu, "Optimal Control Systems", CRC Press, NewYork, 2003, 1st Edition.
2. Frank L. Lewis, Draguna Vrabie, Vassilis L. Syrmos, Optimal Control,3rd Edition, Wiley Publication, 2012, 3rd Edition.
3. Yan Wang, Cheng-Lin Liu, Zhi Cheng Ji, "Quantitative Analysis and Optimal Control of Energy Efficiency in Discrete Manufacturing System", Springer, 2020, 1st Edition.
4. Donald E. Kirk, Optimal Control Theory – An Introduction, Dover Publications, Inc. Mineola, New York, 2012, 10th Edition.
5. https://www.ieee-ras.org/model-based-optimization-for robotics/resources/optimization-tools
6. https://www.codeproject.com/Articles/863257/Simple-Software-for-Optimal-Control

COURSE OUTCOMES:

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

CO1: Explain different type of optimal control problems such as time-optimal, fuel optimal, energy optimal control problems.

CO2: Design linear quadratic regulator for time-invariant and time-varying linear system (Continuous time and Discrete-time systems).
CO3: Design optimal controller using dynamic programming approach and H-J-B equation.
CO4: Explain the pontryagin minimum principle.
CO5: Explain different type of optimal control problems such as time-optimal, fuel optimal, energy optimal control problems.

22EEPE610 POWER SYSTEM OPERATION AND CONTROL SEMESTER VI

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- The significance of power system operation and control
- Real power– frequency interaction and design of power-frequency controller
- Reactive power– voltage interaction and the compensators for maintaining the voltage profile.
- The generation scheduling and economic operation of power system.
- SCADA and its application for real time operation and control of power systems.

UNIT-I: INTRODUCTION **9**

Power scenario in Indian grid – National and Regional load dispatching centres – Requirements of good power system – Necessity of voltage and frequency regulation – real power vs frequency and reactive power vs voltage control loops - System load variation, load curves – Load

forecasting – Computational methods in load forecasting – Load shedding and Islanding – deregulation - Basics of electrical energy tariff.

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

Basics of speed governing mechanisms and modeling – Speed regulation of two generators in parallel Load Frequency Control (LFC) of single area system – Static and dynamic analysis – LFC of two area system –Tie line modeling – Block diagram representation of two area system – Static and dynamic analysis – Tie line with frequency bias control – State variable model – Integration of economic dispatch control with LFC.

UNIT-III: REACTIVE POWER-VOLTAGE CONTROL **9**

Generation and absorption of reactive power – Basics of reactive power control – Automatic Voltage Regulator (AVR) – Brushless AC excitation system – Block diagram representation of AVR loop static and dynamic analysis – Stability compensation – Voltage drop in transmission line – Methods of reactive power injection – Tap changing transformer, SVC and STATCOM for voltage control.

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

Statement of economic dispatch problem – Input and output characteristics of thermal plant incremental cost curve – Optimal operation of thermal units without and with transmission losses (no derivation of transmission loss coefficients) – Lambda–iteration method – Base point and participation factors method. Statement of Unit Commitment (UC) problem – Constraints on UC problem – Solution of UC problem using priority list – Special aspects of short term and long-term hydrothermal scheduling problems

UNIT-V: COMPUTER AIDED CONTROL OF POWER SYSTEM **9**

Need of computer control of power system – Concept of energy control centers and functions – PMU system monitoring, Data acquisition and controls – System hardware configurations – SCADA and EMS functions – State estimation – Measurements and errors – Weighted least square estimation –Various operating states – State transition diagram.

Contact Periods:

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

REFERENCES:

1. Kothari D.P. and Nagrath I.J., "Power System Engineering", Tata McGraw– Hill Education, Second Edition, Reprint 2018.
2. Hadi Saadat, "Power System Analysis", McGraw Hill Education Pvt. Ltd., New Delhi, 23rd reprint, 2015.
3. Kundur P., "Power System Stability and Control", McGraw Hill Education Pvt. Ltd., New Delhi, 12th reprint, 2015.
4. B.M. Weedy, B.J. Cory et al, "Electric Power systems", Wiley, 5th Edition, 2012.
5. Olle. I. Elgerd, "Electric Energy Systems theory – An introduction", McGraw Hill Education Pvt.Ltd., New Delhi, 2nd edition, 2017.
6. Allen. J. Wood and Bruce F. Wollen berg, "Power Generation, Operation and Control", John Wiley & Sons, Inc., 3rd edition, 2013.

COURSE OUTCOMES:

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

CO1: Understand the day-to-day operation of power system.

CO2: Model and analyze the control actions that are implemented to meet the minute-to-minute variation of system real power demand.

CO3: Model and analyze the compensators for reactive power control and various devices used for voltage control.

CO4: Prepare day ahead and real time economic generation scheduling.

CO5: Understand the necessity of computer control of power systems.

22EEPE611 ENERGY MANAGEMENT AND AUDITING SEMESTER VI

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the concepts behind economic analysis and load management.
- To understand the basics of materials and energy balance.
- To analyze the energy efficiency in thermal utilities.
- To know the concept of compressed air system.
- To illustrate the concept of lighting systems and cogeneration.

UNIT-I: GENERAL ASPECTS OF ENERGY MANAGEMENT AND ENERGY AUDIT **9**

Commercial and Non-commercial energy - final energy consumption - energy needs of growing economy - energy pricing - energy conservation and its importance - Re-structuring of the energy supply sector - Energy Conservation Act 2001, Energy Conservation (Amendment) Act,

2010, and its features - electricity tariff - Thermal Basics - need and types of energy audit – Energy management/audit approach- understanding energy costs - maximizing system efficiencies -optimizing the input energy requirements - energy audit instruments - Case study.

UNIT-II: MATERIAL AND ENERGY BALANCE **9**

Methods for preparing process flow - material and energy balance diagrams - Energy policy purpose - location of energy management - roles and responsibilities of energy manager – employees training and planning- Financial Management: financial analysis techniques, simple payback period, return on investment, net present value, internal rate of return – Case Study.

UNIT-III: ENERGY EFFICIENCY IN THERMAL UTILITIES **9**

Introduction to fuels - properties of fuel oil, coal and gas - principles of combustion - combustion of oil, coal and gas - Boilers: Types, combustion in boilers, performances evaluation, analysis of losses - energy conservation opportunities - FBC boilers - Steam System: Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, condensate and flash steam recovery system, identifying opportunities for energy savings - Furnaces: Classification, general fuel economy measures in furnaces, excess air, heat distribution, temperature control, draft control, waste heat recovery – Refractory : types, selection and application of refractories, heat loss - Cogeneration: classification and saving potentials - Case Study.

UNIT-IV: ENERGY EFFICIENCY IN COMPRESSED AIR SYSTEM **9**

Compressed Air System: Types of air compressors - efficient compressor operation – Compressed air system components - leakage test - savings opportunities - Refrigeration System: Vapour compression refrigeration cycle – refrigerants - coefficient of performance - factors affecting Refrigeration and Air conditioning system - savings opportunities - Vapour absorption refrigeration system: working principle - types and comparison with vapour compression system – saving potential - Cooling Tower: Types and performance evaluation, efficient system operation – flow control strategies and energy saving - Diesel Generating system: Factors affecting selection - energy performance assessment of diesel conservation avenues - Case Study.

UNIT-V: ENERGY EFFICIENCY IN ELECTRICAL UTILITIES **9**

Electrical load management and maximum demand control - power factor improvement and its benefit - selection and location of capacitors - performance assessment of PF capacitors - automatic power factor controllers - transformer losses - Electric motors: Types - losses in induction motors - motor efficiency - factors affecting motor performance - rewinding and motor replacement issues - energy saving opportunities with energy efficient motors - soft starters with energy saver - variable speed drives – Fans and blowers: Types - efficient system operation – flow control strategies -Pumps and Pumping System: Types - system operation - flow control methods - Lighting System: Light source, choice of lighting, luminance requirements – ballast – occupancy sensors - energy efficient lighting controls - energy conservation avenues - Case Study.

Contact Periods:

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

REFERENCES:

1. Moncef Krati, "Energy Audit of Building Systems: An Engineering Approach", Third Edition, CRC Press, Dec, 2020.
2. Sonal Desai, "Handbook of Energy Audit", McGraw Hill Education (India) Private Limited,2015
3. Michael P.Deru, Jim Kelsey, "Procedures for Commercial Building Energy Audits", American Society of Heating, Refrigerating and Air conditioning Engineers,2011.
4. Thomas D.Eastop, "Energy Efficiency: For Engineers and Technologists", Longman Scientific & Technical, 1990, 1st Edition.
5. "Energy Managers and Energy Auditors Guide book", Bureau of Energy Efficiency,2006.
6. Larry C. Witte, Philip S.Schmidt, David R.Brown, "Industrial Energy Management and Utilization", Springer Berlin Heidelberg, 1988.

COURSE OUTCOMES:

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

CO1: Students able to acquire knowledge in the field of energy management and auditing process.
CO2: Learned the about basic concepts of economic analysis and load management.
CO3: Able to design the effective thermal utility system.
CO4: Able to improve the efficiency in compressed air system.
CO5: Acquired the design concepts in the field of lighting systems, light sources and various forms of cogeneration.

22EEPE612 PROTECTION AND SWITCHGEAR SEMESTER VI

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the significance of protection, protection schemes and role of earthing.
- To study the characteristics, functions and application areas of various relays.
- To acquire practical knowledge about common faults in power system apparatus and applying suitable protective schemes.
- To understand the functioning of static relays and Numerical protection concepts.
- To understand the problems associated with circuit breaking and to discuss about various circuit breakers.

UNIT-I: PROTECTION SCHEMES **9**

Significance and need for protective schemes – nature and causes of faults – types of faults Effects of faults - Zones of protection and essential qualities of protection – Types of Protection schemes - Power system Grounding and Methods of Grounding.

UNIT-II: BASICS OF RELAYS **9**

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

UNIT-III: OVERVIEW OF EQUIPMENT PROTECTION **9**

Current transformers and Potential transformers and their applications in protection schemes - Protection of transformer, generator, motor, bus bars and transmission line.

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

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

UNIT-V: CIRCUIT BREAKERS **9**

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

Contact Periods:

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

REFERENCES:

1. Sunil S.Rao, "Switchgear and Protection", Khanna Publishers, New Delhi, Four Edition, 2010.
2. Badri Ram, B.H. Vishwakarma, "Power System Protection and Switchgear", New Age International Pvt Ltd Publishers, Second Edition 2011.
3. B.Rabindranath and N.Chander, "Power System Protection and Switchgear", New Age International Pvt Ltd., Second Edition, 2018.
4. VK Metha, "Principles of Power Systems", S. Chand, Reprint, 2013
5. Y.G.Paithankar and S.R.Bhide, "Fundamentals of power system protection", Second Edition,Prentice Hall of India Pvt. Ltd., New Delhi, 2013.
6. C.L.Wadhwa, "Electrical Power Systems", 6th Edition, New Age International Pvt Ltd., 2018

COURSE OUTCOMES:

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

CO1: Understand and select proper protective scheme and type of earthing.

CO2: Explain the operating principles of various relays.

CO3: Suggest suitable protective scheme for the protection of various power system apparatus.

CO4: Analyze the importance of static relays and numerical relays in power system protection.

CO5: Summarize the merits and demerits and application areas of various circuit breakers.

22EEPE613 EMBEDDED CONTROL FOR ELECTRICAL DRIVES **SEMESTER VI**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide the control concept for electrical drives
- To emphasize the need of embedded systems for controlling the electrical drives
- To provide knowledge about various embedded system-based control strategies for Induction motor
- To provide knowledge about various embedded system-based control strategies for BLDC motor.
- To emphasize the need of embedded systems for controlling the SRM drive.

UNIT-I: INTRODUCTION TO ELECTRIC DRIVES **9**

Electric drives and its classification-Four-quadrant drive-Solid State Controlled Drives-Machine learning and optimization techniques for electrical drives.

UNIT-II: EMBEDDED SYSTEM FOR MOTOR CONTROL **9**

Embedded Processors choice for motor control- Sensors and interface modules for Electric drives- IoT for Electrical drives applications.

UNIT-III: INDUCTION MOTOR CONTROL **9**

Speed control methods-PWM techniques- VSI fed three-phase induction motor- Fuzzy logic Based speed control for three-phase induction motor- Embedded processor based three phase induction motor speed control.

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UNIT-IV: BLDC MOTOR CONTROL **9**

Overview of BLDC Motor -Speed control methods -PWM techniques- Embedded processor based BDLC motor speed control.

UNIT-V: SRM MOTOR CONTROL **9**

Overview of SRM Motor -Speed control methods -PWM techniques- Embedded processor based SRM motor speed control.

Contact Periods:

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

REFERENCES:

1. R.Krishnan, "Electric Motor Drives – Modeling, Analysis and Control",Prentice-Hall of India Pvt. Ltd., New Delhi,2010, 1st Edition.
2. Steve Kilts, "Advanced FPGA Design: Architecture, Implementation, and Optimization" Willey, 2007, 1st Edition.
3. Vedam Subramanyam, "Electric Drives – Concepts and Applications", Tata McGraw- Hill publishing company Ltd., New Delhi, 2002, 2nd Edition.
4. K. Venkataratnam, Special Electrical Machines, Universities Press, 2014, 1st Edition.
5. Steve Furber, 'ARM system on chip architecture', Addision Wesley, 2nd Edition 2015.
6. Ron Sass and Anderew G.Schmidt, "Embedded System design with platform FPGAs: Principles and Practices", Elsevier, 2010, 1st Edition.

COURSE OUTCOMES:

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

CO1: Understand the concept of electric drives
CO2: Interpret the significance of embedded control of electrical drives
CO3: Deliver insight into various control strategies for induction motor control
CO4: Develop embedded system solutions for BLDC motor control
CO5: Develop embedded system solutions for SRM motor control

22EEPE614 EMBEDDED SYSTEM FOR AUTOMOTIVE APPLICATIONS **SEMESTER VI**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To expose the students to the fundamentals and building of Electronic Engine Control systems.
- To teach on sensor functional components for vehicles.
- To discuss on programmable controllers for vehicles management systems.
- To teach logics of automation & communication techniques for vehicle communication.
- To introduce the infotainment system development.

UNIT-I: INTRODUCTION TO AUTOMOTIVE SYSTEMS **9**

Overview of Automotive systems, fuel economy, air-fuel ratio, emission limits and vehicle performance; Electronic control Unit– open-source ECU.

UNIT-II: SENSORS AND ACTUATORS FOR AUTOMOTIVES **9**

Review of automotive sensors- sensors interface to the ECU, Smart sensor and actuators for automotive applications.

UNIT-III: VEHICLE MANAGEMENT SYSTEMS **9**

Energy Management system -Adaptive cruise control - anti-locking braking system - Safety and Collision Avoidance.

UNIT-IV: ONBOARD DIAGONSTICS AND COMMUNICATION **9**

OBD , Vehicle communication protocols- Bluetooth, CAN, LIN, FLEXRAY and MOST.

UNIT-V: RECENT TRENDS **9**

Navigation- Autonomous car- Role of IoT in Automotive systems.

Contact Periods:

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

REFERENCES:

1. William B. Ribbens, "Understanding Automotive Electronics", Elseiver,8th Edition, 2017.
2. L.Vlacic,M.Parent,F.Harahima, "Intelligent Vehicle Technologies",SAE International, 2001, 1st Edition, 2017.
3. Automotive Electricals / Electronics System and Components, Tom Denton, 5th Edition, 2017.
4. Automotive Hand Book, Robert Bosch, Bently Publishers, 10th Edition, 2018.
5. Automotive Electricals Electronics System and Components, Robert Bosch Gmbh, 5th Edition, 2014.
6. Jack Erjavec,JeffArias,"Alternate Fuel Technology-Electric ,Hybrid& Fuel Cell Vehicles",Cengage ,2012, 2nd Edition.

COURSE OUTCOMES:

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

CO1: Insight into the significance of the role of embedded system for automotive applications.

CO2: Illustrate the need, selection of sensors and actuators and interfacing with ECU.

CO3: Develop the Embedded concepts for vehicle management and control systems.

CO4: Demonstrate the need of Electrical vehicle and able to apply the embedded system technology for various aspects of Evs.

CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design and its application in automotive systems.

22EEPE614 ELECTRIC VEHICLE DESIGN, MECHANICS AND CONTROL **SEMESTER VI**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn the basics of EV and vehicle mechanics
- To know the EV architecture
- To study the energy storage system concepts
- To derive model for batteries and to know the different types of batteries and itscharging methods
- To learn the control preliminaries for DC-DC converters.

UNIT I: INTERNAL COMBUSTION ENGINES **9**

IC Engines, BMEP and BSFC, Vehicle Fuel Economy, Emission Control Systems, Treatment of Diesel Exhaust Emissions.

UNIT II: ELECTRIC VEHICLES AND VEHICLE MECHANICS **9**

Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings- Comparisons of EV with internal combustion Engine vehicles- Fundamentals of vehicle mechanics.

UNIT III: BATTERY MODELING, TYPES AND CHARGING **9**

Batteries in Electric and Hybrid Vehicles - Battery Basics -Battery Parameters. Types- Lead Acid Battery - Nickel-Cadmium Battery - Nickel-Metal-Hydride (NiMH) Battery - Li-Ion Battery - Li-Polymer Battery, Zinc-Air Battery, Sodium-Sulphur Battery, Sodium-Metal-Chloride, Research and Development for Advanced Batteries. Battery Modelling, Electric Circuit Models. Battery Pack Management, Battery Charging.

UNIT IV: CONTROL PRELIMINARIES **9**

Control Design Preliminaries - Introduction - Transfer Functions – Bode plot analysis for First order and second order systems - Stability - Transient Performance- Power transfer function for boost converter - Gain margin and Phase margin study-open loop mode.

UNIT V: CONTROL OF AC MACHINES **9**

Introduction- Reference frame theory, basics-modeling of induction and synchronous machine in various frames-Vector control- Direct torque control.

Contact Periods:

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

REFERENCES:

1. Electric and Hybrid Vehicles, Design Fundamentals, Third Edition, Iqbal Husain, CRC Press,2021.
2. Power Electronic Converters,: Dynamics and Control in Conventional and Renewable EnergyApplications, Teuvo Suntio, Tuomas Messo, Joonas Puukko, 1st Edition, Wiley - VCH.
3. Ali Emadi, Mehrdad Ehsani, John M.Miller, "Vehicular Electric Power Systems", Special IndianEdition, Marcel dekker, Inc 2003, 1st Edition.
4. C.C. Chan and K.T. Chau, 'Modern Electric Vehicle Technology', OXFORD University Press,2001, 1st Edition.
5. Wie Liu, "Hybrid Electric Vehicle System Modeling and Control", Second Edition, John Wiley &Sons, 2017, 2nd Edition
6. Electrical Machine Fundamentals with Numerical Simulation using MATLAB/ SIMULINK, AtifIqbal, Shaikh Moinoddin, Bhimireddy Prathap Reddy, Wiley, 2021, 1st Edition.

COURSE OUTCOMES:

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

CO1: Describe the concepts related with internal combustion engine vehicles

CO2: Describe the concepts related with EV and HEV

CO3: Explain the concepts related with batteries and parameters of battery

CO4: Find gain margin & phase margin for various types of transfer functions of boost converter

CO5: Demonstrate the control of A C Machines