

P. A. COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution, Affiliated to Anna University, Chennai)

**An ISO 9001:2015 Certified Institution - Accredited by NBA and NAAC with 'A' Grade
Pollachi – 642 002**



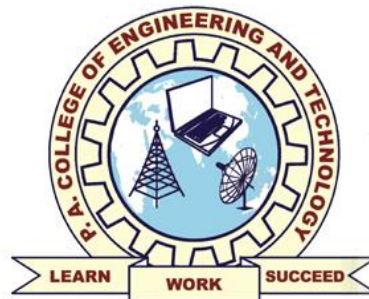
B. E. ELECTRICAL AND ELECTRONICS ENGINEERING

CURRICULA AND SYLLABI

(I to VIII Semester)

REGULATIONS

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	22CAHS604	Professional Ethics in Engineering	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

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.

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.

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.

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.

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.

22EES106

**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.

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 3
– SCULPTU**

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 3
MOVEMENT AND INDIAN CULTURE**

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.

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.

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.

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.

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 $[F(p,q) = 0 \text{ and } z = px + qy + f(p,q)]$ - 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.

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.

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.

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: CO₂ - 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", 4th Edition, 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.

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 (T_g) – significance - factors affecting T_g , 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.

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.

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.

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.

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: 15Periods Practical: 0 Periods Total: 60Periods

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.

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: 15Periods Practical: 0 Periods Total: 60Periods

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 fields and 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

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.

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

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 transformers
- 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 transformers
- CO5:** Perform the testing of DC machines and transformers

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

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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.

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.

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: 15Periods Practical: 0 Periods Total: 60Periods

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.

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 India Pvt. 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 Coffey, '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.

22EEPC403	MEASUREMENTS AND INSTRUMENTATION	SEMESTER IV
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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, Elsevier, 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.

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 X_d and X_q .

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 performance of synchronous 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.

COURSE OBJECTIVES:

- To learn and understand the fabrication of ICs.
- To acquire knowledge about the 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		
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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. Deshmukh 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..

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

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COURSE OBJECTIVES:

- To know 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 SEMESTER IV
LABORATORY**

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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.

COURSE OBJECTIVES:

- To impart 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.

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.

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

REFERENCES:

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.

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
- Mathematical modeling and simulation of physical systems in two fields.
 6. 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.

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

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.

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 knowledge about various types of inverters and PWM techniques.
- CO5:** Acquire knowledge about various types of AC voltage controllers.

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

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.

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.

COURSE OBJECTIVES:

- To understand various types of over voltages in power system and protection methods.
- To understand Generation of over voltages in laboratories.
- To enhance measurement of over voltages.
- To learn the nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
- To test the power apparatus and insulation coordination

UNIT-I: OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS 9

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary overvoltages, Corona and its effects – Reflection and Refraction of Travelling waves - Protection against overvoltages.

UNIT-II: DIELECTRIC BREAKDOWN 9

Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality – Breakdown mechanisms in solid and composite dielectrics.

UNIT-III: GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS 9

Generation of High DC, AC, impulse voltages and currents – Triggering and control of impulse generators.

UNIT-IV: MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS 9

High Resistance with series ammeter – Dividers, Resistance, Capacitance and Mixed dividers – Peak Voltmeter, Generating Voltmeters – Capacitance Voltage Transformers, Electrostatic Voltmeters Sphere Gaps – High current shunts – Digital techniques in high voltage measurement.

UNIT-V: HIGH VOLTAGE TESTING & INSULATION COORDINATION 9

High voltage testing of electrical power apparatus as per International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators and transformers – Insulation Coordination.

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. E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals', Newnes 2nd Edition, Elsevier, New Delhi, 2005.
3. C.L. Wadhwa, 'High voltage Engineering', New Age International Publishers, 4th Edition, 2020.
4. L.L.Alston, High Voltage Technology, Oxford University Press, 1st Indian Edition 2006.

5. Subir Ray, ' An Introduction to High Voltage Engineering' PHI Learning Private Limited, New Delhi, 2nd Edition, 2013.
6. Mazen Abdel – Salam, Hussein Anis, Ahdab A-Morshedy, RoshdayRadwan, High Voltage Engineering – Theory &Practice, 2nd Edition, Taylor & Francis Gourp, 2019

COURSE OUTCOMES:

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

- CO1:** Explain various overvoltage's and its effects on power systems.
- CO2:** Understand the breakdown phenomena in different medium under uniform and non-uniform fields.
- CO3:** Explain the methods of generating and measuring high DC, AC, Impulse voltage and currents.
- CO4:** Suggest and conduct suitable HV testing of electrical power apparatus as per Standards
- CO5:** Examine the test power apparatus and insulation coordination

COURSE OBJECTIVES:

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

UNIT-I: HUMAN VALUES**9**

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

UNIT-II: ENGINEERING ETHICS**9**

Senses of ‘Engineering Ethics’ – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg’s theory – Gilligan’s theory – Consensus and controversy – Models of professional roles – Theories about right action – Self-interest – Customs and Religion – Uses of ethical theories. .

UNIT-III: ENGINEERING AS SOCIAL EXPERIMENTATION**9**

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

UNIT-IV: SAFETY, RESPONSIBILITIES AND RIGHTS**9**

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

UNIT-V: GLOBAL ISSUES**9**

Multinational corporations – Environmental ethics – Computer ethics – Weapons development – Engineers as managers – Consulting Engineers – Engineers as expert witnesses and advisors – Moral leadership – Code of conduct – Corporate social responsibility.

Contact Periods:

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

REFERENCES:

1. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, —Engineering Ethics – Concepts and Cases, Cengage Learning, 2009. .
2. Govindarajan M., Natarajan S. and Senthil Kumar V. S., —Engineering Ethics, Prentice Hall of India, New Delhi, 2004.
3. Charles B. Fleddermann, —Engineering Ethics, Pearson Prentice Hall, New Jersey, 2004.

4. John R. Boatright, —Ethics and the Conduct of Business, Pearson Education, New Delhi, 2003
5. Laura P. Hartman and Joe Desjardins, —Business Ethics: Decision Making for Personal Integrity and Social Responsibility, Mc Graw Hill education, India Pvt.
6. Mike W. Martin and Roland Schinzinger, —Ethics in Engineering, Tata McGraw Hill, New Delhi, 2003.
7. Edmund G. and Robert L. Barry, —Fundamentals of Ethics for Scientists and Engineers, Oxford University Press, 2001.

COURSE OUTCOMES:

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

CO1: Apply human values.

CO2: Apply ethical issues related to Engineering.

CO3: Realize the code of Ethics.

CO4: Realize the responsibilities and rights in the society.

CO5: Know Global Issues.

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MINI PROJECT

SEMESTER VII

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COURSE OBJECTIVES:

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

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

Contact Periods:

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

COURSE OUTCOMES:

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

- CO1:** Identify, formulate, design, interpret, analyze and provide solutions to complex engineering and societal issues by applying knowledge gained on basics of science and Engineering.
- CO2:** Choose, conduct and demonstrate a sound technical knowledge of their selected project topics in the field of power components, protection, high voltage, electronics, process automation, power electronics and drives instrumentation and control by exploring suitable engineering and IT tools.
- CO3:** Understand, formulate and propose new learning algorithms to solve engineering and societal problems of moderate complexity through multidisciplinary projects understanding commitment towards sustainable development.
- CO4:** Demonstrate, prepare reports, communicate and work in a team as a member/leader by adhering to ethical responsibilities.
- CO5:** Acknowledge the value of continuing education for oneself and to stay up with technology advancements.

COURSE OBJECTIVES:

- To sketch the evolution of management.
- To extract the functions and principles of management.
- To learn the application of the principles in an organization.
- To study the various HR related activities.
- To analyze the position of self and company goals towards business

UNIT-I: INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager Vs Entrepreneur- types of managers- managerial roles and skills – Evolution of Management –Scientific, human relations, system and contingency approaches– Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises- Organization culture and Environment – Current trends and issues in Management.

UNIT-II: PLANNING 9

Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT-III: ORGANISING 9

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

UNIT-IV: DIRECTING 9

Foundations of individual and group behaviour– Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT.

UNIT-V: CONTROLLING 9

System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.

Contact Periods:

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

REFERENCES:

1. Harold Koontz and Heinz Weihrich “Essentials of management” Tata McGraw Hill,1998.
2. Stephen P. Robbins and Mary Coulter, “Management”, Prentice Hall (India) Pvt. Ltd., 10th Edition, 2009.

3. Robert Kreitner and Mamata Mohapatra, “ Management”, Biztantra, 2008.
4. Stephen A. Robbins and David A. Decenzo and Mary Coulter, “Fundamentals of Management” Pearson Education, 7th Edition, 2011
5. Tripathy PC and Reddy PN, “Principles of Management”, Tata Mcgraw Hill, 1999.

COURSE OUTCOMES:

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

- CO1:** Have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling.
- CO2:** Have same basic knowledge on international aspect of management
- CO3:** Understand management concept of organizing.
- CO4:** Understand management concept of directing.
- CO5:** Understand management concept of controlling.

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PROJECT WORK

SEMESTER VIII

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COURSE OBJECTIVES:

- The student should be made to learn methodology to select a good project and able to work in a team leading to development of hardware/software product.prepare a good technical report. Gain motivation to present the ideas behind the project with clarity.

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

Contact Periods:

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

COURSE OUTCOMES:

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

- CO1:** Identify, formulate, design, interpret, analyze and provide solutions to complex engineering and societal issues by applying knowledge gained on basics of science and Engineering.
- CO2:** Choose, conduct and demonstrate a sound technical knowledge of their selected project topics in the field of power components, protection, high voltage, electronics, process automation, power electronics and drives instrumentation and control by exploring suitable engineering and IT tools.
- CO3:** Understand, formulate and propose new learning algorithms to solve engineering and societal problems of moderate complexity through multidisciplinary projects understanding commitment towards sustainable development.
- CO4:** Demonstrate, prepare reports, communicate and work in a team as a member/leader by adhering to ethical responsibilities.
- CO5:** Acknowledge the value of continuing education for oneself and to stay up with technology advancements.

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.

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.

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.

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.

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.

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 clamped and diode clamped MLI with R and RL load.
- CO5:** Examine MLI with reduced switch configuration using fundamental switching scheme

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. Schaffer 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

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.

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

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 original real world problem.

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”, Addison Wesley, 2nd Edition, 2015.
2. Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield’s, “ARM 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.

COURSE OBJECTIVES:

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

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: INTRODUCTION**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 TRANSMISSION**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.

COURSE OBJECTIVES:

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

UNIT-I: CALCULUS OF VARIATIONS AND OPTIMAL CONTROL 9

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

UNIT-II: LINEAR QUADRATIC OPTIMAL CONTROL SYSTEM 9

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

UNIT-III: DISCRETE TIME OPTIMAL CONTROL SYSTEMS 9

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

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, New York, 2003, 1st Edition.

2. Frank L. Lewis, Draguna Vrabie, Vassilis L. Syrmos, Optimal Control, 3rd Edition, Wiley Publication, 2012, 3rd Edition.
3. Yan Wang, Cheng-Lin Liu, Zhi Cheng Ji, “Quantitative Analysis and Optimal Control of Energy Efficiency in Discrete Manufacturing System”, Springer, 2020, 1st Edition.
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.

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.

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.

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.

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.

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', Addison Wesley, 2nd Edition 2015.

6. Ron Sass and Andrew 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

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 DIAGNOSTICS 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.

22EEPE615 ELECTRIC VEHICLE DESIGN, MECHANICS AND CONTROL SEMESTER VI

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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 its charging 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-Hydrate (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 Energy Applications, Teuvo Suntio, Tuomas Messo, Joonas Puukko, 1st Edition, Wiley - VCH.
3. Ali Emadi, Mehrdad Ehsani, John M.Miller, “Vehicular Electric Power Systems”,

- Special Indian Edition, Marcel dekker, Inc 2003, 1st Edition.
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, Atif Iqbal, 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

22EEPE701

ELECTRIC VEHICLE ARCHITECTURE

SEMESTER VII

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COURSE OBJECTIVES:

- To learn the structure of Electric Vehicle, Hybrid Electric Vehicle
- To study about the EV conversion components
- To know about the details and specifications for Electric Vehicles
- To understand the concepts of Plug-in Hybrid Electric Vehicle
- To model and simulate all types of DC motors

UNIT-I: VEHICLE ARCHITECTURE and SIZING **9**

Electric Vehicle History, and Evolution of Electric Vehicles. Series, Parallel and Series parallel Architecture, Micro and Mild architectures. Mountain Bike - Motorcycle- Electric Cars and Heavy Duty EVs. -Details and Specifications.

UNIT-II: VEHICLE MECHANICS **9**

Vehicle mechanics- Roadway fundamentals, Laws of motion, Vehicle Kinetics, Dynamics of vehicle motion, propulsion power, velocity and acceleration, Tire –Road mechanics, Propulsion System Design.

UNIT-III: POWER COMPONENTS AND BRAKES **9**

Power train Component sizing- Gears, Clutches, Differential, Transmission and Vehicle Brakes. EV power train sizing, HEV Powertrain sizing, Example.

UNIT-IV: HYBRID VEHICLE CONTROL STRATEGY **9**

Vehicle supervisory control, Mode selection strategy, Modal Control strategies.

UNIT-V: PLUG-IN HYBRID ELECTRIC VEHICLE **9**

Introduction-History-Comparison with electrical and hybrid electrical vehicle-Construction and working of PHEV-Block diagram and components-Charging mechanisms-Advantages of PHEVs

Contact Periods:

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

REFERENCES:

1. Mehrdad Ehsani, YiminGao, Sebastian E. Gay, Ali Emadi, 'Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design', CRC Press, 2004.
2. Build Your Own Electric Vehicle, Seth Leitman , Bob Brant, McGraw Hill, Third Edition 2013.
3. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press, First edition 2017.
4. The Electric Vehicle Conversion Handbook: How to Convert Cars, Trucks, Motorcycles, and Bicycles -- Includes EV Components, Kits, and Project Vehicles Mark Warner, HP Books, 2011.
5. Heavy-duty Electric Vehicles from Concept to Reality, Shashank Arora, Alireza Tashakori Abkenar, Shantha Gamini Jayasinghe, Kari Tammi, Elsevier Science, 2021

6. Hybrid Electric Vehicles: A Review of Existing Configurations and Thermodynamic Cycles, Rogelio León , Christian Montaleza , José Luis Maldonado , Marcos Tostado-Véliz and Francisco Jurado, Thermo, 2021, 1, 134–150. <https://doi.org/10.3390/thermo1020010>.

COURSE OUTCOMES:

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

- CO1:** Summarize the History and Evolution of EVs, Hybrid and Plug-In Hybrid EVs
- CO2:** Describe the various EV components
- CO3:** Describe the concepts related in the Plug-In Hybrid Electric Vehicles
- CO4:** Analyze the details and Specifications for the various EVs developed
- CO5:** Describe the hybrid vehicle control strategy.

COURSE OBJECTIVES:

- To understand steady state operation and transient dynamics of a motor load system.
- To study and analyze the operation of the converter / chopper fed dc drive, both qualitatively and quantitatively.
- To study and understand the operation and performance of AC Induction and synchronous motor drives.
- To study and understand the operation of rotor side control of Induction motor drives.
- To analyze and design the current and speed controllers for a closed loop solid state DC motor drives

UNIT-I: DRIVE CHARACTERISTICS 9

Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, starting & stopping – typical load torque characteristics – Selection of motor.

UNIT-II: CONVERTER / CHOPPER FED DC MOTOR DRIVE 9

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

UNIT-III: SPEED CONTROL OF AC MOTORS 9

Speed control of AC motors – Speed / Torque characteristics – Braking methods. AC-AC controller fed AC drives, inverter fed AC drives, frequency control, V/F control of induction and synchronous motor – Self control, margin angle control and power factor control.

UNIT-IV: ROTOR SIDE CONTROL OF FREQUENCY CONTROLLED INDUCTION MOTOR DRIVES 9

Rotor side control of slip ring induction motor with thyristor chopper – Static control of rotor resistance – Slip-energy recovery scheme – Static scherbius and kramer systems – Applications of microprocessor to AC motor speed control.

UNIT-V: DESIGN OF CONTROLLERS FOR DRIVES 9

Transfer function for DC motor / load and converter – closed loop control with current and speed feedback – armature voltage control and field weakening mode – design of controllers; current controller and speed controller-converter selection and characteristics.

Contact Periods:

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

REFERENCES:

1. S.K.Pillai, A First course on Electrical Drives, Wiley Eastern Limited, 3rd Edition 2012.
2. Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 2nd Edition January 2010.

3. Bimal K.Bose. Modern Power Electronics and AC Drives, Pearson Education, 2002 1st Edition.
4. Murphy J.M.D and Turnbull, Thyristor Control of AC Motor, Pergamon Press, Oxford 1988, 1st Edition.
5. R.Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Prentice hall of India, 2001, 1st Edition.

COURSE OUTCOMES:

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

- CO1:** Understand the basic requirements of motor selection for different load profiles.
- CO2:** Analyse the steady state behavior and stability aspects of drive systems.
- CO3:** Analyse the dynamic performance of the DC drive using converter and chopper control.
- CO4:** Analyse the AC drive
- CO5:** Design the controller for electrical drives.

COURSE OBJECTIVES:

- To understand the working of special machines like stepper motor, switched reluctance motor, BLDC motor & PMSM
- To derive torque equation and study the characteristics of special machines
- To design the controller for special machines
- To study the working principle of synchronous reluctance motor
- To simulate closed loop operation of BLDC motor

UNIT-I: STEPPER MOTORS**9**

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

UNIT-II: SWITCHED RELUCTANCE MOTORS**9**

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

UNIT-III: PERMANENT MAGNET BRUSHLESS DC MOTORS**9**

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

UNIT-IV: PERMANENT MAGNET SYNCHRONOUS MOTORS**9**

Principle of operation – EMF, power input and torque expressions – Phasor diagram – Power controllers – Torque – Speed characteristics – Self control – Vector control – Current control schemes- Constructional features, operating principle and characteristics of synchronous reluctance motor.

UNIT-V: STUDY OF OTHER SPECIAL ELECTRICAL MACHINES**9**

Principle of operation and characteristics of Hysteresis motor – AC series motors – Linear motor – Applications.

Contact Periods:

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

REFERENCES:

1. Bilgin, Berker Emadi, Ali Jiang, James Weisheng - Switched reluctance motor drives: fundamentals to applications-CRC 2019.
2. R. Krishnan - Switched Reluctance Motor Drives Modeling, Simulation, Analysis, Design, and Applications -CRC Press 2017.
3. Ramu Krishnan - Permanent Magnet Synchronous and Brushless DC Motor Drives -CRC Press, Marcel Applications -CRC Press 2009.

4. T.Kenjo, 'Stepping motors and their microprocessor controls', Oxford University press, New Delhi, 2000 Dekker 2009.
5. Jacek F. Gieras, Dr. Rong-Jie Wang, Professor Maarten J. Kamper - Axial Flux Permanent Magnet Brushless Machines-Springer Netherlands 2008.
6. T.J.E. Miller, 'Brushless magnet and Reluctance motor drives', Clarendon press, London, 1989.

COURSE OUTCOMES:

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

- CO1:** Model and analyze power electronic systems and equipment using computational software.
- CO2:** Optimally design magnetics required in special machines based drive systems using FEM based software tools.
- CO3:** Analyse the dynamic performance of special electrical machines
- CO4:** Understand the operation and characteristics of other special electrical machines.
- CO5:** Design and conduct experiments towards research.

COURSE OBJECTIVES:

- To know the charging station and standards
- To learn the concepts of power converters in charging
- To find the charging scheme in renewable based EV charging
- To demonstrate the wireless power transfer technique
- To design & simulate power factor correction circuits

UNIT-I: CHARGING STATIONS AND STANDARDS 9

Introduction-Charging technologies- Conductive charging, EV charging infrastructure, International standards and regulations - Inductive charging, need for inductive charging of EV, Modes and operating principle, Static and dynamic charging, Bidirectional power flow, International standards and regulations

UNIT-II: POWER ELECTRONICS FOR EV CHARGING 9

Layouts of EV Battery Charging Systems-AC charging-DC charging systems- Power Electronic Converters for EV Battery Charging- AC-DC converter with boost PFC circuit, with bridge and without bridge circuit - Bidirectional DC-DC Converters- Non-isolated DC-DC bidirectional converter topologies- Half-bridge bidirectional converter.

UNIT-III: EV CHARGING USING RENEWABLE AND STORAGE SYSTEMS 9

Introduction- - EV charger topologies , EV charging/discharging strategies - Integration of EV charging-home solar PV system , Operation modes of EVC-HSP system , Control strategy of EVC- HSP system - fast-charging infrastructure with solar PV and energy storage.

UNIT-IV: WIRELESS POWER TRANSFER 9

Introduction - Inductive, Magnetic Resonance, Capacitive types. Wireless Chargers for Electric Vehicles - Types of Electric Vehicles - Battery Technology in EVs -Charging Modes in EVs - Benefits of WPT. - WPT Operation Modes - Standards for EV Wireless Chargers, SAE J2954, IEC 61980. ISO 19363

UNIT-V: POWER FACTOR CORRECTION IN CHARGING SYSTEM 9

Need for power factor correction- Boost Converter for Power Factor Correction, Sizing the Boost Inductor, Average Currents in the Rectifier and calculation of power losses

Contact Periods:

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

REFERENCES:

1. Mobile Electric Vehicles Online Charging and Discharging, Miao Wang Ran Zhang Xuemin (Sherman) Shen, Springer 2016, 1st Edition.
2. Alicia Triviño-Cabrera, José M. González-González, José A. Aguado, Wireless Power Transferor Electric Vehicles: Foundations and Design Approach, Springer Publisher 1st Edition. 2020.

3. Nil Patel, Akash Kumar Bhoi, Sanjeevikumar Padmanaban, Jens Bo Holm-Nielsen, Electric Vehicles Modern Technologies and Trends. Springer Publisher 1st Edition, 2021.
4. Cable Based and Wireless Charging Systems for Electric Vehicles, Technology and control, management and grid integration, Rajiv Singh, Sanjeevikumar Padmanaban, Sanjeet Dwivedi, Marta Molinas and Frede Blaabjerg, IET 2021, 1st Edition.
5. Electric and Hybrid Electric Vehicles, James D Halderman, Pearson, 2022, 1st Edition.
6. Handbook of Automotive Power Electronics and Motor Drives, Ali Emadi, Taylor & Francis, 2005.

COURSE OUTCOMES:

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

- CO1:** Illustrate various charging techniques and to know charging standards and regulations.
- CO2:** Demonstrate the working of DC-DC converters used for charging systems and principles
- CO3:** Illustrate the advantages of renewable system based charging systems
- CO4:** Demonstrate the principles of wireless power transfer.
- CO5:** Design the boost converter based power factor correction.

COURSE OBJECTIVES:

- To know various standardization procedures
- To learn the testing procedures for EV & HEV components
- To know the functional safety and EMC
- To realize the effect of EMC in EVs
- To study the effect of EMI in motor drives and in DC-DC converter system

UNIT I: EV STANDARDIZATION**9**

Introduction - Current status of standardization of electric vehicles, electric Vehicles and Standardization - Standardization Bodies Active in the Field – Standardization activities in countries like Japan. The International Electro Technical Commission - Standardization of Vehicle Components.

UNIT II: TESTING OF ELECTRIC MOTORS AND CONTROLLERS FOR ELECTRIC AND HYBRID ELECTRIC VEHICLES**9**

Test Procedure Using M-G Set, electric motor, controller, application of Test Procedure, Analysis of Test Items for the Type Test - Motor Test and Controller Test (Controller Only). - Test Procedure Using Eddy Current Type Engine Dynamometer, Test Strategy, Test Procedure, Discussion on Test Procedure. Test Procedure Using AC Dynamometer.

UNIT III: FUNDAMENTALS OF FUNCTIONAL SAFETY AND EMC**9**

Functional safety life cycle - Fault tree analysis - Hazard and risk assessment – software development - Process models - Development assessments - Configuration management – Reliability -Reliability block diagrams and redundancy - Functional safety and EMC - Functional safety and quality - Standards - Functional safety of autonomous vehicles.

UNIT IV: EMC IN ELECTRIC VEHICLES**9**

Introduction - EMC Problems of EVs, EMC Problems of Motor Drive, EMC Problems of DC-DC Converter System, EMC Problems of Wireless Charging System, EMC Problem of Vehicle Controller, EMC Problems of Battery Management System, Vehicle EMC Requirements

UNIT V: EMI IN MOTOR DRIVE AND DC-DC CONVERTER SYSTEM**9**

Overview -EMI Mechanism of Motor Drive System, Conducted Emission Test of Motor Drive System, IGBT EMI Source, EMI Coupling Path, EMI Modelling of Motor Drive System. EMI in DC-DC Converter, EMI Source, The Conducted Emission High-Frequency, Equivalent Circuit of DC-DC Converter System, EMI Coupling Path

Contact Periods:

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

REFERENCES:

1. Handbook of Automotive Power Electronics and Motor Drives, Ali Emadi, Taylor & Francis, 2005, 1st Edition.
2. Electromagnetic Compatibility of Electric Vehicle, Li Zhai, Springer 2021, 1st Edition.

3. EMC and Functional Safety of Automotive Electronics, Kai Borgeest, IET 2018, 1st Edition.
4. Automotive EMC, Mark Steffika, Springer 2013, 1st Edition.
5. Electric Vehicle Systems Architecture and Standardization Needs, Reports of the PPP European Green Vehicles Initiative, Beate Müller, Gereon Meyer, Springer 2015, 1st Edition.
6. EMI/EMC Computational Modeling Handbook, Druce Archam beault, colin branch, OmarM.Ramachi ,Springer 2012, 2nd Edition.

COURSE OUTCOMES:

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

- CO1:** Describe the status and other details of standardization of EVs
- CO2:** Illustrate the testing protocols for EVs and HEV components
- CO3:** Analyze the safety cycle and need for functions safety for EVs
- CO4:** Analyze the problems related with EMC for EV components.
- CO5:** Evaluate the EMI in motor drive and DC-DC converter system.

COURSE OBJECTIVES:

- Understand the various types of energy storage Technologies.
- Analyze thermal storage system.
- Analyze different battery storage technologies
- Analyze the thermodynamics of Fuel Cell
- Study the various applications of energy storage systems.

UNIT-I: INTRODUCTION**9**

Necessity of energy storage – types of energy storage – comparison of energy storage technologies – Applications.

UNIT-II: THERMAL STORAGE SYSTEM**9**

Thermal storage – Types – Modeling of thermal storage units – Simple water and rock bed storage system – pressurized water storage system – Modelling of phase change storage system – Simple units, packed bed storage units - Modelling using porous medium approach, Use of TRNSYS.

UNIT-III: ELECTRICAL ENERGY STORAGE**9**

Fundamental concept of batteries – measuring of battery performance, charging and discharging, power density, energy density, and safety issues. Types of batteries – Lead Acid, Nickel – Cadmium, Zinc Manganese dioxide, Li-ion batteries - Mathematical Modelling for Lead Acid Batteries – Flow Batteries.

UNIT-IV: FUEL CELL**9**

Fuel Cell – History of Fuel cell, Principles of Electrochemical storage – Types – Hydrogen oxygen cells, Hydrogen air cell, Hydrocarbon air cell, alkaline fuel cell, detailed analysis – advantages and disadvantages.

UNIT-V: ALTERNATE ENERGY STORAGE TECHNOLOGIES**9**

Flywheel, Super capacitors, Principles & Methods – Applications, Compressed air Energy storage, Concept of Hybrid Storage – Applications, Pumped Hydro Storage – Applications.

Contact Periods:

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

REFERENCES:

1. Ibrahim Dincer and Mark A. Rosen, ‘Thermal Energy Storage Systems and Applications’, John Wiley & Sons, 3rd Edition, 2021.
2. Ru-shi Liu, Lei Zhang and Xueliang sun, ‘Electrochemical technologies for energy storage and conversion’, Wiley publications, 2nd Volume set, 2012.
3. James Larminie and Andrew Dicks, ‘Fuel cell systems Explained’, Wiley publications, 3rd Edition, 2018.
4. Lunardini.V.J, ‘Heat Transfer in Cold Climates’, John Wiley and Sons 1981, 1st Edition.

5. Schmidt.F.W. and Willmott.A.J., 'Thermal Energy Storage and Regeneration', Hemisphere Publishing Corporation, 1981, 1st Edition.

COURSE OUTCOMES:

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

- CO1:** Understand different types storage technologies
- CO2:** Design a thermal storage system
- CO3:** Model battery storage system
- CO4:** Analyze the thermodynamics of fuel cell and appropriate storage technologies for different applications
- CO5:** Explore the alternate energy storage technologies.

COURSE OBJECTIVES:

- To know various electric drives and traction motors with applications
- To introduce the energy saving concept by different ways of illumination.
- To understand the different methods of electric heating and electric welding.
- To know the conversion of solar and wind energies into electrical energy for different applications.
- To study the domestic utilization of electrical energy.

UNIT-I: ELECTRIC DRIVES AND TRACTION 9

Fundamentals of electric drive - choice of an electric motor - application of motors for particular services traction generator set, traction motors, power transformers - characteristic features of traction motor - systems of railway electrification - electric braking - train movement and energy consumption -traction motor control - track equipment and collection gear.

UNIT-II: ILLUMINATION 9

Introduction - definition and meaning of terms used in illumination engineering - classification of light sources - incandescent lamps, sodium vapour lamps, mercury vapour lamps, fluorescent lamps – design of illumination systems - indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting - energy saving lamps, LED.

UNIT-III: HEATING AND WELDING 9

Introduction - advantages of electric heating – modes of heat transfer - methods of electric heating -resistance heating - arc furnaces - induction heating - dielectric heating - electric welding – types -resistance welding - arc welding - power supply for arc welding - radiation welding.

UNIT-IV: ENERGY CONSERVATION AND ITS IMPORTANCE 9

Energy conservation act 2001 and its Features-Review of Industrial Energy Conservation-Energy conservation in electrical Industries-Simulation study of energy conservation using power factor controller. (Three phase circuit simulation with and without capacitor).

UNIT-V: DOMESTIC UTILIZATION OF ELECTRICAL ENERGY 9

House wiring - working principle of air conditioning system, Induction based appliances, Online and OFF line UPS, Batteries - Power quality aspects – nonlinear and domestic loads – Earthing system for Domestic, Industrial and Substation.

Contact Periods:

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

REFERENCES:

1. R.K.Rajput, Utilisation of Electric Power, Laxmi publications 2nd Edition 2016.
2. H.Partab, Art and Science of Utilisation of Electrical Energy”, Edition, Dhanpat Rai and Co New Delhi-2004.

3. C.L.Wadhwa, “Generation, Distribution and Utilisation of Electrical Energy”, New Age international Pvt.Ltd., 3rd Edition, 2015 January.
4. N.V. Suryanarayana, “Utilisation of Electric Power”, Wiley Eastern Limited, New Age International Limited, 1994 & Second Edition 2017 Feb.
5. J.B.Gupta, “Utilisation Electric power and Electric Traction”, S.K.Kataria and sons, 2000 2012th Edition, 2013, January.
6. G.D.Rai, ”Non-Conventional Energy sources”, Khanna publications Ltd., New Delhi 1998.

COURSE OUTCOMES:

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

- CO1:** Choose suitable electric drives for different applications
- CO2:** Design the illumination systems for energy saving
- CO3:** Demonstrate the utilization of electrical energy for heating and welding purposes
- CO4:** Know the effective usage of solar and wind energies for electrical applications
- CO5:** Do electric connection for any domestic appliance like refrigerator, battery charging circuit for a specific household application.
- CO6:** Illustrate the need for energy conservation and to simulate three phase power control.

COURSE OBJECTIVES:

- Understand the various types of neural networks.
- To acquire knowledge about pattern association and competition of neural networks.
- To adequate inputs on fuzzy logic controllers.
- To recognize membership function of neural networks..
- Study the various applications of neural networks and fuzzy logic.

UNIT-I: INTRODUCTION TO NEURAL NETWORKS 9

Fundamentals Concepts, Basic Models, Important Terminologies, McCulloch - Pitts Neuron, Linear Separability, Hebb Network, Perceptron, Adaline, Madaline - Architecture, algorithm and Simple Applications

UNIT-II: NEURAL NETWORKS BASED ON PATTERN ASSOCIATION AND COMPETITION 9

Training Algorithms for Pattern Association - Hebb rule and Delta rule, Hetero-associative and Auto-associative Net, Bidirectional Associative Memory - Architecture, Algorithm and Simple Applications., Backpropagation - Architecture, Algorithm and Applications. Unsupervised Learning - Kohonen Self-Organising Maps, ART1 and ART2 and Counter Propagation

UNIT-III: FUZZY LOGIC 9

Introduction, Classical and Fuzzy Sets: Properties and Operations, Crisp and Fuzzy Relations - Cardinality, Properties and Operations, Composition, Tolerance and Equivalence Relations, Simple Problems.

UNIT-IV: MEMBERSHIP FUNCTIONS 9

Features of membership function, Standard forms and Boundaries, Fuzzification, membership value assignments, Fuzzy to Crisp Conversions, Lambda Cuts for fuzzy sets and relations, Defuzzification methods

UNIT-V: APPLICATIONS OF NEURAL NETWORKS AND FUZZY LOGIC 9

Applications of Neural Networks: Pattern Recognition - Image compression – Communication - Control systems - Applications of Fuzzy Logic: Fuzzy Process Control - Fuzzy Optimization - Fuzzy Logic Controllers.

Contact Periods:

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

REFERENCES:

1. Sivanandam S N, Sumathi S, Deepa S N, "Introduction to Neural Networks using MATLAB 6.0", Tata McGraw- Hill, New Delhi, 2014.
2. Zimmermann H J , "Fuzzy Set Theory and its Applications", Allied Publisher, New Delhi, 2013.
3. Sivanandam S N, Deepa S N , "Principles of Soft Computing", Wiley India (P) Ltd, New Delhi, 2011.

4. Timothy Ross , "Fuzzy Logic with Engineering Applications", Mc Graw-Hill, Singapore, 2010.
5. Sivanandam S N, Sumathi S, Deepa S N, "Introduction to Fuzzy Logic using MATLAB", Springer-Verlag, Berlin Heidelberg, 2010.
6. Laurene Fausett , "Fundamentals of Neural Networks", Pearson Education India, New Delhi, 2008.

COURSE OUTCOMES:

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

- CO1:** Understand the various types of neural networks.
- CO2:** Get adequate inputs on pattern association and competition of neural networks.
- CO3:** Knowledge in inputs on fuzzy logic controllers.
- CO4:** Understand basics about membership function of neural networks.
- CO5:** Knowledge in capturing various applications of neural networks and fuzzy logic.

COURSE OBJECTIVES:

- To learn the basic definitions in Power Quality.
- To study the power quality issues in Single Phase and Three Phase Systems.
- To understand the principles of Power System Harmonics.
- To know the way to use DSTATCOM for Harmonic Mitigation.
- To learn the concepts related with Series Compensation.

UNIT-I: INTRODUCTION**9**

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

UNIT-II: ANALYSIS OF SINGLE PHASE AND THREE PHASE SYSTEM**9**

Single phase linear and non-linear loads – single phase sinusoidal, non-sinusoidal source – supplying linear and nonlinear loads – three phase balanced system – three phase unbalanced system – three phase unbalanced and distorted source supplying non-linear loads – concept of power factor – three phase- three wire – three phase - four wire system.

UNIT-III: MITIGATION OF POWER SYSTEM HARMONICS**9**

Introduction - Principle of Harmonic Filters – Series-Tuned Filters – Double Band-Pass Filters –damped Filters – Detuned Filters – Active Filters – Power Converters – Harmonic Filter Design – Tuned Filter – Second-Order Damped Filter – Impedance Plots for Filter Banks – Impedance Plots for a Three-Branch 33 kV Filter.

UNIT-IV: LOAD COMPENSATION USING DSTATCOM**9**

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

UNIT-V: SERIES COMPENSATION OF POWER DISTRIBUTION SYSTEM**9**

Rectifier supported DVR – DC Capacitor supported DVR – DVR Structure – Voltage Restoration –Series Active Filter – Unified Power Quality Conditioner

Contact Periods:

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

REFERENCES:

1. R.C.Duggan “Electric Power Systems Quality”, Tata MC Graw Hill Publishers, Third Edition, 2012.
2. Arrillga “Power System Harmonics”, John Wiely and Sons, 2003 2nd Edition.

3. Derek A.Paice “Power Electronic Converter Harmonics” IEEE Press, 1995, Wiley – IEE Press 1999, 18th Edition.
4. Arindam Ghosh and Gerard Ledwich “Power Quality Enhancement Using Custom Power Devices”, Kluwer Academic Publishers, First Edition,2002
5. G.T.Heydt, “Electric Power Quality”, Stars in a Circle Publications, Second Edition, 2011
6. George J. Wakileh, “Power System Harmonics – Fundamentals, Analysis and Filter Design”, Springer – Verlag Berlin Heidelberg, New York, 2019.

COURSE OUTCOMES:

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

- CO1:** Use various definitions of power quality for power quality issues.
- CO2:** Describe the concepts related with single phase / three phase, linear / nonlinear loads and single phase / three phase sinusoidal, non-sinusoidal source.
- CO3:** Solve problems related with mitigation of Power System Harmonics.
- CO4:** Use DSTATCOM for load compensation.
- CO5:** Demonstrate the role of DVR, SAFs UPQC in power distribution systems.

COURSE OBJECTIVES:

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

UNIT-I: CHARACTERISTICS AND OPERATION OF POWER PLANTS 9

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

UNIT-II: OPTIMAL OPERATION OF GENERATING PLANTS 9

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

UNIT-III: HYDRO THERMAL COORDINATION 9

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

UNIT-IV: UNIT COMMITMENT 9

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

UNIT-V: GENERATION SYSTEM RELIABILITY ANALYSIS 9

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

Contact Periods:

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

REFERENCES:

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

6. Sullivan R.L., "Power System Planning", McGraw Hill, New York, 1977.

COURSE OUTCOMES:

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

CO1: Understand the Thermal and Hydro generator characteristics.

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

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

CO4: Analyze the importance of constraints in unit commitment.

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

COURSE OBJECTIVES:

- To understand the fundamental concepts related to Image formation and processing.
- To learn feature detection, matching and detection
- To become familiar with feature based alignment and motion estimation
- To develop skills on 3D reconstruction
- To understand image based rendering and recognition

UNIT-I: INTRODUCTION TO IMAGE FORMATION AND PROCESSING 9

Computer Vision - Geometric primitives and transformations - Photometric image formation – The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.

UNIT-II: FEATURE DETECTION, MATCHING AND SEGMENTATION 9

Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.

UNIT-III: FEATURE-BASED ALIGNMENT & MOTION ESTIMATION 9

2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration – Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow – Layered motion.

UNIT-IV: 3D RECONSTRUCTION 9

Shape from X - Active rangefinding - Surface representations - Point-based representations Volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos.

UNIT-V: IMAGE-BASED RENDERING AND RECOGNITION 9

View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes - Videobased rendering-Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding- Recognition databases and test sets..

Contact Periods:

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

REFERENCES:

1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer- Texts in Computer Science, Second Edition, 2022.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.
3. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
4. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006

5. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.
6. Salman Khan, Hossein Rahmani, Syed Afaq Ali Shah, Mohammed Bennamoun, “ A Guide to Convolutional Neural Networks for Computer Vision”, Synthesis Lectures on Computer Vision, Morgan & Claypool publishers, 2018.

COURSE OUTCOMES:

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

- CO1:** To understand basic knowledge, theories and methods in image processing and computer vision.
- CO2:** To implement basic and some advanced image processing techniques in OpenCV.
- CO3:** To apply 2D a feature-based based image alignment, segmentation and motion estimations.
- CO4:** To apply 3D image reconstruction techniques
- CO5:** To design and develop innovative image processing and computer vision applications.

22ADOE02

ETHICS AND AI

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COURSE OBJECTIVES:

- Study the morality and ethics in AI
- Learn about the Ethical initiatives in the field of artificial intelligence
- Study about AI standards and Regulations
- Study about social and ethical issues of Robot Ethics
- Study about AI and Ethics- challenges and opportunities

UNIT-I: INTRODUCTION **9**

Definition of morality and ethics in AI-Impact on society-Impact on human psychology-Impact on the legal system-Impact on the environment and the planet-Impact on trust.

UNIT-II: ETHICAL INITIATIVES IN AI **9**

International ethical initiatives-Ethical harms and concerns-Case study: healthcare robots, Autonomous Vehicles , Warfare and weaponization.

UNIT-III: AI STANDARDS AND REGULATION **9**

Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations - Ontological Standard for Ethically Driven Robotics and Automation Systems.

UNIT-IV: ROBOETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS **9**

Robot-Roboethics- Ethics and Morality- Moral Theories-Ethics in Science and Technology – Ethical Issues in an ICT Society- Harmonization of Principles- Ethics and Professional ResponsibilityRoboethics Taxonomy.

UNIT-V: AI AND ETHICS- CHALLENGES AND OPPORTUNITIES **9**

Challenges - Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine- decision-making role in industries- National and International Strategies on AI.

Contact Periods:

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

REFERENCES:

1. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield ,”The ethics of artificial intelligence: Issues and initiatives”, EPRS European Parliamentary Research Service Scientific Foresight Unit March 2020.
2. Patrick Lin, Keith Abney, George A Bekey,,” Robot Ethics: The Ethical and Social Implications of Robotics”, The MIT Press- January 2014
3. Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington, November 2017
4. Mark Coeckelbergh,,” AI Ethics”, The MIT Press Essential Knowledge series, April 2020
5. Research Methodology for Natural Sciences by Soumitro Banerjee, IISc Press, January

2022

6. The Nonreligious: Understanding Secular People and Societies, Luke W. Galen Oxford University Press, 2016.

COURSE OUTCOMES:

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

- CO1:** Learn about morality and ethics in AI
- CO2:** Acquire the knowledge of real time application ethics, issues and its challenges.
- CO3:** Understand the ethical harms and ethical initiatives in AI
- CO4:** Learn about AI standards and Regulations like AI Agent, Safe Design of Autonomous and Semi-Autonomous Systems
- CO5:** Understand the concepts of Roboethics and Morality with professional responsibilities.

22ADOE03 NETWORK SECURITY AND FIREWALLS

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COURSE OBJECTIVES:

- To learn the fundamentals of cryptography.
- To learn the key management techniques and authentication approaches.
- To explore the network and transport layer security techniques.
- To understand the application layer security standards.
- To learn the real time security practices.

UNIT-I: INTRODUCTION

9

Basics of cryptography, conventional and public-key cryptography, hash functions, authentication and digital signatures.

UNIT-II: KEY MANAGEMENT AND AUTHENTICATION

9

Key Management and Distribution: Symmetric Key Distribution, Distribution of Public Keys, X.509 Certificates, Public-Key Infrastructure. User Authentication: Remote User-Authentication Principles, Remote User-Authentication Using Symmetric Encryption, Kerberos Systems, Remote User Authentication Using Asymmetric Encryption.

UNIT-III: ACCESS CONTROL AND SECURITY

9

Network Access Control: Network Access Control, Extensible Authentication Protocol, IEEE 802.1X Port-Based Network Access Control - IP Security - Internet Key Exchange (IKE). Transport-Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS standard, Secure Shell (SSH) application.

UNIT-IV: APPLICATION LAYER SECURITY

9

Electronic Mail Security: Pretty Good Privacy, S/MIME, DomainKeys Identified Mail. Wireless Network Security: Mobile Device Security

UNIT-V: FIREWALLS

9

Firewalls and Intrusion Detection Systems: Intrusion Detection Password Management, Firewall Characteristics Types of Firewalls, Firewall Basing, Firewall Location and Configurations. Blockchains, Cloud Security and IoT security

Contact Periods:

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

REFERENCES:

1. Cryptography and Network Security: Principles and Practice, 6th Edition, William Stallings, 2014, Pearson, ISBN 13:9780133354690.
2. Network Security: Private Communications in a Public World, M. Speciner, R. Perlman, C. Kaufman, Prentice Hall, 2002.
3. Linux iptables Pocket Reference, Gregor N. Purdy, O'Reilly, 2004.
4. Linux Firewalls, by Michael Rash, No Starch Press, October 2007, ISBN: 978-1-59327-141-1.

5. Network Security, Firewalls And VPNs, J. Michael Stewart, Jones & Bartlett Learning, 2013, ISBN-10: 1284031675, ISBN-13: 978-1284031676.
6. The Network Security Test Lab: A Step-By-Step Guide, Michael Gregg, Dreamtech Press, 2015, ISBN-10:8126558148, ISBN-13: 978-8126558148.

COURSE OUTCOMES:

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

- CO1:** Classify the encryption techniques
- CO2:** Illustrate the key management technique and authentication.
- CO3:** Evaluate the security techniques applied to network and transport layer
- CO4:** Discuss the application layer security standards.
- CO5:** Apply security practices for real time applications.

COURSE OBJECTIVES:

- To understand the basics in R programming in terms of constructs, control statements, string functions.
- To learn to apply R programming for Text processing.
- To expose the use of R Big Data analytics.
- To able to appreciate and apply the R programming from a statistical perspective.
- To make clear the concept for data visualization and statistics and probability.

UNIT-I: INTRODUCTION TO R**9**

Introducing to R – R Data Structures – Help functions in R – Vectors – Scalars – Declarations – recycling – Common Vector operations – Using all and any – Vectorized operations – NA and NULL values – Filtering – Vectorised if-then else – Vector Equality – Vector Element name.

UNIT-II: MATRICES, ARRAYS AND LISTS**9**

Matrices, Arrays and Lists Creating matrices – Matrix operations – Applying Functions to Matrix Rows and Columns – Adding and deleting rows and columns – Vector/Matrix Distinction – Avoiding Dimension Reduction – Higher Dimensional arrays – lists – Creating lists – General list operations – Accessing list components and values – applying functions to lists – recursive lists.

UNIT-III: DATA FRAMES**9**

Creating Data Frames – Matrix-like operations in frames – Merging Data Frames – Applying functions to Data frames – Factors and Tables – factors and levels – Common functions used with factors – Working with tables - Other factors and table related functions.

UNIT-IV: CONTROL STATEMENTS, FUNCTIONS, R GRAPHS**9**

Control statements – Arithmetic and Boolean operators and values – Default values for arguments - Returning Boolean values – functions are objects – Environment and Scope issues – Writing Upstairs - Recursion – Replacement functions – Tools for composing function code – Math and Simulations in R Creating Graphs – Customizing Graphs – Saving graphs to files – Creating three-dimensional plots.

UNIT-V: INTERFACING**9**

Interfacing R to other languages – Parallel R – Basic Statistics – Linear Model – Generalized Linear models – Non-linear models – Time Series and Auto-correlation – Clustering.

Contact Periods:

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

REFERENCES:

1. Andy Vickler, “R Programming: This book includes: R Basics for Beginners + R Data Analysis and Statistics + R Data Visualization”, Ladoo Publishing LLC, 2022.

2. Jared P. Lander, “R for Everyone: Advanced Analytics and Graphics”, Addison-Wesley Data & Analytics Series, 2013.
3. Mark Gardener, “ Beginning R – The Statistical Programming Language”, Wiley, 2013.
4. Robert Knell, “Introductory R: A Beginner's Guide to Data Visualisation, Statistical Analysis and Programming in R”, Amazon Digital South Asia Services Inc, 2013.
5. Norman Matloff, “The Art of R Programming: A Tour of Statistical Software Design”, No Starch Press, 2011.

COURSE OUTCOMES:

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

CO1: Create artful graphs to visualize complex data sets and functions.

CO2: Write more efficient code using parallel R and vectorization.

CO3: Interface R with C / C++ and Python for increased speed or functionality.

CO4: Evaluate new packages for text analysis, image manipulation, and perform statistical analysis of the same.

CO5: Develop interfacing R to other Languages.

COURSE OBJECTIVES:

- To understand .Net as simple, modern, object- oriented computer programming language
- To understand CLR Framework
- To design web services
- To design and build interactive webpages and server side logic
- To understand the data access

UNIT-I: INTRODUCTION TO .NET FRAMEWORK AND MANAGED CODE 9

Introduction to .NET Framework: Managed Code and the CLR- Intermediate Language, Metadata and JIT Compilation - Automatic Memory Management

UNIT-II: LANGUAGE CONCEPTS, CLR, AND FRAMEWORK CLASS LIBRARY 9

Language Concepts and the CLR: Visual Studio .NET - Using the .NET Framework. The Framework Class Library: NET objects - ASP .NET - .NET web services – Windows Forms

UNIT-III: ASP.NET FEATURES AND WEB SERVICES 9

ASP.NET Features: Change the Home Directory in IIS - Add a Virtual Directory in IIS- Set a Default Document for IIS - Change Log File Properties for IIS - Stop, Start, or Pause a Web Site

UNIT-IV: WEB CONTROLS AND CREATING WEB FORMS 9

Creating Web Controls: Web Controls - HTML Controls, Using Intrinsic Controls, Using Input Validation Controls, Selecting Controls for Applications - Adding web controls to a Page. Creating Web Forms: Server Controls - Types of Server Controls - Adding ASP.NET Code to a Page.

UNIT-V: ASP.NET DATA ACCESS 9

ASP.NET Data Access: Data Binding Server Controls-Viewing Data Collections in a Grid. ASP.NET Caching Mechanism for caching Dynamic response data. Page Output Caching.

Contact Periods:

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

REFERENCES:

1. Jason N. Gaylord, Christian Wenz, Pranav Rastogi, Todd Miranda, and Scott Hanselman "Professional ASP.NET 4.5 in C# and VB"
2. Jonas Fagerberg , "ASP.NET Core 5 for Beginners"
3. Alex Homer, Dave Sussman, Professional ASP.NET 1.1, Wrox Publication
4. .NET Framework, OREILY Publication.
5. Deitel and Deitel, Visual Basic.NET How to Program, Pearson Education,2nd edition Greg Buczek, ASP.NET Developer's Guide, Tata McGraw-Hill, 2002.

COURSE OUTCOMES:

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

CO1: Learn fundamentals of .net framework

CO2: Enrich knowledge about Windows Forms, Controls and ASP.NET based applications.

CO3: Create Web services for web based application.

CO4: Create Web forms for web applications

CO5: Web-based applications and Reports using .net technologies

22CSOE01 COMPUTER GRAPHICS AND SIMULATION

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COURSE OBJECTIVES:

- To Gain knowledge about graphics hardware devices and software used.
- To Understand the two dimensional graphics and their transformations.
- To Understand the three dimensional graphics and their transformations.
- To Appreciate illumination and color models.
- To be familiar with understand clipping techniques.

UNIT-I: INTRODUCING **9**

Survey of computer graphics, Overview of graphics systems – Video display devices, Raster scan systems, Random scan systems, Graphics monitors and Workstations, Input devices, Hard copy Devices, Graphics Software; Output primitives – points and lines, line drawing algorithms, loading the frame buffer, line function; circle and ellipse generating algorithms; Pixel addressing and object geometry, filled area primitives.

UNIT-II: TWO DIMENSIONAL GRAPHICS **9**

Two dimensional geometric transformations – Matrix representations and homogeneous coordinates, composite transformations; Two dimensional viewing – viewing pipeline, viewing coordinate reference frame; widow-to-viewport coordinate transformation, Two dimensional viewing functions; clipping operations – point, line, and polygon clipping algorithms

UNIT-III: THREE DIMENSIONAL GRAPHICS **9**

Three dimensional concepts; Three dimensional object representations – Polygon surfaces- Polygon tables- Plane equations - Polygon meshes; Curved Lines and surfaces, Quadratic surfaces; Blobby objects; Spline representations – Bezier curves and surfaces -B-Spline curves and surfaces. TRANSFORMATION AND VIEWING: Three dimensional geometric and modeling transformations – Translation, Rotation, Scaling, composite transformations; Three dimensional viewing – viewing pipeline, viewing coordinates, Projections, Clipping; Visible surface detection methods.

UNIT-IV: ILLUMINATION AND COLOUR MODELS **9**

Light sources - basic illumination models – halftone patterns and dithering techniques; Properties of light - Standard primaries and chromaticity diagram; Intuitive colour concepts - RGB colour model - YIQ colour model - CMY colour model - HSV colour model - HLS colour model; Colour selection.

UNIT-V: ANIMATIONS & REALISM **9**

ANIMATION GRAPHICS: Design of Animation sequences – animation function – raster animation – key frame systems – motion specification –morphing – tweening. COMPUTER GRAPHICS REALISM: Tiling the plane – Recursively defined curves – Koch curves – C curves – Dragons – space filling curves – fractals – Grammar based models – fractals – turtle graphics – ray tracing.

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

1. John F. Hughes, Andries Van Dam, Morgan Mc Guire, David F. Sklar , James D. Foley, Steven K. Feiner and Kurt Akeley ,”Computer Graphics: Principles and Practice”, , 3rd Edition, AddisonWesley Professional,2013. (UNIT I, II, III, IV).
2. Donald Hearn and Pauline Baker M, “Computer Graphics”, Prentice Hall, New Delhi, 2007 (UNIT V).
3. Donald Hearn and M. Pauline Baker, Warren Carithers,“Computer Graphics With Open GL”, 4th Edition, Pearson Education, 2010.
4. Jeffrey McConnell, “Computer Graphics: Theory into Practice”, Jones and Bartlett Publishers, 2006.
5. Hill F S Jr., "Computer Graphics", Maxwell Macmillan” , 1990

COURSE OUTCOMES:

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

CO1: Identify graphics hardware devices and software used.

CO2: Design and apply two dimensional transformations

CO3: Design three dimensional graphics.

CO4: Apply Illumination and color models.

CO5: Apply clipping techniques to graphics and Design animation sequences.

COURSE OBJECTIVES:

- To understand the concepts of BI and ETL.
- To inculcate and express knowledge of Talend architecture and its various components.
- To explain the different integration process using advanced components.
- To examine Big Data, Hadoop concepts and the benefits of integrating Talend with Hadoop.
- To focus the various Hadoop Eco systems.

UNIT-I: FUNDAMENTALS OF BI AND ETL **9**

Introduction to Business Problem Analysis – Business Intelligence, Data warehousing, Data Collection and Description, Data Extraction – ETL Process, Schema Integration, Data integration, Data Quality

UNIT-II: INTRODUCTION TO TALEND **9**

Introduction – Architecture of Talend Tool, Starting a Talend Tool, Talend models, Talend Metadata, Managing Metadata, Data Integration features, Data integration Components

UNIT-III: INTRODUCTION TO BIG DATA **9**

Introduction - Historical Interpretation of Big Data - Defining Big Data From 3Vs to 3²Vs - Big Data Analytics and Machine Learning - Big Data Analytics and Cloud Computing - Real-Time Analytics: Characteristics of Real-Time Systems, Real-Time Processing for Big Data — Concepts and Platforms

UNIT-IV: BASICS OF HADOOP **9**

Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – file-based data structures

UNIT-V: HADOOP ECOSYSTEM **9**

Introduction to Sqoop components – Tables and Databases, Introduction to Pig Components – Load and Store operations, Grouping and joining, Combining and splitting, Filtering and Sorting Spark and Hbase - Basic Concepts.

Contact Periods:

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

REFERENCES:

1. Domenico Talia, Paolo Trunfio, Fabrizio Marozzo, Loris Belcastro, Riccardo Cantini, Alessio Orsino, “Programming Big Data Applications: Scalable Tools And Frameworks For Your Needs Hardcover”, World Scientific Europe Ltd, 2024.
2. Wilfried Grossmann, Stefanie Rinderle-Ma, “Fundamentals of Business Intelligence”, Springer-Verlag Berlin and Heidelberg GmbH & Co. K, 2016.
3. Rajkumar Buyya, Rodrigo N. Calheiros, Amir Vahid Dastjerdi, “Big Data Principles and

- Paradigms”, Morgan Kaufmann, 2016.
4. Marz N and Warren J, “Big Data”, Manning Publications, 2015.
 5. Richard Daniel Barton, “Talend Open Studio Cookbook”, Packt Pub Ltd, 2013.
 6. Chuck Lam, “Hadoop in Action”, Manning Publications, 2010.

COURSE OUTCOMES:

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

- CO1:** Gain the basic concepts of BI and ETL schema and architecture.
- CO2:** Apply Talend tool architecture and suitable components for data analysis.
- CO3:** Design various integration techniques using different components.
- CO4:** Compare appropriate Hadoop concepts with integrating Talend to observe Big Data.
- CO5:** Automate the different Hadoop Eco systems.

22CSOE03

GAME PROGRAMMING

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COURSE OBJECTIVES:

- To know the basics of 2D and 3D graphics for game development.
- To know the stages of game development.
- To understand the basics of a game engine.
- To survey the gaming development environment and tool kits.
- To learn and develop simple games using Pygame environment

UNIT-I: 3D GRAPHICS FOR GAME DESIGN

9

Genres of Games, Basics of 2D and 3D Graphics for Game Avatar, Game Components – 2D and 3D Transformations – Projections – Color Models – Illumination and Shader Models – Animation – Controller Based Animation.

UNIT-II: GAME DESIGN PRINCIPLES

9

Character Development, Storyboard Development for Gaming – Script Design – Script Narration, Game Balancing, Core Mechanics, Principles of Level Design – Proposals – Writing for Preproduction, Production and Post – Production.

UNIT-III: GAME ENGINE DESIGN

9

Rendering Concept – Software Rendering – Hardware Rendering – Spatial Sorting Algorithms Algorithms for Game Engine– Collision Detection – Game Logic – Game AI – Pathfinding.

UNIT-IV: OVERVIEW OF GAMING PLATFORMS AND FRAMEWORKS

9

Pygame Game development – Unity – Unity Scripts – Mobile Gaming, Game Studio, Unity Single player and Multi-Player games

UNIT-V: GAME DEVELOPMENT USING PYGAME

9

Developing 2D and 3D interactive games using Pygame – Avatar Creation – 2D and 3D Graphics Programming – Incorporating music and sound – Asset Creations – Game Physics Algorithms Development – Device Handling in Pygame – Overview of Isometric and Tile Based Arcade Games – Puzzle Games.

Contact Periods:

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

REFERENCES:

1. Sanjay Madhav, “Game Programming Algorithms and Techniques: A Platform Agnostic Approach”, Addison Wesley,2013.
2. Will McGugan, “Beginning Game Development with Python and Pygame: From Novice to Professional”, Apress,2007.
3. Paul Craven, “Python Arcade games”, Apress Publishers,2016
4. David H. Eberly, “3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics”, Second Edition, CRC Press,2006.

5. Jung Hyun Han, “3D Graphics for Game Programming”, Chapman and Hall/CRC, 2011.
6. Y.Narahari, “Game Theory and Mechanism Design”, IISC Press, World Scientific.

COURSE OUTCOMES:

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

- CO1:** Explain the concepts of 2D and 3D Graphics
- CO2:** Design game design documents.
- CO3:** Implementation of gaming engines.
- CO4:** Survey gaming environments and frameworks.
- CO5:** Implement a simple game in Pygame

COURSE OBJECTIVES:

- Characterize the functionalities of logical and physical components of storage
- Describe various storage networking technologies
- Identify different storage virtualization technologies
- Discuss the different backup and recovery strategies
- Understand common storage management activities and solutions

UNIT I: STORAGE SYSTEMS 9

Introduction to Information Storage: Digital data and its types, Information storage, Key characteristics of data center and Evolution of computing platforms. Information Lifecycle Management. Third Platform Technologies: Cloud computing and its essential characteristics, Cloud services and cloud deployment models, Big data analytics, Social networking and mobile computing, Characteristics of third platform infrastructure and Imperatives for third platform transformation. Data Center Environment: Building blocks of a data center, Compute systems and compute virtualization and Software-defined data center.

UNIT II : INTELLIGENT STORAGE SYSTEMS AND RAID 9

Components of an intelligent storage system, Components, addressing, and performance of hard disk drives and solid-state drives, RAID, Types of intelligent storage systems, Scale-up and scaleout storage Architecture.

UNIT III: STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION 9

Block-Based Storage System, File-Based Storage System, Object-Based and Unified Storage. Fibre Channel SAN: Software-defined networking, FC SAN components and architecture, FC SAN topologies, link aggregation, and zoning, Virtualization in FC SAN environment. Internet Protocol SAN: iSCSI protocol, network components, and connectivity, Link aggregation, switch aggregation, and VLAN, FCIP protocol, connectivity, and configuration. Fibre Channel over Ethernet SAN: Components of FCoE SAN, FCoE SAN connectivity, Converged Enhanced Ethernet, FCoE architecture.

UNIT IV: BACKUP, ARCHIVE AND REPLICATION 9

Introduction to Business Continuity, Backup architecture, Backup targets and methods, Data deduplication, Cloud-based and mobile device backup, Data archive, Uses of replication and its characteristics, Compute based, storage-based, and network-based replication, Data migration, Disaster Recovery as a Service (DRaaS).

UNIT V: SECURING STORAGE INFRASTRUCTURE 9

Information security goals, Storage security domains, Threats to a storage infrastructure, Security controls to protect a storage infrastructure, Governance, risk, and compliance, Storage infrastructure management functions, Storage infrastructure management processes.

Contact Periods:

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

REFERENECS:

1. Brad Dayley, Brendan Dayley, Caleb Dayley, ‘Node.js, MongoDB and Angular Web Development’, Addison-Wesley, Second Edition, 2018
2. Vasan Subramanian, ‘Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node’, Second Edition, Apress, 2019.
3. Chris Northwood, ‘The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer’, Apress; 1st edition, 2018
4. Kirupa Chinnathambi, ‘Learning React: A Hands-On Guide to Building Web Applications Using React and Redux’, Addison-Wesley Professional, 2nd edition, 2018
5. https://www.tutorialspoint.com/the_full_stack_web_development/index.asp
6. <https://www.coursera.org/specializations/full-stack-react>

COURSE OUTCOMES:

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

- CO1:** Demonstrate the fundamentals of information storage management and various models of Cloud infrastructure services and deployment
- CO2:** Illustrate the usage of advanced intelligent storage systems and RAID
- CO3:** Interpret various storage networking architectures - SAN, including storage subsystems and virtualization
- CO4:** Examine the different role in providing disaster recovery and remote replication technologies
- CO5:** Infer the security needs and security measures to be employed in information storage management

COURSE OBJECTIVES:

- To understand the foundations of the recommender system.
- To learn the significance of machine learning and data mining algorithms for Recommender systems
- To learn about collaborative filtering
- To make students design and implement attack resisted recommender system.
- To learn about evaluating recommender system

UNIT-I: INTRODUCTION**9**

Introduction and basic taxonomy of recommender systems - Traditional and non-personalized Recommender Systems - Overview of data mining methods for recommender systems- similarity measures- Dimensionality reduction – Singular Value Decomposition (SVD) - Applications of recommendation systems, Issues with recommender system.

UNIT-II: CONTENT-BASED RECOMMENDATION SYSTEMS**9**

High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents, Obtaining item features from tags, CO1, CO2 Representing item profiles, Methods for learning user profiles, Similarity based retrieval, Classification algorithms.

UNIT-III: COLLABORATIVE FILTERING**9**

A systematic approach, Nearest-neighbour collaborative filtering (CF), user-based and item-based CF, components of neighbourhood methods (rating normalization, similarity weight computation, and neighbourhood selection

UNIT-IV: ATTACK-RESISTANT RECOMMENDER SYSTEMS**9**

Introduction – Types of Attacks – Detecting attacks on recommender systems – Individual attack – Group attack – Strategies for robust recommender design - Robust recommendation algorithms.

UNIT-V: EVALUATING RECOMMENDER SYSTEMS**9**

Introduction, General properties of evaluation research, Evaluation designs, Evaluation on historical datasets, Error metrics, Decision-Support metrics, User-Centred metrics. Evaluating Paradigms – User Studies – Online and Offline evaluation – Goals of evaluation design – Design Issues – Accuracy metrics – Limitations of Evaluation measures

Contact Periods:

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

REFERENCES:

1. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016

2. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press (2011), 1st edition.
3. Francesco Ricci , Lior Rokach , Bracha Shapira , Recommender Sytems Handbook, 1st ed, Springer (2011)
4. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer(2011), 1st edition
5. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, 3rd edition, Cambridge University Press, 2020.
6. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer (2013),1st edition

COURSE OUTCOMES:

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

- CO1:** Understand the basic concepts of recommender systems.
- CO2:** Evaluate Types of recommender systems: non-personalized, content based filtering
- CO3:** Implementation of Collaborative Filtering in carrying out performance evaluation of recommender systems based on various metrics.
- CO4:** Design and implement attack resisted recommender system.
- CO5:** Evaluate the recommender system

COURSE OBJECTIVES:

- Study about uninformed and Heuristic search techniques.
- Learn techniques for reasoning under uncertainty.
- Introduce Machine Learning and supervised learning algorithms
- Study about ensembling and unsupervised learning algorithms
- Learn the basics of deep learning using neural networks.

UNIT-I: PROBLEM-SOLVING**9**

Introduction to AI - AI Applications – Problem-solving agents – Search algorithms – Uninformed search strategies – Heuristic search strategies – Local search and optimization problems – Adversarial search – Constraint satisfaction problems (CSP)

UNIT-II: PROBABILISTIC REASONING**9**

Acting under uncertainty – Bayesian inference – Naïve bayes models. Probabilistic reasoning – Bayesian networks – Exact inference in BN – Approximate inference in BN – Causal networks.

UNIT-III: SUPERVISED LEARNING**9**

Introduction to machine learning – Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Probabilistic discriminative model – Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random forests.

UNIT-IV: ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING**9**

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning – Bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization

UNIT-V: NEURAL NETWORKS**9**

Perceptron – Multilayer perceptron, activation functions, network training – Gradient descent optimization – Stochastic gradient descent, error backpropagation, from shallow networks to deep networks – Unit saturation (aka the vanishing gradient problem) – ReLU, hyperparameter tuning, batch normalization, regularization, dropout.

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

1. Stuart Russell and Peter Norvig, “Artificial Intelligence – A Modern Approach”, Fourth Edition, Pearson Education, 2021.

2. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.
3. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007.
4. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008.
5. Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006.

COURSE OUTCOMES:

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

CO1: Use appropriate search algorithms for problem solving.

CO2: Apply reasoning under uncertainty.

CO3: Build supervised learning models.

CO4: Understand ensembling and unsupervised models.

CO5: Outline the deep learning neural network models.

22ECOE02

WEARABLE DEVICES

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3	0	0	3

COURSE OBJECTIVES:

- To know the hardware requirement of wearable systems.
- To describe the energy harvesting for wearable devices.
- To know the concepts of BAN in health care.
- To understand the security aspects in the wearable devices
- To know the applications of wearable devices in the field of medicine

UNIT-I: INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS 9

Wearable Systems – Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems – Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor.

UNIT-II: SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICE 9

Wearability issues – Physical shape and placement of sensor, Technical challenges – Sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements – Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles

UNIT-III: WIRELESS HEALTH SYSTEMS 9

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges – System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques.

UNIT-IV: SMART TEXTILE 9

Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks. Case study-smart fabric for monitoring biological parameters – ECG, respiration.

UNIT-V: APPLICATIONS OF WEARABLE SYSTEMS 9

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

Contact periods:

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

REFERENCES:

1. Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011.
2. Zhang and Yuan-Ting, Wearable Medical Sensors and Systems, Springer, 2013.
3. Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014.
4. Mehmet R. Yuce and JamilY.Khan, Wireless Body Area Networks Technology, Implementation applications, Pan Stanford Publishing Pte. Ltd, Singapore, 2012.
5. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.

COURSE OUTCOMES:

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

CO1: Describe the concepts of wearable system.

CO2: Explain the energy harvestings in wearable device.

CO3: Use the concepts of BAN in health care.

CO4: Illustrate the concept of smart textile.

CO5: Compare the various wearable devices in healthcare system.

22ECOE03

**VLSI TESTING AND DESIGN FOR
TESTABILITY**

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COURSE OBJECTIVES:

- To Learn fault models and fault simulation techniques.
- To understand faults in combinational logic circuits.
- To Have Knowledge on faults in sequential logic circuits.
- To introduces the different testability methods.
- To understand fault diagnosis approaches.

UNIT-I: FAULT MODELLING AND SIMULATION 9

Introduction to testing – Faults in digital circuits – Modeling of faults – Logical fault models – Fault detection – Fault location – Fault dominance – Single stuck fault model and multiple stuck.

UNIT-II: TESTING FOR SINGLE STUCK AT FAULTS 9

Test generation algorithms for combinational circuits – Fault oriented ATG – D Algorithm – Examples – PODEM – Fault independent ATG – Random Test generation – ATGs for SSFs in sequential circuits – TG using iterative array models – Random test generation.

UNIT-III: DELAY TEST 9

Delay test problem – Path delay test – Test generation for combinational circuits, Number of paths in a circuit– Transition faults – Delay test methodologies – Slow clock combinational test, Enhanced scan test, normal scan sequential test, Variable – Clock Non-scan sequential test, Rated-clock Non-scan sequential test.

UNIT-IV: DESIGN FOR TESTABILITY 9

Testability – Controllability and observability, Ad-hoc design for testability techniques – Controllability and observability by means of scan registers – Storage cells for scan design – Level sensitive scan design (LSSD) – Partial scan using I-Paths – Boundary scan standards.

UNIT-V: FAULT DIAGNOSIS 9

Logical level diagnosis – Diagnosis by UUT reduction – Fault diagnosis for combinational circuits – Self-checking design – System level diagnosis.

Contact periods:

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

REFERENCES:

1. Abramovici M, Brever A and Friedman D., "Digital Systems Testing and Testable Design", Jaico Publishing House, 2002.
2. Parag K. Lala, "Fault Tolerant and Fault Testable Hardware Design", BS Publications, 2002.

3. Michael L. Bushnell and Vishwani D. Agarwal, “Essentials of Electronic Testing for Digital, Memory and Mixed Signal Circuits”, Springer, Verlag2000.
4. Stanley L. Hurst, “VLSI Testing: Digital and Mixed Analogue Digital Techniques”, Institute of Electrical Engineers, 1998.
5. Xiaoqing Wen, Cheng Wen Wu and LaungTerng Wang, “VLSI Test Principles and Architectures: Design for Testability”, Cambridge University Press, 2000.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1: Discuss various fault models and fault simulation techniques.

CO2: Examine faults in combinational logic circuits.

CO3: Analyze faults in sequential logic circuits.

CO4: Explain different testability methods.

CO5: Outline fault diagnosis approaches.

22ECOE04

IOT BASED SYSTEMS DESIGN

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COURSE OBJECTIVES:

- To understand the basics of IoT.
- To get knowledge about the various services provided by IoT.
- To familiarize themselves with various communication techniques and networking.
- To know the implementation of IoT with different tools.
- To understand the various applications in IoT.

UNIT-I: INTRODUCTION TO INTERNET OF THINGS 9

Rise of the machines – Evolution of IoT – Web 3.0 view of IoT – Definition and characteristics of IoT – IoT Enabling Technologies – IoT Architecture – Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects – IoT levels and deployment templates – A panoramic view of IoT applications.

UNIT-II: MIDDLEWARE AND PROTOCOLS OF IOT 9

Middleware technologies for IoT system (IoT Ecosystem Overview – Horizontal Architecture Approach for IoT Systems – SOA based IoT Middleware) Middleware architecture of RFID, WSN, SCADA, M2M – Interoperability challenges of IoT-Protocols for RFID, WSN, SCADA, M2M – Zigbee, KNX, BACNet, MODBUS – Challenges Introduced by 5G in IoT Middleware.

UNIT-III: COMMUNICATION AND NETWORKING 9

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks.

UNIT-IV: IOT IMPLEMENTATION TOOLS 9

Introduction to Python, Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor-based applications through embedded system platform, Implementing IoT concepts with Python, Implementation of IoT with Raspberry Pi.

UNIT-V: APPLICATIONS AND CASE STUDIES 9

Home automations - Smart cities – Environment – Energy – Retail – Logistics – Agriculture – Industry - Health and life style – Case study.

Contact periods:

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

REFERENCES:

1. Honbo Zhou, “Internet of Things in the cloud:A middleware perspective”, CRC press, 2012.
2. Vijay Madiseti and Arshdeep Bahga, “Internet of Things (A Hands-onApproach)”, VPT, 1st Edition, 2014.

3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017
4. Constandinos X. Mavromoustakis, George Mastorakis, Jordi MongayBatalla, "Internet of Things (IoT) in 5G Mobile Technologies" Springer International Publishing Switzerland 2016..
5. Dieter Uckelmann, Mark Harrison, Florian Michahelles, "Architecting the Internet of Things" Springer-Verlag Berlin Heidelberg, 2011.

COURSE OUTCOMES:

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

CO1: Articulate the main concepts, key technologies, strength and limitations of IoT.

CO2: Identify the architecture, infrastructure models of IoT

CO3: Analyze the networking and how the sensors are communicated in IoT.

CO4: Analyze and design different models for IoT implementation.

CO5: Identify and design the new models for market strategic interaction

COURSE OBJECTIVES:

- Introduce tools & techniques of design thinking for innovative products.
- Development Illustrate customer-centric product innovation.
- Use cases Demonstrate development of Minimum usable Prototypes
- Outline principles of solution concepts & their evaluation
- Describe system thinking principles as applied to complex systems.

UNIT-I: DESIGN THINKING PRINCIPLES 9

Exploring Human-centered Design – Understanding the Innovation process, discovering areas of opportunity, Interviewing & empathy – Building techniques, Mitigate validation risk with FIR [Forge Innovation rubric] – Case studies.

UNIT-II: ENDUSER-CENTRIC INNOVATION 9

Importance of customer-centric innovation – Problem Validation and Customer Discovery – Understanding problem significance and problem incidence – Customer Validation. Target user, User persona & user stories. Activity: Customer development process – Customer interviews and field visits.

UNIT-III: APPLIED DESIGN THINKING TOOLS 9

Concept of Minimum Usable Prototype [MUP] – MUP challenge brief – Designing & Crafting the value proposition – Designing and Testing Value Proposition; Design a compelling value proposition; Process, tools and techniques of Value Proposition Design.

UNIT-IV: CONCEPT GENERATION 9

Solution Exploration, Concepts Generation and MUP design – Conceptualize the solution concept; explore, iterate and learn; build the right prototype; Assess capability, usability and feasibility. Systematic concept generation; evaluation of technology alternatives and the solution concepts.

UNIT-V: SYSTEM THINKING 9

System Thinking, Understanding Systems, Examples and Understandings, Complex Systems.

Contact periods:

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

REFERENCES:

1. Steve Blank, (2013), The four steps to epiphany: Successful strategies for products that win, Wiley.
2. Alexander Osterwalder, Yves Pigneur, Gregory Bernarda, Alan Smith, Trish Papadacos, (2014), Value.
3. Proposition Design: How to Create Products and Services Customers Want, Wiley.

4. Donella H. Meadows, (2015), “Thinking in Systems -A Primer”, Sustainability Institute.
5. Tim Brown,(2012) “Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation”, Harper Business.

COURSE OUTCOMES:

At the end of each unit, the students will be able to -

CO1: Define & test various hypotheses to mitigate the inherent risks in product innovations.

CO2: Understand customer-centric product innovation.

CO3: Design the solution concept based on the proposed value by exploring alternate solutions to achieve value-price fit.

CO4: Develop skills in empathizing, critical thinking, analyzing, storytelling & pitching

CO5: Apply system thinking in a real-world scenario.

22 EEOE01

POWER PLANT ENGINEERING

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COURSE OBJECTIVES:

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

UNIT-I: COAL BASED THERMAL POWER PLANTS 9

Layout of modern coal power plant, super critical boilers, FBC boilers, subsystems of thermal power plants – Fuel and ash handling and draught system, feed water treatment.

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

Components of diesel and gas turbine power plants - Combined cycle power plants - Integrated gasifier based combined cycle systems.

UNIT-III: NUCLEAR POWER PLANTS 9

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

UNIT-IV: POWER FROM RENEWABLE ENERGY 9

Hydroelectric power plants – Classification, typical layout and associated components. Principle, construction and working of Wind, Tidal, Solar thermal and Fuel cell power systems.

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

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

Contact Periods:

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

REFERENCES:

1. Nag P. K., “Power Plant Engineering”, 4th Edition, Tata McGraw – Hill Publishing Company Ltd., 2014.

2. El -Wakil M. M., “Power Plant Technology”, Tata McGraw – Hill Publishing Company Ltd., 2010.
3. Godfrey Boyle, “Renewable energy”, Open University, Oxford University Press in association with the Open University, 2004.
4. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, “Standard Handbook of Power Plant Engineering”, 2nd Edition, McGraw – Hill Professional, 2012.

COURSE OUTCOMES:

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

- CO1:** Understand the layout, construction and working of the components inside a thermal power plant.
- CO2:** Acquire knowledge about the layout, construction and working of the components inside a diesel, gas and combined cycle power plants.
- CO3:** Gain the basic knowledge of construction and working of the components inside nuclear power plants.
- CO4:** Explore the construction and working of the components inside renewable energy power plants.
- CO5:** Analysis and solve energy and economic related issues in power sector.

COURSE OBJECTIVES:

- To understand the concepts of measurement technology.
- To learn the various motion, proximity and ranging sensors used to measure various physical parameters.
- To understand the various force, magnetic and heading sensors used to measure various physical parameters.
- To know the various optical, pressure and temperature sensors used to measure various physical parameters.
- To understand the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

UNIT I : INTRODUCTION**9**

Basics of measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor output signal types.

UNIT II : MOTION, PROXIMITY AND RANGING SENSORS**9**

Motion sensors – Potentiometers, resolver, encoders – Optical, magnetic, inductive, capacitive, LVDT – RVDT – Synchro – Microsyn, accelerometer – GPS, bluetooth, range sensors – Ultrasonic ranging, Laser range sensor (LIDAR).

UNIT III : FORCE, MAGNETIC AND HEADING SENSORS**9**

Strain gage, Load cell, Magnetic sensors – Types, principle, requirement and advantages: Magneto resistive – Hall effect – Current sensor, heading sensors – Compass, gyroscope.

UNIT IV : OPTICAL, PRESSURE AND TEMPERATURE SENSORS**9**

Photo conductive cell, Photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, bellows, Piezoelectric – Tactile sensors, Temperature – IC, thermistor, RTD, thermocouple. Acoustic Sensors – Flow and level measurement, radiation sensors – Smart Sensors – MEMS & Nano sensors.

UNIT V : SIGNAL CONDITIONING AND DAQ SYSTEMS**9**

Amplification – Filtering – Sample and hold circuits – Data acquisition: single channel and multi channel data acquisition – Data logging – Applications – Automobile, aerospace, home appliances, manufacturing, environmental monitoring.

Contact Periods:

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

REFERENCES:

1. Ernest O. Doebelin, "Measurement Systems - Applications and Design", Tata McGraw-Hill, 2009.
2. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th Edition, Dhanpat Rai & Co, New Delhi, 2013.
3. Patranabis D., "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2010.
4. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.
5. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd Edition, CRC Press, 2015.

COURSE OUTCOMES:

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

- CO1:** Expertise in various calibration techniques and signal types for sensors.
- CO2:** Apply the various sensors in the automotive and mechatronics applications.
- CO3:** Study the basic principles of various magnetic sensors.
- CO4:** Study the basic principles of various smart sensors.
- CO5:** Implement the DAQ systems with different sensors for real time applications.

COURSE OBJECTIVES:

- To provide knowledge about different types of hybrid energy systems.
- To analyze the various electrical Generators used for the Wind Energy Conversion Systems.
- To design the power converters used in SPV Systems.
- To analyze the various power converters used in hybrid energy systems and to understand the importance of standalone and grid-connected operation in Hybrid renewable energy systems.
- To analyze the performance of the various hybrid energy systems

UNIT-I: INTRODUCTION TO HYBRID ENERGY SYSTEMS 9

Hybrid Energy Systems – Need for Hybrid Energy Systems – Solar-Wind-Fuel Cell-Diesel, Wind- Biomass-Diesel, Micro-Hydel-PV, Ocean and geyser energy - Classification of Hybrid Energy systems – Importance of Hybrid Energy systems – Advantages and Disadvantages - Environmental aspects of renewable energy - Impacts of renewable energy generation on the environment - Present Indian and international energy scenario of conventional and RE sources - Ocean energy, Hydel Energy - Wind Energy, Biomass energy, Hydrogen energy - Solar Photovoltaic (PV) and Fuel cells: Operating principles and characteristics.

UNIT-II: ELECTRICAL MACHINES FOR WIND ENERGY CONVERSION SYSTEMS (WECS) 9

Review of reference theory fundamentals –Construction, Principle of operation and analysis: Squirrel Cage Induction Generator (SCIG), Doubly Fed Induction Generator (DFIG) - Permanent Magnet Synchronous Generator (PMSG).

UNIT-III: POWER CONVERTERS AND ANALYSIS OF SOLAR PV SYSTEMS 9

Power Converters for SPV Systems - Line commutated converters (inversion-mode) - Boost and buck- boost converters- selection of inverter, battery sizing, array sizing - Analysis of SPV Systems - Block diagram of the solar PV systems - Types of Solar PV systems: Stand-alone PV systems.

UNIT-IV: ANALYSIS OF POWER CONVERTERS FOR HYBRID ENERGY SYSTEMS 9

Introduction to Power Converters – Stand-alone Converters -AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters - Bi-Directional Converters - Grid-Interactive Inverters - Matrix converter – Merits and Limitations.

UNIT-V: CASE STUDIES FOR HYBRID RENEWABLE ENERGY SYSTEMS 9

Hybrid Systems- Range and type of Hybrid systems – Performance Analysis – Cost Analysis - Case studies of Diesel-PV, Wind-PV-Fuel-cell, Micro-hydel-PV, Biomass-Diesel-Fuel-cell systems.

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

1. Bahman Zohuri, "Hybrid Energy Systems", Springer, First Edition, 2018.
2. S.M. Muyeen, "Wind Energy Conversion Systems", Springer First Edition, 2012
3. Md. Rabiul Islam, Md. Rakibuzzaman Shah, Mohd Hasan Ali, "Emerging Power Converters for Renewable Energy and Electric Vehicles", CRC Press, First Edition, 2021
4. Ernst Joshua, Wind Energy Technology, PHI, India, 2018, 3rd Edition.
5. S.N.Bhadra, D. Kasta, & S. Banerjee "Wind Electrical Systems", Oxford University Press, 7th Impression, 2005.
6. Rashid.M. H "Power electronics Hand book", Academic press, 4th Edition, 2018.

COURSE OUTCOMES:

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

- CO1:** Analyze the impacts of hybrid energy technologies on the environment and demonstrate them to harness electrical power.
- CO2:** Select a suitable Electrical machine for wind energy conversion systems and simulate wind energy conversion system
- CO3:** Design the power converters such as AC-DC, DC-DC, and AC-AC converters for SPV systems.
- CO4:** Analyze the power converters such as AC-DC, DC-DC, and AC-AC converters for Hybrid energy systems.
- CO5:** Interpret the hybrid renewable energy systems

22 EEOE04

BIOMEDICAL INSTRUMENTATION

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COURSE OBJECTIVES:

- To provide knowledge about the physical foundations of biological systems.
- To grasp the various electro physiological measurements in the human body.
- To get knowledge on the measurement of non-electrical parameters in the human body.
- To study the various medical imaging techniques and their applications.
- To provide knowledge in medical assisting and therapy equipment.

UNIT-I: PHYSIOLOGY

9

Man instrument system – Problems encountered in measuring a living system – Transducers for biomedical applications – Cell and its structure – Resting and action potential – Propagation of action potentials – The heart and cardiovascular system – Electrophysiology of cardiovascular system – Physiology of the respiratory system – Nervous system – Central nervous system and Peripheral nervous system – Electrode theory – Bio-potential electrodes.

UNIT-II: ELECTRO PHYSIOLOGICAL MEASUREMENT

9

ECG – Vector cardiographs – EEG – EMG – ERG – EOG – Lead system and recording methods – Typical waveforms.

UNIT-III: NON- ELECTRICAL PARAMETER MEASUREMENTS

9

Measurement of blood pressure, blood flow and cardiac output – Plethysmography – Measurement of heart sounds – Gas analysers – Blood gas analysers – Oximeters.

UNIT-IV: MEDICAL IMAGING AND TELEMETRY

9

X-ray machine – Echocardiography – Computer tomography – MRI – Diagnostic ultrasound – PET – SPECT – Electrical impedance tomography – Thermograph – Biotelemetry.

UNIT-V: ASSISTING AND THE RAPEUTIC DEVICE

9

Pacemakers – Defibrillators – Ventilator – Anesthesia machine – Nerve and muscle stimulator – Heart lung machine – Kidney machine – Audiometers – Diathermy – Endoscopes – Lasers in biomedicine.

Contact Periods:

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

REFERENCES:

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", PHI, New Delhi, 2015.
2. Khandpur R.S., "Handbook of Biomedical Instrumentation", 2nd Edition, Tata McGraw Hill 2016.
3. Geddes L. A and Baker L.E., "Principles of Applied Biomedical Instrumentation", 3rd Edition, John Wiley, New York, 2015.

4. Richard Aston, "Principles of Bio-medical Instrumentation and Measurement", Merrill Publishing Company, New York, 2016.
5. Ed. Joseph D. Bronzino, "The Biomedical Engineering Handbook" 2nd Edition, Boca Raton, CRC Press LLC, 2014.

COURSE OUTCOMES:

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

- CO1:** Understand the physical foundations of biological systems.
- CO2:** Realize the various electro physiological measurements in the human body.
- CO3:** Acquire knowledge on the measurement of non-electrical parameters in the human body.
- CO4:** Analyze the various medical imaging techniques and their applications.
- CO5:** Apply the concepts on the working of medical assisting and therapy equipment.

22 EEOE05

ELECTRIC AND HYBRID VEHICLES

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3 0 0 3

COURSE OBJECTIVES:

- To understand the operation and architecture of electric and hybrid vehicles
- To identify various energy source options like battery and fuel cell
- To select suitable electric motor for applications in hybrid and electric vehicles.
- To explain the role of power electronics in hybrid and electric vehicles
- To analyze the energy and design requirement for hybrid and electric vehicles.

UNIT-I: DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES 9

Need for Electric vehicle- Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. - Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance- Transmission efficiency- Electric vehicle chassis and Body Design, Electric Vehicle Recharging and Refuelling Systems.

UNIT-II: ENERGY SOURCES 9

Battery Parameters- - Different types of batteries – Lead Acid- Nickel Metal Hydride - Lithium ion- Sodium based- Metal Air. Battery Modelling - Equivalent circuits, Battery charging- Quick Charging devices. Fuel Cell- Fuel cell Characteristics- Fuel cell types-Half reactions of fuel cell. Ultra capacitors. Battery Management System.

UNIT-III: MOTORS AND DRIVES 9

Types of Motors- DC motors- AC motors, PMSM motors, BLDC motors, Switched reluctance motors working principle, construction and characteristics.

UNIT-IV: POWER CONVERTERS AND CONTROLLERS 9

Solid state Switching elements and characteristics – BJT, MOSFET, IGBT, SCR and TRIAC - Power Converters – rectifiers, inverters and converters - Motor Drives - DC, AC motor, PMSM motors, BLDC motors, Switched reluctance motors – four quadrant operations –operating modes

UNIT-V: HYBRID AND ELECTRIC VEHICLES 9

Main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Power Split devices for Hybrid Vehicles - Operation modes - Control Strategies for Hybrid Vehicle - Economy of hybrid Vehicles - Case study on specification of electric and hybrid vehicles.

Contact Periods:

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

REFERENCES:

1. Iqbal Husain, “Electric and Hybrid Vehicles-Design Fundamentals”, CRC Press,2003

2. Mehrdad Ehsani, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, CRCPress,2005.
3. James Larminie and John Lowry, “Electric Vehicle Technology Explained “John Wiley & Sons,2003
4. Lino Guzzella, “Vehicle Propulsion System” Springer Publications,2005
5. Ron Hod Kinson, “Light Weight Electric/ Hybrid Vehicle Design”, Butterworth Heinemann Publication,2005.

COURSE OUTCOMES:

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

- CO1:** Learn the operation and architecture of electric and hybrid vehicles
- CO2:** Classify various energy source options like battery and fuel cell
- CO3:** Select suitable electric motor for applications in hybrid and electric vehicles.
- CO4:** Explicate the role of power electronics in hybrid and electric vehicles
- CO5:** Analyze the energy and design requirement for hybrid and electric vehicles.

22ITOE01

MOBILE ADHOC NETWORKS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Understanding of the current topics in MANETs and WSNs, both from an industry and research point of views.
- Understanding of the principles of mobile ad hoc networks (MANETs) and what distinguishes them from infrastructure-based networks.
- Understand how proactive routing protocols function and their implications on data transmission delay and bandwidth consumption.
- Know about routing protocol
- Analyze various routing algorithms

9

UNIT-I: INTRODUCTION

Introduction to ad-hoc networks – definition, characteristics features, applications. Characteristics of wireless channel, ad-hoc mobility models: indoor and outdoor models.

9

UNIT-II:MEDIUM ACCESS PROTOCOLS

MAC Protocols: Design issues, goals and classification. Contention based protocols – with reservation, scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN.

9

UNIT-III: NETWORK PROTOCOLS

Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, energy aware routing algorithm, hierarchical routing, QoS aware routing.

9

UNIT-IV: END-END DELIVERY AND SECURITY

Transport Layer: Issues in designing – Transport layer classification, adhoc transport protocols. Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols

9

UNIT-V: CROSS LAYER DESIGN

Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, cross layer cautionary perspective. Integration of adhoc with Mobile IP networks.

Contact Periods:

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

REFERENCES:

1. Behrouz A. Forouzan, “Data Communications and Networking”, 5th Edition TMH, 2013.

2. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, 5th Edition, Morgan Kaufmann Publishers Inc., 2012.
3. William Stallings, “Data and Computer Communications”, 10th Edition, Pearson Education, 2013.
4. C. Siva Ram Murthy and B. S. Manoj, Ad hoc Wireless Networks Architecture and Protocols, 2nd edition, Pearson Edition, 2007.
5. Charles E. Perkins, Ad hoc Networking, Addison – Wesley, 2000.
6. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, Mobile ad-hoc networking, Wiley-IEEE press, 2004.

COURSE OUTCOMES:

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

- CO1:** Gain the knowledge of basic layers of adhoc networks.
- CO2:** Evaluate the performance MAC protocols and standards.
- CO3:** Understand the functions of routing protocols.
- CO4:** Know different protocols involved in network security enhancement.
- CO5:** Analyze the necessity of cross layer designs and Mobile IP networks.

22ITOE02

BLOCKCHAIN TECHNOLOGIES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To assess blockchain applications in a structured manner.
- To impart knowledge in block chain techniques and able to present the concepts clearly and structured.
- To understand the modern concepts of blockchain technology.
- To get familiarity with future currencies and to create own crypto token.
- To analyze the market scenario of cryptocurrency.

UNIT I: BASIC CONCEPTS 9

Introduction - Decentralized society - Disturbed Database, Byzantine General problem - Fault tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete - P2P network - Private key - Public key - Cryptography - Hash Function - Digital Signature - ECDSA - Memory Hard Algorithm - Zero Knowledge Proof.

UNIT II: BLOCKCHAIN 9

Introduction - Advantage over conventional distributed database – Network and protocols - Block chain network - Mining - Mechanism - Life Cycle of Block chain - Distributed consensus - Merkle Patricia Tree - Gas Limit - Transactions and Fee - Anonymity - Reward - Chain policy- Life of Block chain applications -Soft and Hard Fork - Private and Public blockchain.

UNIT III: DISTRIBUTED CONSENSUS 9

Nakamoto consensus - Proof of work - Proof of Stake - Proof of Burn - Difficulty level - Sybil Attack - Energy Utilization and alternate – Fabric model - SDKs - Components of Fabric Model - Architecture of Hyperledger fabric.

UNIT IV: CRYPTOCURRENCY 9

History - Distributed ledger - Bitcoin protocols - Mining strategy and rewards - Ethereum - construction - Truffle - DAO - dApps - Smart Contract - Boot strapping - GHOST Vulnerability - Attacks - Sidechain - Namecoin.

UNIT V: CRYPTOCURRENCY REGULATIONS 9

Stakeholders - Roots and Bitcoin - Legal Aspects - Crypto currency exchange - Black market and Global economy. Applications : IoT - Medical Record Management system - Domain Name Service and future of Blockchain - Business applications and assessing blockchain projects.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 30 Periods Total: 75 Periods

REFERENECS:

1. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained”, Second Edition, Packt Publishing, 2018.
2. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction” Princeton University Press, 2016
3. Antonopoulos, Mastering Bitcoin, O’Reilly Publishing, 2014. .
4. Antonopoulos and G. Wood, “Mastering Ethereum: Building Smart Contracts and Dapps”, O’Reilly Publishing, 2018.
5. D. Drescher, Blockchain Basics. Apress, 2017.

COURSE OUTCOMES:

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

- CO1:** Understand the various technologies and its business use.
- CO2:** Analyse the block chain applications in a structure manner.
- CO3:** Explain the modern concepts of block chain technology systematically.
- CO4:** Handle the cryptocurrency.
- CO5:** Understand the modern currencies and its market usage

22ITOE03

OPEN SOURCE TECHNOLOGIES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To differentiate open source software and commercial software.
- To familiarize with Linux operating system.
- To examine web applications using open source web technologies like Apache, MySQL and PHP (LAMP/XAMP).
- To implement table commands and table joins.
- To learn cookies and sessions with PHP and MySQL.

UNIT-I: OPEN SOURCE

9

Introduction to Open Source – Open Source vs. Commercial Software – What is Linux? - Free Software – Basics of Linux - Linux Kernel – Linux Distributions.

UNIT-II: LINUX

9

Introduction to Linux Essential Commands - File system Concept - Standard Files - The Linux Security Model - Vi Editor - Partitions creation - Shell Introduction - String Processing - Investigating and Managing Processes - Network Clients – Installing Application.

UNIT-III: APACHE

9

Apache Explained - Starting, Stopping, and Restarting Apache - Modifying the Default Configuration - Securing Apache - Set User and Group - Consider Allowing Access to Local Documentation - Don't Allow public html Web sites - Apache control with .htaccess.

UNIT-IV: MYSQL

9

Introduction to MYSQL - The Show Databases and Table - The USE command - Create Database and Tables - Describe Table - Select, Insert, Update, and Delete statement - Some Administrative detail - Table Joins - Loading and Dumping a Database.

UNIT-V: PHP

9

Introduction- General Syntactic Characteristics - PHP Scripting - Commenting your code -Primitives, Operations and Expressions - PHP Variables - Operations and Expressions Control Statement - Array - Functions - Basic Form Processing - File and Folder Access - Cookies - Sessions - Database Access with PHP - MySQL - MySQL Functions - Inserting Records - Selecting Records - Deleting Records - Update Records.

Contact Periods:

Lecture: 45 Periods

Tutorial: 0 Periods

Practical: 0 Periods

Total: 45 Periods

REFERENCES:

1. Steven Weber, "The success of Open Source", Harvard University Press October 31, First Edition, 2021.
2. Ellen Siever, Stephen Figgins, Robert Love, Arnold Robbins, "Linux in a Nutshell", Sixth Edition, O'Reilly Media, 2009.
3. James Lee and Brent Ware, "Open Source Web Development with LAMP using Linux, Apache, MySQL, Perl and PHP", Dorling Kindersley (India) Pvt. Ltd, 2008.
4. Eric Rosebrock, Eric Filson, "Setting Up LAMP: Getting Linux, Apache, MySQL, and PHP and working Together", Published by John Wiley and Sons, 2004.

COURSE OUTCOMES:

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

CO1: Compare the open source software and commercial software.

CO2: Study, install and run Linux operating system.

CO3: Identify and install open source web technology Apache and manage applications.

CO4: Manage users and privileges in MySQL and to handle SQL functions.

CO5: Design and develop complete website using PHP.

22ITOE04 ANDROID APPLICATION DEVELOPMENT

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To facilitate students to understand android SDK
- To gain a basic understanding of Android application development
- To inculcate working knowledge of creating mobile interface
- To learn about testing of android application
- To create basic android applications

UNIT-I: INTRODUCTION TO ANDROID 9

The Android Platform, Android SDK, Eclipse Installation, Android Installation, Building you First Android application, Understanding Anatomy of Android Application, Android Manifest file.

UNIT-II: ANDROID APPLICATION DESIGN ESSENTIALS: 9

Anatomy of an Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions.

UNIT-III: ANDROID USER INTERFACE DESIGN ESSENTIALS 9

User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation

UNIT-IV: TESTING ANDROID APPLICATION 9

Testing Android applications, Publishing Android application, Using Android preferences, Managing Application resources in a hierarchy, working with different types of resources.

UNIT-V: ANDROID APPLICATION 9

Using Common Android APIs: Using Android Data and Storage APIs, Managing data using Sqlite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World.

Contact Periods:

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

REFERENCES:

1. Lauren Darcey and Shane Conder, “Android Wireless Application Development”, Pearson Education, 2nd ed. (2011)
2. Reto Meier, “Professional Android 2 Application Development”, Wiley India Pvt Ltd

3. Mark L Murphy, “Beginning Android”, Wiley India Pvt Ltd
4. Android Application Development All in one for Dummies by Barry Burd, Edition: I

COURSE OUTCOMES:

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

- CO1:** Identify various concepts of mobile programming that make it unique from programming for other platforms,
- CO2:** Critique mobile applications on their design pros and cons,
- CO3:** Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces
- CO4:** Program mobile applications for the Android operating system that use basic and advanced phone features
- CO5:** Deploy applications to the Android marketplace for distribution

22ITOE05

DIGITAL AND MOBILE FORENSICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand basic digital forensics and techniques.
- To understand digital crime and investigation.
- To understand how to be prepared for digital forensic readiness.
- To understand and use forensics tools for iOS devices.
- To understand and use forensics tools for Android devices.

UNIT I: INTRODUCTION TO DIGITAL FORENSICS 9

Forensic Science – Digital Forensics – Digital Evidence – The Digital Forensics Process – Introduction – The Identification Phase – The Collection Phase – The Examination Phase – The Analysis Phase – The Presentation Phase

UNIT II : DIGITAL CRIME AND INVESTIGATION 9

Digital Crime – Substantive Criminal Law – General Conditions – Offenses – Investigation Methods for Collecting Digital Evidence – International Cooperation to Collect Digital Evidence

UNIT III: DIGITAL FORENSIC READINESS 9

Introduction – Law Enforcement versus Enterprise Digital Forensic Readiness – Rationale for Digital Forensic Readiness – Frameworks, Standards and Methodologies – Enterprise Digital Forensic Readiness – Challenges in Digital Forensics

UNIT IV: iOS FORENSICS 9

Mobile Hardware and Operating Systems - iOS Fundamentals – Jailbreaking – File System – Hardware – iPhone Security – iOS Forensics – Procedures and Processes – Tools – Oxygen Forensics – MobilEdit – iCloud

UNIT V: ANDROID FORENSICS 9

Android basics – Key Codes – ADB – Rooting Android – Boot Process – File Systems – Security – Tools – Android Forensics – Forensic Procedures – ADB – Android Only Tools – Dual Use Tools – Oxygen Forensics – MobilEdit – Android App Decompiling

Contact Periods:

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

REFERENECS:

1. Andre Arnes, “Digital Forensics”, Wiley, 2018.

2. Chuck Easttom, “An In-depth Guide to Mobile Device Forensics”, First Edition, CRC Press, 2022.
3. Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.

COURSE OUTCOMES:

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

- CO1:** Have knowledge on digital forensics.
- CO2:** Know about digital crime and investigations.
- CO3:** Be forensic ready.
- CO4:** Investigate, identify and extract digital evidence from iOS devices.
- CO5:** Investigate, identify and extract digital evidence from Android devices.

22MEOE01

TESTING OF MATERIALS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Basic fundamentals of materials and their properties.
- Various mechanical testing methods, processes, properties and applications.
- Different types of NDT testing methods, processes, properties and applications.
- The different methods of materials, their properties, classifications and applications and acquire knowledge to apply on the respective fields.
- Various tests on different materials and know about the failure mechanism.

UNIT I: INTRODUCTION TO MATERIALS TESTING

9

Overview of materials, Classification of material testing, Purpose of testing, Selection of material, Development of testing, Testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing.

UNIT II: MECHANICAL TESTING

9

Introduction to mechanical testing, Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT III: NON-DESTRUCTIVE TESTING

9

Visual inspection, Liquid penetrant test, Magnetic particle test, Thermography test – Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission- Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT IV: MATERIAL CHARACTERIZATION TESTING

9

Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) – Principles, Types, Advantages and Limitations, Applications. Diffraction techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.

UNIT-V: OTHER TESTING

9

Thermal Testing: Differential scanning calorimetry, Differential thermal analysis. Thermomechanical and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass spectrometry.

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

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing”, Narosa Publishing House, 2009.
2. Cullity, B. D., “Elements of X-ray diffraction”, 3rdEdition, Addison-Wesley Company Inc., New York, 2000.
3. P. Field Foster, “The Mechanical Testing of Metals and Alloys” 7thEdition, Couse Press, 2007.
4. Brandon D.G., “Modern Techniques in Metallography”, Von Nostrand Inc. NJ, USA, 1986.
5. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9thEdition, American Society for Metals, 1978.
6. ASM Metals Handbook, “Non-Destructive Evaluation and Quality Control”, American Society of Metals, Metals Park, Ohio, USA 2000.

COURSE OUTCOMES:

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

- CO1:** Apply the fundamental concepts of material selection and acquire knowledge on testing.
- CO2:** Identify the suitable testing methods and process to attain the specified microstructural changes in the metal.
- CO3:** Choose the different types of methods and testing on the basis of the material and make use of them in their specific application areas.
- CO4:** Identify the different methods of materials, their properties, classifications and applications and acquire knowledge to apply on the respective fields.
- CO5:** Select the various tests on different materials and know about the failure mechanism.

22MEOE02

WELDING TECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the gas and arc welding processes.
- To learn the resistance welding processes.
- To understand the solid state welding processes.
- To study the special welding processes.
- To understanding of inspection methods of welded products and also helps to know the material considerations of this operation.

UNIT-I: GAS AND ARC WELDING PROCESSES

9

Fundamental principles – Air Acetylene welding, Oxyacetylene welding, Carbon arc welding, Shielded metal arc welding, Submerged arc welding, TIG & MIG welding, Plasma arc welding and Electroslag welding processes - Advantages, Limitations and Applications.

UNIT-II: RESISTANCE WELDING PROCESSES

9

Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussion welding and High frequency resistance welding processes –Advantages, Limitations and Applications.

UNIT-III: SOLID STATE WELDING PROCESSES

9

Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, Roll welding and Hot pressure welding processes - Advantages, Limitations and Applications.

UNIT-IV: OTHER WELDING PROCESSES

9

Thermit welding, Atomic hydrogen welding, Electron beam welding, Laser Beam welding, Friction stir welding, Under Water welding, Welding automation in aerospace, Nuclear and surface transport vehicles.

UNIT-V:DESIGN OF WELD JOINTS, WELDABILITY AND TESTING OF WELDMENTS

9

Various weld joint designs – Welding defects – Causes and remedies – Weldability of Aluminium, Copper, and Stainless steels. Destructive and non-destructive testing of weldments.

Contact periods:

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

REFERENCES:

1. O.P.Khanna, "Welding Technology", Dhanpat Rai and sons, 2011.
2. Davis A.C., "The Science and Practice of Welding", Cambridge University Press, Cambridge, 2010.
3. Little R.L., "Welding and welding Technology", Tata McGraw Hill Publishing Co., Ltd., New Delhi, 34th reprint, 2008.
4. Parmer R.S., "Welding Engineering and Technology", 1st Edition, Khanna Publishers, New Delhi, 2008.
5. Nadkarni S.V., "Modern Arc Welding Technology", South Asia Books, 2008.
6. Parmer R.S., "Welding Processes and Technology", Khanna Publishers, New Delhi, 1992

COURSE OUTCOMES:

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

CO1: Understand the construction and working principles of gas and arc welding process.

CO2: Understand the construction and working principles of resistance welding process.

CO3: Understand the construction and working principles of various solid state welding process.

CO4: Understand the construction and working principles of various special welding processes.

CO5: Understand the concepts on weld joint design, Weldability and testing of weldments.

22MEOE03	INDUSTRIAL SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study about the safety concept Technical and Managerial roles in the Industries.
- To apply knowledge on investigation and reporting in the working environment.
- To use quality of safety education and training to foresee and solve issues in the industrial situations.
- To learn about the safety management associated with the agencies.
- To familiarize with safety audit and regulation.

UNIT I: SAFETY CONCEPT 9

Evolution of modern safety concept – History of safety movement –Influence of environmental safety – Hazards – Safety policy – Safety survey, Safety inspection safety culture and Behavioural safety.

UNIT II: ACCIDENT INVESTIGATION AND REPORTING 9

Concept of an accident, Reportable and non reportable accidents – Principles of accident prevention accident investigation and analysis – Documentation of accidents – Unsafe act and unsafe condition domino sequence – Role of safety committee and cost of accident.

UNIT III: SAFETY EDUCATION AND TRAINING 9

Importance of training – Training methods –Method of promoting safe practice – Motivation – Role of government agencies and private consulting agencies in safety training – Creating awareness – Safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign.

UNIT IV: SAFETY MANAGEMENT 9

General concept of safety management – National Safety Council-OSHA, their roles in safety propagation – Evolution of modern safety concept – Planning for safety for optimization of productivity – Line and staff functions for safety – Safety sampling, fault tree analysis.

UNIT-V: SAFETY AUDIT AND SAFETY REGULATION 9

Components of safety audit, types of audit, audit methodology, non-conformity reporting (NCR), audit checklist and report – Review of inspection, safety measures in factories act, pollution control act for water, air, and land. OSHAS18001, ISO14001.

Contact periods:

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

REFERENCES:

1. Vollman TE., "Manufacturing Planning and Control Systems", Galgotia Publications, 2002.
2. Elwood S. Buffa, and Rakesh K. Sarin, "Modern Production/Operation Management", 8th Edition, John Wiley & Sons, 2000.
3. Krishnan N.V, "Safety management in Industry", Jaico Publishing House, Bombay, 1997.
4. Dan Petersen, "Techniques of Safety Management", Mc Graw-Hill Company, Tokyo, 1981.
5. "Accident Prevention Manual for Industrial Operations", N.S.C Chicago, 1980.
6. Heinrich H.W, "Industrial accident Prevention", McGraw-Hill Company, New York, 1980.

COURSE OUTCOMES:

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

- CO1:** Anticipate, identify, evaluate, and control workplace hazardous conditions and practices.
- CO2:** Develop effective safe operating procedures and comprehensive safety and health programs.
- CO3:** Address identified hazards, conditions, and practices in a cost effective manner.
- CO4:** Apply the general concept of safety management and planning for safety for optimization of productivity.
- CO5:** Measure and evaluate occupational safety and health performance.

22MEOE04

MARKETING MANAGEMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To familiarize with the basic concepts, and techniques of salesmanship.
- To learn and behave about the quality of salesman.
- To create awareness of marketing Remuneration / Compensation.
- To analyse and solve marketing problems in the complex and fast changing business environment.
- To understand the behaviour of consumers.

UNIT I: SALESMANSHIP

9

Meaning, Definition, Characteristics, Concept, Kinds, Nature – Evolution, and psychology in selling, Scope, Limitations and importance – Sales management: meaning, definition, Characteristics, Principles, Functions and importance, Difference between sales management and marketing management.

UNIT II: SALESMAN

9

Types, Qualities, Objectives, Duties and responsibilities of good salesman, Recruitment, selection and training of salesman: Sources of recruitment, Principles of selection, Selection procedure, Meaning, Advantages, Disadvantages, Methods, Principles and limitation, Subject matter and Types of good training programme.

UNIT III: REMUNERATION/ COMPENSATION

9

Essentials of Good Remuneration Plan, Objectives – Methods, Factors determining Remuneration Plan, Comparative study of various plans. Motivating sales force: Meaning, Definition, Objectives, Importance and methods.

UNIT IV: SALES PLANNING

9

Meaning, Components, Elements, Types, Importance and limitations, Sales fields or territories: Meaning, Definition, Objectives, Factors determining Size, Allocation of sales territories, Steps in setting sales territories. Sales quota: Meaning, Definition, Objectives, Factors determining sales quota, Methods of determining sales quota, Types, Principles of successful sales quota, Advantages and disadvantages of sales quota.

UNIT-V: CONSUMER BEHAVIOUR

9

Meaning, Definition, Variables and factors affecting Consumer behaviour – Buying Motives: Meaning, Kinds, Chief buying motives – Different types of consumers – Behaviour and customer service.

Contact periods:

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

REFERENCES:

- 1.Santoki, “Sales Management”, Kalyani Publisher 2010.
- 2.Gupta S L., “Sales and Distribution Management”, Excel Books, New Delhi, 2008.
- 3.Still R and Richard, “Sales Management”, Pearson Prentice Hall, Delhi 2007.
- 4.Schiffman, Kanuk and Kumar, “Consumer Behaviour”, Pearson, 10th Edition 2005.
- 5.Kotler and Keller, “Marketing Management”, Pearson Publication 2004.

COURSE OUTCOMES:

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

CO1:Understand the concepts for salesmanship.

CO2:Developed knowledge of salesman responsibilities.

CO3:Understand the concepts for remuneration and compensation methods.

CO4:Developed knowledge of sales planning techniques.

CO5: Understand the use of consumer behaviour concepts.

22MEOE05

MAINTENANCE ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the principles, functions and practices adapted in industry for the successful management of maintenance activities.
- To identify the different maintenance categories like Preventive maintenance and Total Productive Maintenance.
- To illustrate some of the simple instruments used for condition monitoring in industry.
- To learn the fundamental components of mechanical systems functions and predict the faulty locations.
- To study the appropriate repair methods and maintaining records.

UNIT I: PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING 9

Basic principles of maintenance planning – Objectives and principles of planned maintenance – Importance and benefits of sound maintenance systems – Reliability and machine availability – MTBF, MTTR and MWT – Factors of availability – Maintenance organization – Maintenance economics.

UNIT II: MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE 9

Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, Repair cycle – Principles and methods of lubrication – TPM.

UNIT III: CONDITION MONITORING 9

Condition monitoring – Cost comparison with and without CM – On-load testing and off-load testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – Wear debris analysis.

UNIT IV: REPAIR METHODS FOR BASIC MACHINE ELEMENTS 9

Repair methods for beds, slide ways, Spindles, Gears, Lead screws and bearings – Failure analysis – Failures and their development – Logical fault location methods – Sequential fault location.

UNIT-V: REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT 9

Repair methods for material handling equipment – Equipment records – Job order systems – Use of computers in maintenance.

Contact periods:

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

REFERENCES:

1. Bhattacharya S N., "Installation, Servicing and Maintenance", S. Chand and Co., 2013.
2. Venkataraman K., "Maintenance Engineering and Management", PHI Learning Pvt. Ltd. 2010.
3. Srivastava S.K., "Industrial Maintenance Management", - S. Chand and Co., 2006.
4. Higgins L R., "Maintenance Engineering Hand book", McGraw Hill, 5th Edition, 1994.
5. White E N., "Maintenance Planning", I Documentation, Gower Press, 1979.
6. Garg M R., "Industrial Maintenance", S. Chand & Co., 1987.

COURSE OUTCOMES:

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

- CO1:** Explain basic principle of maintenance and practices the maintenance in organization and economics.
- CO2:** Practice the various maintenance policies and the various preventive maintenances.
- CO3:** Describe various aspects of condition monitoring and able to perform estimation Analysis.
- CO4:** Practice various repairs and able to predict the faulty locations.
- CO5:** Familiarize various methods of repairing material handling equipments.