UG-R22 Curriculum
With effective from 2022-23

Electrical and Electronics Engineering

Scheme of Instruction and Syllabi of
B.E I to IV Semester of
Four Year Degree Course

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
(An Autonomous Institute | Affiliated to Osmania University)
Accreditated by NBA & NAAC (A++)
Kokapet Village, Gandipet Mandal, Hyderabad -500075, Tel
E-mail: principal@cbit.ac.in, Website: www.cbit.ac.i
Phone No. : 040-24193276 / 277 / 279

HEAD
Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

SCHEME OF INSTRUCTION AND SYLLABI (R-22)

OF

B.E. I to IV SEMESTERS OF FOUR YEAR DEGREE COURSE

IN

ELECTRICAL & ELECTRONICS ENGINEERING

(Inline with AICTE Model Curriculum with effect from AY 2022-23)

(R–22 Regulation)

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Affiliated to OU, Approved by AICTE, Accredited by NBA, NAAC (A++)

Kokapet Village, Gandipet Mandal, Hyderabad– 500 075. Telangana

E-Mail: principal@cbit.ac.in; Website: www.cbit.ac.in;

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Gandipet, Hyderabad-75

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
(Autonomous)

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

INSTITUTE VISION AND MISSION

Vision:
To be centre of excellence in technical education and research

Mission:
To address the emerging needs through quality technical education and advanced research

DEPARTMENT VISION & MISSION

Vision:

To achieve Academic and Professional Excellence in Teaching and Research in the frontier areas of Electrical and Electronics Engineering Vis-a -Vis serve as a Valuable Resource for Industry and Society.

Mission:

Empowering the Faculty and Student Rendezvous to Nurture Interest for Conceptual Keystone, Applied Multidisciplinary Research, and Inspiring Leadership and Efficacious Entrepreneurship culture, Impeccable Innovation in frontier areas to be synergetic with Environmental, Societal and Technological Developments of the National and International community for Universal Intimacy.

M1: Emphasis on providing Strong Theoretical Foundation & Engineering Leadership Eminence, infusion of Creativity and Management skill while maintaining Ethics and Moral for Sustainable Development. **(Individual development)**

M2: Enable the Faculty and Student Interactions to trigger interest for Applied Multidisciplinary Research and Entrepreneurship Culture resulting in Significant Advancement of the field of Specialization with Involvement of Industries and Collaborative Educational Networks. **(Sense of Ownership, Networking and Eco system Development)**

M3: Extend the Conducive Neighbourhoods for Innovation in frontier areas to keep pace with Environmental, Societal and Technological Developments of the National and International Community to Serve Humanity. **(Service to Society, Atmanirbhar Bharat)**

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PROGRAME EDUCATIONAL OBJECTIVES (PEOS):

- **PEO1-** Graduates will Ennoble in offering Design solutions for Complex Engineering Problems using appropriate modern Software tools, with the specified need of the Industry and Protagonist in transforming the Society into a Knowledge Society.

- **PEO2-** Graduates will Elevate Engineering Leadership and will be recognized as Experts working in in Government, Consulting firms, International organizations with their Creativity in Design of Experiments, Analysis and Interpretation of Data and Synthesis of Information.

- **PEO 3-** Graduates will Exalt in their Professional career by Persistence in Team work, Ethical behavior, Proactive involvement, and Effective Communication.
- **PEO 4-** Graduate will Excel by becoming Researches , Professors and Entrepreneurs who will create and Disseminate new knowledge in the frontier areas of Engineering , Technology and Management

PROGRAM OUTCOMES (POs):

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

2. **Problem Analysis**: Identify, formulate, review research literature, and analyse 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.

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

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

PROGRAM SPECIFIC OUTCOMES (PSOS):

PSO 1: Evaluate complex Engineering Problems to meet the distinct need of Industry & Society, by utilizing knowledge of Mathematics, Science, Emerging Technologies such as AI, Block chain & IT tools.

PSO 2: Exhibit Latent talent in understanding the Engineering and Administration standards at work place as a team leader to manage Projects in the Multi-Disciplinary Environments.

PSO 3: Establish Engineering Expertise in Power system, Machines and Drives Systems and also Pursue Research in the Frontier areas such as Embedded systems, Renewable Energy, E-Mobility and Smart grid.

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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

(Inline with AICTE Model Curriculum with effect from AY 2022-23)

SEMESTER – I

S. No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per Week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	22MTC02	Calculus	3	1	0	3	40	60	4
2	22CYC01	Chemistry	3	0	0	3	40	60	3
3	22EEC01	Basic Electrical Engineering	2	1	0	3	40	60	3
4	22CSC01	Problem Solving and Programming	2	1	0	3	40	60	3
PRACTICAL									
5	22CYC02	Chemistry Lab	0	0	3	3	50	50	1.5
6	22MBC02	Community Engagement	0	0	3	-	50	-	1.5
7	22CSC02	Problem Solving and Programming Lab	0	0	3	3	50	50	1.5
8	22MEC37	Robotics & Drones Lab	0	2	2	-	100	-	3
9	22EEC02	Basic Electrical Engineering Lab	0	0	2	3	50	50	1
TOTAL			**10**	**5**	**13**	**-**	**460**	**390**	**21.5**
Clock Hours Per Week: 28									

L: Lecture **D: Drawing** **CIE: Continuous Internal Evaluation**
T:Tutorial **P: Practical/Project Seminar/Dissertation** **SEE: Semester End Examination**

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22MTC02

CALCULUS
(EEE)

Instruction	3 L+1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

COURSE OBJECTIVES: This course aims to:

1. To explain the solutions of system of linear equations by Matrix Methods.
2. To discuss mean value theorems.
3. To explain the Partial Derivatives and the extreme values of functions of two variables.
4. To explain the shape of curves, their areas and volumes of revolutions.
5. To discuss the convergence and divergence of the series.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Apply the Matrix Methods to solve system of linear equations.
2. Analyze the geometrical interpretation of Mean value theorems and curvature.
3. Determine the extreme values of functions of two variables.
4. Find the shape of the curve, surface areas and volumes of revolution.
5. Examine the convergence and divergence of infinite Series.

CO-PO Articulation Matrix:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	-	-	-	-	-	-	-	2
CO 2	3	3	3	3	-	-	-	-	-	-	-	2
CO 3	3	3	3	3	-	-	-	-	-	-	-	2
CO 4	3	3	3	3	-	-	-	-	-	-	-	2
CO 5	3	3	3	1	-	-	-	-	-	-	-	1

UNIT-I

Matrices: Rank of a matrix, Echelon form, consistency of linear system of equations, Linear dependence and independence of vectors. Eigen values, Eigenvectors, Properties of Eigen values and Eigen vectors, Cayley Hamilton theorem, Quadratic form, Reduction of quadratic form to canonical form by linear transformation, Nature of quadratic form.

UNIT-II

Calculus: Rolle's Theorem, Lagrange's Mean value theorem, Cauchy's Mean value theorem (without proofs). Curvature, Radius of curvature, Centre of curvature, Evolute and Involute, Envelopes.

UNIT-III

Partial Differentiation and Its Applications: Functions of two or more variables, Partial derivatives, Higher order partial derivatives, Total derivative, Differentiation of implicit functions, Jacobians, Taylor's expansion of functions of two variables, Maxima and minima of functions of two variables.

UNIT-IV

Applications of definite integrals: Curve tracing of standard curves (Cartesian only), Applications of definite integrals to evaluate length of curves, surface areas and volumes of revolutions.

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UNIT-V

Sequences and Series: Convergence of sequence and series. Tests for convergence of series: Comparison test, limit comparison test, D'Alembert's ratio test, Raabe's test, Cauchy's root test, Alternating series, Leibnitz's series, absolute and conditional convergence.

TEXT BOOKS:

1. B.S.Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.

SUGGESTED READING:

1. B.V.Ramana., "Higher Engineering Mathematics", 11th Reprint, Tata McGraw-Hill, New Delhi, 2010.
2. R.K.Jain, S.R.K.Iyengar, "Advanced Engineering Mathematics", 5th edition, Narosa Publications, 2016.
3. David.Poole, "Linear Algebra: A Modern Introduction", 2nd Edition, Brooks/ Cole, 2005.

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22CY C01

CHEMISTRY
(EEE)

Instruction:	3L Hours per Week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	60 Marks
Continuous Internal Evaluation:	40 Marks
Credits:	3

COURSE OBJECTIVES: This course aims

1. This syllabus helps at providing the concepts of chemical bonding and chemical kinetics to the students aspiring to become practicing engineers
2. Thermodynamic and Electrochemistry units give conceptual knowledge about processes and how they can be producing electrical energy and efficiency of systems.
3. To teach students the value of chemistry and to improve the research opportunities knowledge of stereochemistry and organic reactions is essential.
4. Water chemistry unit impart the knowledge and understand the role of chemistry in the daily life.
5. New materials lead to discovering of technologies in strategic areas for which an insight into Polymers, nanomaterials and basic drugs of modern chemistry is essential.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Identify the microscopic chemistry in terms of molecular orbitals, intermolecular forces and rate of chemical reactions.
2. Discuss the properties and processes using thermodynamic functions, electrochemical cells and their role in batteries and fuel cells.
3. Illustrate the major chemical reactions that are used in the synthesis of organic molecules.
4. Classify the various methods used in treatment of water for domestic and industrial use.
5. Outline the synthesis of various Engineering materials & Drugs.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	-	-	2	2	-	-	-	-	2
CO 2	3	2	2	-	-	2	2	-	-	-	-	2
CO 3	3	2	3	-	-	2	2	-	-	-	-	2
CO 4	3	2	3	-	-	2	2	-	-	-	-	2
CO 5	3	2	2	-	-	2	2	-	-	-	-	2

UNIT-I

Atomic and molecular structure and Chemical Kinetics: Atomic and molecular structure: Molecular Orbital theory - atomic and molecular orbitals. Linear combination of atomic orbitals (LCAO) method. Molecular orbitals of diatomic molecules. Molecular Orbital Energy level diagrams (MOED) of diatomic molecules & molecular ions (H_2, He_2^+, N_2, O_2, O_2^-, CO, NO). Pi- molecular orbitals of benzene and its aromaticity.
Chemical Kinetics: Introduction, Terms involved in kinetics: rate of reaction, order & molecularity; First order reaction-Characteristics: units of first order rate constant & its half-life period, second order reaction-Characteristics: units of second order rate constant & its half- life period. Numericals.

UNIT-II

Use of free energy in chemical equilibria: Use of free energy in chemical equilibria: Thermodynamic functions: Internal energy, entropy and free energy. Significance of entropy and free energy (criteria of spontaneity). Free energy and emf (Gibbs Helmholtz equations and its applications). Cell potentials, electrode potentials, and – Reference electrodes (NHE, SCE) electrochemical series. Nernst equation and its applications. Determination of pH using combined Glass & Calomel electrode. Potentiometric Acid base & Redox Titrations. Numericals.
Battery technology: Rechargeable batteries & Fuel cells.

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Lithium batteries: Introduction, construction, working and applications of Li-MnO_2 and Li-ion batteries.
Fuel Cells: Introduction, difference between conventional cell and fuel cell, limitations & advantages. Construction, working & applications of methanol-oxygen fuel cell.

UNIT- III

Stereochemistry and Organic reactions: Stereochemistry: Representations of 3 dimensional structures, Types of stereoisomerism- Conformational isomerism – confirmations of n-butane (Newman and sawhorse representations), Configurational isomerism -Geometrical (cis-trans) isomerism & Optical isomerism- optical activity, Symmetry and chirality: Enantiomers (lactic acid)&Diastereomers (Tartaric acid), Absolute configurations, Sequence rules for R&S notation.

Types of Organic reactions: Substitution Reactions- Electrophilic substitution (Nitration of Benzene); Nucleophilic Substitution (S_N1& S_N2); Free Radical Substitution (Halogenation of Alkanes)

Addition Reactions: Electrophilic Addition – Markonikoff's rule, Free radical Addition - Anti Markonikoff's rule (Peroxide effect), Nucleophilic Addition – (Addition of HCN to carbonyl compounds)

Eliminations-E1 and E2 (dehydrohalogenation of alkyl halides), Cyclization (Diels - Alder reaction)

UNIT–IV :

Water Chemistry: Hardness of water – Types, units of hardness, Disadvantages of hard water, Alkalinity and Estimation of Alkalinity of water, Boiler troubles - scales & sludge formation, causes and effects, Softening of water by lime soda process (Cold lime soda process), ion exchange method and Reverse Osmosis. Specifications of potable water & industrial water. Disinfection of water by Chlorination; break point chlorination, BOD and COD definition, Estimation (only brief procedure) and significance, Numericals.

UNIT-V

Engineering Materials and Drugs: Introduction, Terms used in polymer science; Thermoplastic polymers (PVC) &Thermosetting polymers (Bakelite); Elastomers (Natural rubber). Conducting polymers- Definition, classification and applications.

Polymers for Electronics: Polymer resists for integrated circuit fabrication, lithography and photolithography

Nano materials-Introduction to nano materials and general applications, basic chemical methods of preparation-Sol-gel method. Carbon nanotubes and their applications. Characterisation of nanomaterials by SEM and TEM (only Principle).

Drugs-Introduction, Synthesis and uses of Aspirin (analgesic), Paracetamol (Antipyretic), Atenolol (antihypertensive).

TEXT BOOKS

1. P.C. Jain and M. Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company Ltd., New Delhi,16th edition (2015).
2. W.U. Malik, G.D.Tuli and R.D.Madan, "Selected topics in Inorganic Chemistry", S Chand & Company Ltd, New Delhi, reprint (2009).
3. R.T. Morrison, R.N. Boyd and S.K. Bhattacharjee, "Organic Chemistry", Pearson, Delhi, 7th edition(2019).
4. A Textbook of Polymer Science and Technology , Shashi Chawla ,Dhanpat Rai & Co. (2014)
5. T. Pradeep, Nano: The Essentials, Tata McGraw-Hill Education, Delhi, 2012 G.L. David Krupadanam, D. Vijaya Prasad, K. Varaprasad Rao, K.L.N. Reddy and C.Sudhakar, "Drugs", Universities Press (India) Limited, Hyderabad (2007).

SUGGESTED READINGS

1. B. H. Mahan, "University Chemistry", Narosa Publishing house, New Delhi, 3rd edition (2013).
2. B.R. Puri, L.R. Sharma and M.S. Pathania, "Principles of Physical Chemistry", S. Nagin Chand & Company Ltd., 46th edition(2013).
3. T.W. Graham Solomons, C.B. Fryhle and S.A. Snyder, "Organic Chemistry", Wiley,12th edition (2017).
4. P.W. Atkins, J.D. Paula, "Physical Chemistry", Oxford, 8th edition (2006).

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22EEC01

BASIC ELECTRICAL ENGINEERING

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. To understand the behaviour of different circuit elements R, L & C, and the basic concepts of electrical AC circuit analysis
2. To comprehend the basic principle of operation of AC and DC machines
3. To infer about different types of electrical wires and cables, domestic and industrial wiring, safety rules and methods of earthing.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Understand the concepts of Kirchhoff's laws and their application various theorems to get solution of simple dc circuits.
2. Predict the steady state response of RLC circuits with AC single phase/three phase supply.
3. Infer the basics of single phase transformer
4. Describe the construction, working principle of DC machine and 3-phase Induction motor.
5. Acquire the knowledge of electrical wires, cables, earthing, Electrical safety precautions to be followed in electrical installations and electric shock and its safety and energy calculations.

CO-PO Articulation Matrix:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO-1	3	3	2	-	-	-	-	-	1	2	-	3
CO-2	3	3	2	-	-	-	-	-	1	2	-	3
CO-3	3	3	2	1	-	-	-	-	1	2	-	3
CO-4	2	1	-	-	-	-	-	-	1	2	-	3
CO-5	2	-	2	-	-	-	-	-	1	2	-	3

1 - Slightly; 2 - Moderately; 3 - Substantially

UNIT-I

DC Circuits: Electrical circuit elements (R,L and C), voltage and current sources, Kirchhoff current and voltage laws, analysis of simple circuits with dc excitation, Superposition, Thevenin's and Norton's Theorems.

UNIT-II

AC Circuits: Representation of sinusoidal waveforms, peak and RMS values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L, C, series RL and RC. Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT-III

Single Phase Transformer: Construction, Working principle, EMF Equation, Ideal and Practical transformer, Equivalent circuit of Transformer, OC and SC tests on a transformer, Efficiency and Regulation

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UNIT-IV

DC and AC Machines: DC Generators: Construction, Principle of operation, EMF equation, Classification, Characteristics of shunt generators. DC Motors: Classification, Torque Equation, Characteristics and Speed control of DC Shunt and Series Motors, Losses and efficiency Three - Phase Induction Motors: Principle of operation, Applications

UNIT-V

Electrical Installations: Electrical Wiring: Types of wires and cables, Electrical Safety precautions in handling electrical appliances, electric shock, and first aid for electric shock, safety rules. Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, Earthing (Elementary Treatment only), Elementary calculations for energy consumption

TEXT BOOKS:

1. L. S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011.
2. E. Hughes, Electrical and Electronics Technology, Pearson, 2010.

SUGGESTED READING:

1. D. P. Kothari & I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989
3. D.C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009
4. P.V. Prasad, S. Sivanagaraju, R. Prasad, "Basic Electrical and Electronics Engineering" Cengage Learning, 1st Edition, 2013

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22CSC01

PROBLEM SOLVING AND PROGRAMMING

Instruction	2L + 1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Develop logical skills and basic technical skills so that students should be able to solve basic computational problems.
2. Learn any basic programming language.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Understand real world problems and develop computer solutions for those problems.
2. Understand the basics of Python.
3. Apply Python for solving basic programming solutions.
4. Create algorithms/flowcharts for solving real-time problems.
5. Build and manage dictionaries to manage data.
6. Handle data using files.

CO-PO Articulation Matrix:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
1	3	1	1	-	1	-	-	-	-	-	-	1
2	3	1	1	-	1	-	-	-	-	-	-	1
3	3	1	1	-	1	-	-	-	-	-	-	1
4	3	1	1	-	1	-	-	-	-	-	-	1
5	3	1	1	-	1	-	-	-	-	-	-	1
6	3	1	1	-	1	-	-	-	-	-	-	1

UNIT I:

Introduction to Programming - *Evolution of languages*: Machine, Assembly and High-level languages. *Software requirements for programming*: OS, compiler, linker, loader, editor. Design specification: Algorithms and Flowcharts.

UNIT II:

Data Types and Operators, Variable, Sequences and Iteration - Data types, Expressions, Precedence Rules, Operators: arithmetic, relational, logical, bit-wise and miscellaneous operators; local variable, global variables, List, String, Tuples, Sequence mutation and accumulating patterns.

UNIT III:

Conditional Statement, Loops, Arrays and Strings, user-defined Data Types - if..else, for, while, nested iteration, Concept and use of arrays, declaration and usage of arrays, 2-dimensional arrays, different types of user defined data types.

UNIT IV:

Dictionaries and Dictionary Accumulation, Functions/Methods - Dictionary basics, operations, methods, accumulation, advantages of modularizing program into functions, function definition and function invocation. Positional parameters passing arrays to functions, recursion, library functions.

UNIT V:

File Handling and Memory Management - Concepts of files and basic file operations, writing/reading data to/from a .csv file, Memory Management Operations.

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TEXT BOOKS AND REFERENCES:

1. R.S. Salaria, "Programming for Problem Solving", First Edition, Khanna Book Publishing Co., Delhi.
2. Jeeva Jose, "Taming Python by Programming", Revised Edition, Khanna Book Publishing Co., Delhi.
3. Mark Lutz, "Learning Python", 5th Edition, O'Reilly Media, Inc.
4. Python Crash Course: A Hands-On, Project-Based Introduction to Programming by Eric Matthes, No Starch Press.
5. "Programming in Python", R.S. Salaria, Khanna Book Publishing Co., Delhi.

NPTEL/SWAYAM Course:

1. Introduction to Problem Solving and Programming, Video Lectures, Prof. D Gupta, IIT Delhi.
2. Problem Solving Aspects and Python Programming, Dr. S Malinga, Dr Thangarajan, Dr. S V Kogilavani, Kongu Engineering College.
3. https://www.coursera.org/specializations/python-3-programming

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22CY C02

CHEMISTRY LAB
(EEE)

Instruction:	3P Hours per Week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	50 Marks
Continuous Internal Evaluation:	50 Marks
Credits:	1.5

COURSE OBJECTIVES: This course aims to

1. To impart fundamental knowledge in handling the equipment / glassware and chemicals in Chemistry laboratory.
2. To provide the knowledge in both qualitative and quantitative chemical analysis
3. The student should be conversant with the principles of volumetric analysis
4. To apply various instrumental methods to analyse the chemical compounds and to improve understanding of theoretical concepts.
5. To interpret the theorical concepts in the preparation of new materials like drugs and polymers.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Identify the basic chemical methods to analyse the substances quantitatively & qualitatively.
2. Estimate the amount of chemical substances by volumetric analysis.
3. Determine the rate constants of reactions from concentration of reactants/ products as a function of time.
4. Calculate the concentration and amount of various substances using instrumental techniques.
5. Develop the basic drug molecules and polymeric compounds.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	-	-	2	2	-	-	-	-	2
CO 2	3	2	1	-	-	1	2	-	-	-	-	2
CO 3	3	2	3	-	-	2	2	-	-	-	-	2
CO 4	3	2	2	-	-	2	2	-	-	-	-	2
CO 5	3	2	3	-	-	2	2	-	-	-	-	2

List of Experiments:

1. Introduction: Preparation of standard solution of oxalic acid and standardisation of NaOH.
2. Estimation of metal ions (Co^{+2} & Ni^{+2}) by EDTA method.
3. Estimation of temporary and permanent hardness of water using EDTA solution
4. Determination of Alkalinity of water
5. Determination of rate constant for the reaction of hydrolysis of methyl acetate. (first order)
6. Determination of rate constant for the reaction between potassium per sulphate and potassium Iodide. (second order)
7. Estimation of the amount of HCl Conductometrically using NaOH solution.
8. Estimation of amount of HCl and CH_3COOH present in the given mixture of acids Conductometrically using NaOH solution.
9. Estimation of the amount of HCl Potentiometrically using NaOH solution.
10. Estimation of amount of Fe^{+2} Potentiometrically using $KMnO_4$ solution
11. Preparation of Nitrobenzene from Benzene.
12. Synthesis of Aspirin drug and Paracetamol drug.
13. Synthesis of phenol formaldehyde resin.

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TEXT BOOKS

1. J. Mendham and Thomas , "Vogel's textbook of quantitative chemical analysis", Pearson education Pvt.Ltd. New Delhi ,6th ed. 2002.
2. Senior practical physical chemistry by B.D.Khosla, V.C.Garg & A.Gulati,; R. Chand & Co. : New Delhi (2011).

SUGGESTED READINGS:

1. Dr. Subdharani , "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing, 2012.
2. S.S. Dara , "A Textbook on experiment and calculation in engineering chemistry", S.Chand and Company, 9th revised edition, 2015.

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22MBC02

COMMUNITY ENGAGEMENT

Instruction	3P Hours per week
SEE	--
CIE	50 Marks
Credits	1.5

COURSE OBJECTIVES: This course aims to

1. Develop an appreciation of Rural culture, life-style and wisdom among the Students.
2. Learn about the various livelihood activities that contribute to Rural economy.
3. Familiarize the Rural Institutions and the Rural Development Programmes in India.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Gain an understanding of Rural life, Culture and Social realities.
2. Develop a sense of empathy and bonds of mutuality with Local Communities.
3. Appreciate significant contributions of Local communities to Indian Society and Economy.
4. Exhibit the knowledge of Rural Institutions and contributing to Community's Socio-Economic improvements.
5. Utilise the opportunities provided by Rural Development Programmes.

Module I
Appreciation of Rural Society
Rural life style, Rural society, Caste and Gender relations, Rural values with respect to Community, Nature and Resources, elaboration of 'soul of India lies in villages' (Gandhi), Rural Infrastructure.

Module II
Understanding Rural Economy and Livelihood
Agriculture, Farming, Landownership, Water management, Animal Husbandry, Non-farm Livelihood and Artisans, Rural Entrepreneurs, Rural markets, Rural Credit Societies, Farmer Production Organization/Company.

Module III
Rural Institutions
Traditional Rural organizations, Self-Help Groups, Panchayati Raj Institutions (Gram Sabha), Gram Panchayat, Standing Committees, Local Civil Society, Local Administration.

Module IV
Rural Development Programmes
History of Rural Development in India, Current National Programmes: SarvaShikshaAbhiyan, BetiBhachao, BetiPadhao, Ayushman, Bharat, Swachh Bharat, PM AwasYojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA etc.

TEXT BOOKS:

1. Singh, Katar, Rural Development: Principles, Policies and Management, Sage Publications, New Delhi, 2015.
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002.
3. United Nations, Sustainable Development Goals, 2015, un.org/sdgs
4. M.P Boraia, Best Practices in Rural Development, Shanlax Publishers, 2016.

JOURNALS:

1. Journal of Rural development (published by NIRD & PR, Hyderabad).
2. Indian Journal of Social Work, (by TISS, Bombay).
3. Indian Journal of Extension Educations (by Indian Society of Extension Education).
4. Journal of Extension Education (by Extension Education Society).
5. Kurukshetra (Ministry of Rural Development, GOI).
6. Yojana (Ministry of Information & Broadcasting, GOI).

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22CSC02

PROBLEM SOLVING AND PROGRAMMING LAB

Instruction	3P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

COURSE OBJECTIVES: This course aims to

1. Master the fundamentals of writing Python scripts
2. Learn Python elements such as variables, flow controls structures, and functions
3. Discover how to work with lists and sequence data, and files

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Understand various Python program development Environments
2. Demonstrate the concepts of Python.
3. Implement algorithms/flowcharts using Python to solve real-world problems.
4. Build and manage dictionaries to manage data.
5. Write Python functions to facilitate code reuse.
6. Use Python to handle files and memory.

LABORATORY / PRACTICAL EXPERIMENTS::

1. Explore various Python Program Development Environments.
2. Demonstration of input/output operations.
3. Demonstration of operators.
4. Demonstration of selective control structures.
5. Demonstration of looping control structures.
6. Demonstration of List, Tuple and Set
7. Demonstration of Python Dictionaries.
8. Implementation of searching and sorting techniques.
9. Implementation of string manipulation operations.
10. File handling and memory management operations

TEXT BOOKS AND REFERENCES:

1. R.S Salaria, “Programming for Problem Solving”, Khanna Book Publishing Co., Delhi
2. Jeeva Jose, “Taming Python by Programming”, Khanna Book Publishing Co., Delhi

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22MEC37

ROBOTICS AND DRONES LAB

(Common to All Branches)

Instruction	2T + 2P Hours per week
CIE	100 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. To develop the students' knowledge in various robot and drone structures and their workspace.
2. To develop multidisciplinary robotics that have practical importance by participating in robotics competitions
3. To develop students' skills in performing spatial transformations associated with rigid body motions, kinematic and dynamitic analysis of robot systems.
4. Through projects done in lab, increase the true hands-on student learning experience and enhance their conceptual understanding, increase students' ability, competence and teamwork skills on dealing with real-life engineering problems

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Demonstrate knowledge of the relationship between mechanical structures of robotics and their operational workspace characteristics
2. Understand mechanical components, motors, sensors and electronic circuits of robots and build robots.
3. Demonstrate knowledge of robot controllers.
4. Use Linux environment for robotic programming.
5. Write Python scripts to control robots using Python and Open CV.

CO-PO Articulation Matrix:

PO#/ CO#	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P0 10	PO 11	PO 12
CO1	**3**	**2**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**2**	**2**	**2**
CO2	**2**	**3**	**1**	**2**	**3**	**1**	**1**	**1**	**1**	**2**	**2**	**1**
CO3	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**2**	**2**	**2**
CO4	**2**	**2**	**1**	**2**	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**
CO5	**1**	**1**	**1**	**1**	**1**	**3**	**3**	**3**	**1**	**3**	**3**	**3**

LAB EXPERIMENTS:

1. Assembling of robot mechanical components, mounting of motors, sensors, electronic circuits to the chassis.
2. Connecting to electronic circuitry: motor drivers, incremental encoders proximity sensors, micro controller,
3. Different types of batteries, selection of suitable battery for application, safety precaution.
4. Introduction to Linux Command Line Interface: basic file and directory management and other useful commands
5. Controlling robot using Python: i) Move robot using Python code, ii) Make robot move in patterns using Python
6. Robot programming with Sensor inputs: i) Read sensor data using Python, ii) Visualize sensor data using Python, iii) Code robot to avoid obstacles by using sensor data
7. Open CV: i) Create an Image and display an image; ii) Read and change pixel values; iii) Create colored shapes and save image; iv) Extract the RGB values of a pixel; v) Reading and Writing Videos
8. Open CV: i) Extraction of Regions of Interest; ii) Extraction of RGB values of a pixel
9. Coding robot to work with colors, follow colored objects, identifying shape of the object-oriented
10. Projects: i)Making a line follower robot using a Camera; ii) Writing code for a complex function
11. Assembly of a drone

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SUGGESTED READINGS:

1. https://www.geeksforgeeks.org/robotics-introduction/
2. https://www.ohio.edu/mechanical-faculty/williams/html/PDF/IntroRob.pdf
3. https://www.idtechex.com/en/research-report/new-robotics-and-drones-2018-2038-technologies-forecasts-players/584
4. https://dronebotworkshop.com/

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22EEC02

BASIC ELECTRICAL ENGINEERING LAB

Instruction	2P Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	50 Marks
Credits	1

COURSE OBJECTIVES: This course aims to

1. To acquire the knowledge on different types of electrical elements and to verify the basic electrical circuit laws and theorems.
2. To determine the parameters and power factor of a coil, calculate the time and frequency responses of RLC circuits and to familiarize with measurement of electric power & energy.
3. To determine the characteristics of Transformers, dc, ac machines and switch gear components

COURSE OUTCOMES: After the completion of this course, the student will be able

1. Comprehend the circuit analysis techniques using various circuital laws and theorems.
2. Analyse the parameters of the given coil and measurement of power and energy in AC circuits
3. Determine the turns ration/performance parameters of single-phase transformer
4. Infer the characteristics of DC shunt motor different tests.
5. Illustrate different parts and their function of electrical components, equipment and machines.

CO-PO Articulation Matrix:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	-	-	2	2	-	-	-	-	2
CO 2	3	2	1	-	-	1	2	-	-	-	-	2
CO 3	3	2	3	-	-	2	2	-	-	-	-	2
CO 4	3	2	2	-	-	2	2	-	-	-	-	2
CO 5	3	2	3	-	-	2	2	-	-	-	-	2

1 - Slightly; 2 - Moderately; 3 - Substantially

List of Laboratory Experiments/Demonstrations:

1. Verification of KCL and KVL.
2. Verification of Thevenin's theorem.
3. Verification of Norton's theorem.
4. Charging and discharging of Capacitor.
5. Determination of parameters of a choke or coil by Wattmeter Method.
6. Power factor improvement of single-phase AC System.
7. Active and Reactive Power measurement of a single-phase system using
   i. (i) 3-Ammeter method (ii) 3-Voltmeter method
8. Measurement of 3-Phase Power in a balanced system
9. Calibration of single-phase energy meter.
10. Verification of Turns/voltage ratio of single-phase Transformer.
11. Open Circuit and Short Circuit tests on a given single phase Transformer
12. Brake test on DC Shunt Motor
13. Speed control of DC Shunt Motor
14. Demonstration of Measuring Instruments and Electrical Lab components.
15. Demonstration of Low-Tension Switchgear Equipment/Components
16. Demonstration of cut - out section of Machines like DC Machine, Induction Machine etc.

Note: TEN experiments to be conducted to cover all five Course Outcomes.

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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

(Inline with AICTE Model Curriculum with effect from AY 2022-23)

B.E. –ELECTRICAL & ELECTRONICS ENGINEERING

SEMESTER –II

S. No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per Week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	22MTC05	Vector Calculus and Differential Equations	3	1	0	3	40	60	4
2	22PYC06	Electromagnetic Theory and Quantum Mechanics	3	0	0	3	60	40	3
3	22CEC01	Engineering Mechanics	3	1	0	3	40	60	4
4	22EGC01	English	2	0	0	3	40	60	2
PRACTICAL									
5	22PYC09	Electromagnetic Theory and Quantum Mechanics Lab	0	0	3	3	50	50	1.5
6	22EGC02	English lab	0	0	2	3	50	50	1
7	22MEC01	CAD AND DRAFTING	0	1	3	3	50	50	2.5
8	22MEC38	Digital Fabrication Lab	0	0	3	3	50	50	1.5
TOTAL			**11**	**3**	**11**	**24**	**380**	**420**	**19.5**

L: Lecture **T: Tutorial** **D: Drawing** **P: Practical**

CIE - Continuous Internal Evaluation **SEE - Semester End Examination**

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22MTC05

VECTOR CALCULUS AND DIFFERENTIAL EQUATIONS
(EEE)

Instruction	3 L+1T per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

COURSE OBJECTIVES: This course aims to:

1. To explain scalar and vector functions with its Physical interpretations.
2. To discuss vector line, surface and volume integrals.
3. To explain relevant methods to solve first order differential equations.
4. To discuss the solution of higher order Differential Equations
5. To learn Numerical solution of ODE and Engineering problems.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Apply the vector differential operators to Scalars and Vector functions.
2. Solve line, surface & volume integrals by Greens, Gauss and Stoke's theorems.
3. Calculate the solutions of first order linear differential equations.
4. Solve higher order linear differential equations.
5. Find solution of algebraic, transcendental and ODE by Numerical Methods.

CO-PO Articulation Matrix:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	-	-	-	-	-	-	-	2
CO 2	3	3	3	3	-	-	-	-	-	-	-	2
CO 3	3	3	3	3	-	-	-	-	-	-	-	2
CO 4	3	3	3	3	-	-	-	-	-	-	-	2
CO 5	2	2	2	2	-	-	-	-	-	-	-	1

UNIT-I:

Vector Differential Calculus and multiple Integrals: Scalar and Vector point functions, vector operator Del, Gradient, Directional derivative, Divergence, Curl, Del applied twice to point functions, Del applied to product of point functions (vector identities), Irrotational fields and Solenoidal fields, Double integral, Change of order of Integration and Triple integrals.

UNIT-II

Vector Integral Calculus: Line integral, Surface integral and Volume integral. Verification of Green's theorem in a plane (without proof), verification of Stroke's theorem (without proof) and Gauss's divergence theorem (without proof).

UNIT-III:

First Order Ordinary Differential Equations: Exact differential equations, Equations reducible to exact equations, Linear equation, Bernoulli's equation, Clairaut's equation, Riccati's equation, Orthogonal trajectories, Rate of decay of Radio-active materials.

UNIT-IV:

Higher Orders Linear Differential Equations: Higher order linear differential equations with constant coefficients, rules for finding Complementary function, Particular Integral and General solution. Method of variation of parameters, solution of Cauchy- Euler equation, LR and LCR circuits

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UNIT-V:

Numerical Methods: Solution of Algebraic and transcendental equations by Bisection method, Regula-Falsi method Newton-Raphson method. Numerical Solutions of First Order Ordinary differential equations by Taylor's series method, Euler's method, Modified Euler's method and Runge-Kutta method of fourth order.

TEXT BOOKS:

1. B.S.Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.

SUGGESTED READING

1. N.P.Bali and Dr. Manish Goyal, "A text book of Engineering Mathematics", 9th edition, Laxmi Publications, 2017.
2. R.K.Jain, S.R.K.Iyengar, "Advanced Engineering Mathematics", 5th edition, Narosa Publications, 2016.

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22PYC06

ELECTROMAGNETIC THEORY AND QUANTUM MECHANICS
(ECE & EEE)

Instruction	3L Hours per week
Duration of SEE	3Hours
SEE	60Marks
CIE	40Marks
Credits	3

COURSE OBJECTIVES: This course aims to:
The objectives of the course is to make the student
1. Understand the fundamentals of wave nature of light
2. Familiar with static and dynamic nature of electric and magnetic fields
3. Acquire knowledge of lasers and fiber optics
4. Learn basics of quantum mechanics and properties of solids

COURSE OUTCOMES: After the completion of this course, the student will be able to
1. Interpret the wave nature of the light
2. Extend the laws of electric and magnetic fields for wireless communication
3. Explain the principles of lasers and fiber optic communication
4. Find the applications of quantum mechanics
5. Identify semiconductors for engineering applications

CO-PO Articulation Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	3	1	1	1	1	2	2	1	1	2	1	2
C02	3	2	2	1	1	1	1	1	1	2	2	3
C03	3	1	2	1	2	2	2	1	2	2	2	2
C04	2	2	1	1	1	1	1	1	1	2	1	2
C05	3	2	2	2	2	1	2	2	1	2	1	2

UNIT-I
Wave Optics: Huygen's principle – Superposition of waves – Interference of light by wavefront splitting and amplitude splitting –Interference in thin films (reflected light) – Newton's rings – Fraunhofer diffraction from a single slit – Double slit diffraction–Concept of N-slits–Diffraction grating. Polarization: Introduction–Malus's law –Double refraction –Nicol's prism–Quarter-wave plate and half-wave plate– Optical activity– Laurent's half shade polarimeter.

UNIT-II
Electrostatics: Calculation of electric field and electrostatic potential for a charge distribution–Divergence and curl of electrostatic field– Laplace's and Poisson's equations for electrostatic potential– Uniqueness theorem.

Magnetostatics: Biot-Savart law–Divergence and curl of static magnetic field –Equation for magnetic vector potential and its solution for given current densities – Ferromagnetic, paramagnetic and diamagnetic materials– B-H curve.
Electromagnetic Theory: Review of steady and varying fields–Conduction current and displacement current– Maxwell's equations in differential and integral forms–Electromagnetic wave propagation in free space, dielectric and conducting media – Poynting theorem – Skin depth.

UNIT-III
Lasers: Characteristics of lasers – Einstein's coefficients –Amplification of light by population inversion – Ruby laser – He-Ne laser – Semiconductor laser –Applications of lasers in engineering and medicine.
Fiber Optics: Introduction –Construction –Principle –Propagation of light through an optical fiber – Numerical aperture and acceptance angle – Step-index and graded-index fibers –Pulse dispersion –Fiber losses –Fiber optic communication system –Applications.

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UNIT-IV

Quantum Mechanics: Introduction –Wave nature of particles – de-Broglie hypothesis –Physical significance of ψ –Time-dependent and time-independent Schrodinger equations – Born interpretation – Probability current –Wave-packets –Uncertainty principle –Particle in infinite square well potential.

UNIT-V

Physics of Solids and Semiconductors: Salient features of free electron theory of metals (Classical and Quantum) – Fermi level – Bloch's theorem for particles in a periodic potential –Kronig-Penney model – Origin of energy bands –Classification of solids: metals, semiconductors and insulators –Intrinsic and extrinsic semiconductors–Carrier generation and recombination–Carrier transport: diffusion and drift–P-N junction – Thermistor – Hall effect – LED – Solar cell.

TEXT BOOKS:

1. B. K. Pandey and S. Chaturvedi, *Engineering Physics*, Cengage Publications, 2012.
2. M. N. Avadhanulu and P.G. Kshirsagar, *A Text Book of Engineering Physics*, S. Chand Publications, 2014.
3. M. Arumugam, *Materials Science*, Anuradha Publications, 2015.
4. S. L. Gupta and Sanjeev Gupta, *Modern Engineering Physics*, Dhanpat Rai Publications, 2011.

SUGGESTED READING:

1. R. Murugeshan and Kiruthiga Sivaprasath, *Modern Physics*, S. Chand Publications, 2014.
2. V. Rajendran, *Engineering Physics*, McGraw-Hill Education Publications, 2013.
3. P. K. Palanisamy, *Engineering Physics*, Scitech Publications, 2012.
4. V. Raghavan, *Materials Science and Engineering*, Prentice Hall India Learning Private Limited; 6th Revised edition, 2015.

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22CEC01

ENGINEERING MECHANICS

Instruction	3L+1T Periods per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

COURSE OBJECTIVES: This course aims to

1. Understand the resolution of forces and to obtain resultant of all force systems,
2. Understand equilibrium conditions of static loads for smooth and frictional surface
3. Analyse simple trusses for forces in various members of a truss
4. Obtain centroid, centre of gravity for various regular and composite areas and bodies
5. Obtain Moment of inertia for various regular and composite areas and bodies and also to obtain Mass moments of inertia of elementary bodies

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Calculate the components and resultant of coplanar forces system and Draw free body diagrams to analyze the forces in the given structure
2. Understand the mechanism of friction and can solve friction problems
3. Analyse simple trusses for forces in various members of a truss.
4. Determine the centroid of plane areas, composite areas and centres of gravity of bodies.
5. Determine moments of inertia, product of inertia of plane and composite areas and mass moments of inertia of elementary bodies,

CO-PO Articulation Matrix:

PO / PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-

UNIT – I

Resolution and Resultant of Force System: Basic concepts of a force system. Components of forces in a plane. Resultant of coplanar concurrent force system. Moment of a force, couple and their applications. Resultant of coplanar non-concurrent force system

Equilibrium of force system: Free body diagrams, equations of equilibrium of planar force systems and its applications. Problems on general case of coplanar force systems.

UNIT – II

Theory of friction: Introduction, types of friction, laws of friction, application of friction to a single body & connecting systems. Wedge and belt friction

UNIT – III

Analysis of Simple Trusses: Introduction to trusses, Assumptions, analysis of simple trusses using method of joints and method of sections.

UNIT– IV

Centroid: Significance of centroid, moment of area, centroid of line elements, plane areas, composite areas, theorems of Pappus & its applications. Center of gravity of elementary and composite bodies

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UNIT – V

Moment of Inertia: Definition of MI, Area MI. Polar Moment of Inertia, radius of gyration, transfer theorem, Moment of Inertia of elementary & composite areas, and Product of inertia. Mass moments of inertia of elementary bodies.

TEXT BOOKS:

1. K. Vijay Kumar Reddy and J. Suresh Kumar, Singer's Engineering Mechanics, BS Publications, Hyderabad, 2011.
2. Ferdinand L Singer, Engineering Mechanics, Harper and Collins, Singapore, 1904.

SUGGESTED READING:

1. A. Nelson, Engineering Mechanics, Tata McGraw Hill, New Delhi, 2010.
2. S. Rajashekaran & G. Sankarasubramanyam, Engineering Mechanics, Vikas publications, Hyderabad, 2002.
3. S.B. Junarkar and H.J Shah, Applied Mechanics**,** Charotar publishers, New Delhi, 2001.
4. Basudeb Bhattacharyya, Engineering Mechanics, Oxford University Press, New Delhi, 2008.
5. A K Tayal, Engineering Mechanics, Umesh Publications, New Delhi, 2010

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22EGC01

ENGLISH

(Common to All Branches)

Instruction	2L Hours per week
Duration of SEE	3Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

COURSE OBJECTIVES: This course aims to

1. To the role and importance of communication while developing their basic communication skills in English.
2. To basics of writing coherent paragraphs and formal emails.
3. To techniques of writing a précis and formal letters by using acceptable grammar and appropriate vocabulary.
4. To description, definition and classification of processes while enabling them to draft formal reports following a proper structure.
5. To gaining adequate reading comprehension techniques.

COURSE OUTCOMES: After the completion of this course, the student will be able

1. Illustrate the nature, process and types of communication and communicate effectively without barriers.
2. Construct and compose coherent paragraphs, emails and adhering to appropriate mobile etiquette.
3. Apply techniques of precision to write a précis and formal letters by using acceptable grammar and appropriate vocabulary.
4. Distinguish formal from informal reports and demonstrate advanced writing skills by drafting formal reports.
5. Critique passages by applying effective reading techniques

CO-PO-PSO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	1	1	1	1	1	1	2	3	3	2	3
CO 2	1	1	1	1	-	1	1	1	2	2	1	2
CO 3	-	2	1	1	-	2	1	1	2	2	1	2
CO 4	1	2	1	2	1	2	2	1	2	2	1	2
CO 5	1	2	1	2	1	1	1	1	1	2	1	2

UNIT-I

Understanding Communication in English:

Introduction, nature and importance of communication; Process of communication; Types of communication - verbal and non-verbal; Barriers to communication; Intrapersonal and interpersonal communication; Understanding Johari Window.

Vocabulary &Grammar: The concept of Word Formation; Use of appropriate prepositions and articles.

UNIT-II

Developing Writing Skills I:

Paragraph writing. – Structure and features of a paragraph; Cohesion and coherence. Rearranging jumbled sentences. Email and Mobile etiquette.

Vocabulary & Grammar: Use of cohesive devices and correct punctuation.

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UNIT-III
Developing Writing Skills II:
Précis Writing; Techniques of writing precisely. Letter Writing – Structure, format of a formal letter; Letter of request and the response
Vocabulary and Grammar: Subject-verb agreement. Use of prefixes and suffixes to form derivatives. Avoiding redundancies.

UNIT-IV
Developing Writing Skills III:
Report writing – Importance, structure, elements of style of formal reports; Writing a formal report.
Vocabulary and Grammar: Avoiding ambiguity - Misplaced modifiers. Use of synonyms and antonyms.

UNIT-V
Developing Reading Skills:
The reading process, purpose, different kinds of texts; Reading comprehension; Techniques of comprehension – skimming, scanning, drawing inferences and conclusions.
Vocabulary and Grammar: Words often confused; Use of standard abbreviations.

TEXT BOOKS:
1. Language and Life: A Skills Approach, Board of Editors, Orient Black Swan, 2017.
2. Swan Michael, Practical English Usage.OUP.1995.

SUGGESTED READINGS:
1. Wood F.T, Remedial English Grammar,Macmillan,2007
2. Zinsser William, On Writing Well, Harper Resource Book, 2001
3. Sanjay Kumar and PushpLata, Communication Skills. Oxford University Press, 2011.

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22PYC09

ELECTROMAGNETIC THEORY AND QUANTUM MECHANICS LAB
(ECE & EEE)

Instruction	3P Hours per week
Duration of SEE	3Hours
SEE	50Marks
CIE	50Marks
Credits	1.5

COURSE OBJECTIVES: This course aims to:

1. Apply the concepts of physics while doing experiments
2. Understand the nature of the light experimentally
3. Analyze the behaviour of semiconductor materials and optoelectronic devices

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Experiment with the concept of errors and find the ways to minimize the errors
2. Demonstrate properties of light experimentally
3. Find the applications of lasers and optical fibers in engineering applications
4. Make use of semiconductor devices for practical applications
5. Illustrate the working of optoelectronic devices

CO-PO Articulation Matrix

CO/P	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	3	2	2	3	1	3	1	3	3	2	1	2
C02	3	2	1	2	2	2	1	2	2	1	1	3
C03	3	2	3	2	3	1	2	2	3	2	1	2
C04	3	3	2	2	2	1	2	3	2	1	1	3
C05	3	1	2	3	2	1	1	2	2	2	1	2

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22PYC09

ELECTROMAGNETIC THEORY AND QUANTUM MECHANICS LAB (ECE & EEE)

Instruction	3P Hours per week
Duration of SEE	3Hours
SEE	50Marks
CIE	50Marks
Credits	1.5

COURSE OBJECTIVES: This course aims to

1. Apply the concepts of physics while doing experiments
2. Understand the nature of the light experimentally
3. Analyzethebehaviourofsemiconductormaterialsandoptoelectronicdevices

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Experiment with the concept of errors and find the ways to minimize the errors
2. Demonstrate properties of light experimentally
3. Find the applications of lasers and optical fibers in engineering applications
4. Make use of semiconductor devices for practical applications
5. Illustrate the working of optoelectronic devices

CO-PO Articulation Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	3	2	2	3	1	3	1	3	3	2	1	2
C02	3	2	1	2	2	2	1	2	2	1	1	3
C03	3	2	3	2	3	1	2	2	3	2	1	2
C04	3	3	2	2	2	1	2	3	2	1	1	3
C05	3	1	2	3	2	1	1	2	2	2	1	2

Experiments

1. Error Analysis : Estimation of errors in the determination of time period of a torsional pendulum
2. Newton's Rings : Determination of wavelength of given monochromatic source
3. Single Slit Diffraction : Determination of wavelength of given monochromatic source
4. Diffraction Grating : Determination of wavelengths of two yellow lines of light of mercury lamp
5. Malus's Law : Verification of Malus's law
6. Double Refraction : Determination of refractive indices of O-ray and E-ray of given calcite crystal
7. Polari meter : Determination of specific rotation of glucose
8. Laser : Determination of wavelength of given semiconductor laser
9. Optical Fiber : Determination of numerical aperture and power losses of given optical fiber
10. Energy Gap : Determination of energy gap of given semiconductor
11. P-N Junction Diode : Study of V-I characteristics and calculation of resistance of given diode in forward bias and reverse bias
12. Thermistor : Determination of temperature coefficient of resistance of given thermistor
13. Hall Effect : Determination of Hall coefficient, carrier concentration and mobility of charge carriers of given semiconductor specimen
14. LED : Study of I-V characteristics of given LED

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15. Solar Cell : Study of I-V characteristics of given solar cell and calculation of fill factor,
efficiency and series resistance

NOTE: A minimum of TWELVE experiments should be done.

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22EGC02

ENGLISH LAB
(Common to All Branches)

Instruction	2P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

COURSE OBJECTIVES: This course aims to

1. To nuances of Phonetics and give them sufficient practice in correct pronunciation.
2. To word stress and intonation.
3. To listen to listening comprehension material for honing their listening skills.
4. To activities enabling them overcome their inhibitions while speaking in English with the focus being on fluency rather than accuracy.
5. To team work, role behavior while developing their ability to discuss in groups and making oral presentations.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Define the speech sounds in English and understand the nuances of pronunciation in English
2. Apply stress correctly and speak with the proper tone, intonation and rhythm.
3. Analyze listening comprehension texts to enhance their listening skills.
4. Determine the context and speak appropriately in various situations.
5. Design and present effective posters while working in teams, and discuss and participate in Group discussions.

CO-PO-PSO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	-	-	-	-	-	1	1	-	1
CO 2	-	-	-	-	-	1	-	1	2	2	1	2
CO 3	-	-	-	-	-	1	1	1	2	1	1	2
CO 4	1	-	-	-	-	1	2	2	2	3	1	3
CO 5	1	1	1	1	1	2	2	2	3	3	2	3

Exercises

1. **Introduction to English Phonetics:** Introduction to auditory, acoustic and articulatory phonetics, organs of speech: the respiratory, articulatory and phonatory systems.
2. **Sound system of English:** Phonetic sounds and phonemic sounds, introduction to International Phonetic Alphabet, classification and description of English phonemic sounds, minimal pairs. The syllable: types of syllables, consonant clusters.
3. **Word stress:** Primary stress, secondary stress, functional stress, rules of word stress.
4. **Rhythm & Intonation:** Introduction to Rhythm and Intonation. Major patterns, intonation of English with the semantic implications.
5. **Listening skills** – Practice with Software available in (K-van solutions)
6. **Public speaking** – Speaking with confidence and clarity in different contexts on various issues.
7. **Group Discussions** - Dynamics of a group discussion, group discussion techniques, body language.
8. **Pictionary** – weaving an imaginative story around a given picture.
9. **Information Gap Activity** – Writing a brief report on a newspaper headline by building on the hints given
10. **Poster presentation** – Theme, poster preparation, team work and representation.

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SUGGESTED READING

1. T Balasubramanian. A Textbook of English Phonetics for Indian Students, Macmillan, 2008.
2. J Sethi et al. A Practical Course in English Pronunciation (with CD), Prentice Hall India, 2005.
3. PriyadarshiPatnaik. Group Discussions and Interviews, Cambridge University Press Pvt Ltd. 2011
4. ArunaKoneru, Professional Speaking Skills, Oxford University Press, 2016

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22MEC01

CAD AND DRAFTING

Instruction	1 T + 3 D Hours per week
Duration of SEE	3Hours
SEE	50Marks
CIE	50Marks
Credits	2.5

COURSE OBJECTIVES: This course aims to

1. To get exposure to a cad package and its utility.
2. Understanding orthographic projections.
3. To visualize different solids and their sections in orthographic projection
4. To prepare the student to communicate effectively by using isometric projection.
5. To prepare the student to use the techniques, skills, and modern tools necessary for practice.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Become conversant with appropriate use of CAD software for drafting.
2. Recognize BIS, ISO Standards and conventions in Engineering Drafting.
3. Construct the projections of points, lines, planes, solids
4. Analyse the internal details of solids through sectional views
5. Create an isometric projections and views

CO-PO-PSO Correlation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	2	-	1	2	3	1	3
CO2	3	2	2	1	2	2	-	1	2	2	1	2
CO3	3	3	2	1	2	2	-	1	2	2	1	2
CO4	3	3	3	2	2	2	-	1	2	2	1	2
CO5	3	2	2	1	2	2	-	1	2	2	1	2

List of Exercises:

1. Introduction to CAD package: Settings, draw, modify tools, dimensioning and documentation
2. Construction of Conic Sections by General method
3. Orthographic projection: Principles, conventions, Projection of points
4. Projection of straight lines: Simple position, inclined to one plane
5. Projection of straight lines inclined to both the planes (without traces and mid-point)
6. Projection of planes: Perpendicular planes
7. Projection of planes: Oblique planes
8. Projection of solids: Simple position
9. Projection of solids: Inclined to one plane
10. Sections of solids: Prism, pyramid in simple position
11. Sections of solids: Cone and cylinder in simple position
12. Isometric projections and views
13. Conversion of isometric views to orthographic projections and vice-versa.

TEXT BOOKS:

1. N.D.Bhatt, “Elementary Engineering Drawing”, Charotar Publishers, 2012.
2. K.Venugopal, “Engineering Drawing and Graphics + AutoCAD”, New Age International Pvt.Ltd, 2011.
3. Basanth Agrawal and C M Agrawal, “Engineering Drawing”, 2/e, McGraw-Hill Education (India) Pvt. Ltd.

SUGGESTED READING:

1. Shaw M.B and Rana B.C., “Engineering Drawing”, 2/e, Pearson, 2009.
2. K.L. Narayana and P.K. Kannaiah, “Text Book of Engineering Drawing”, Scitech Publications, 2011
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22MEC38

DIGITAL FABRICATION LAB

Instruction	3P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

COURSE OBJECTIVES: This course aims to

1. Give a feel of Engineering Practices & develop holistic understanding of various Engineering materials and Manufacturing processes.
2. Develop skills of manufacturing, safety, precision, quality, intelligent effort, optimization positive &team work attitude to get things right the first time.
3. Provide basic knowledge of Steel, Plastic, Composite and other materials for suitable applications.
4. Study of Principle and hands on practice on techniques of fabrication, welding, casting, manufacturing, metrology, and allied skills.
5. Advance important hard & pertinent soft skills, productivity, create skilled manpower which is cognizant of industrial workshop components and processes and can communicate their work in a technical, clear and effective way.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Understand safety measures to be followed in workshop to avoid accidents.
2. Identify various tools used in carpentry, house wiring and plumbing.
3. Make a given model by using workshop trades like carpentry, plumbing, House wiring and 3d modeling using solid works software for Additive Manufacturing.
4. Perform pre-processing operations on STL files for 3D printing, also understand reverse engineering process.
5. Conceptualize and produce simple device/mechanism of their choice.

CO-PO-PSO Correlation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	-	-	-	-	-	-	1
CO2	1	-	-	-	1	-	-	-	-	-	-	2
CO3	2	1	1	1	3	-	1	-	-	-	-	2
CO4	2	2	2	1	3	-	-	-	-	-	-	2
CO5	3	2	1	-	3	-	-	-	-	-	-	2

List of exercises:
Group-1

1. To make a lap joint on the given wooden piece according to the given dimensions.
2. To make a dove tail-joint on the given wooden piece according to the given dimensions.
3.
   a. Wiring of one light point controlled by one single pole switch, a three pin socket controlled by a single pole switch
   b. Wiring of two light points connected in series and controlled by single pole switch. Verify the above circuit with different bulbs. Wiring of two light points connected in parallel from two single pole switches and a three pin socket
4. Stair case wiring-wiring of one light point controlled from two different places independently using two 2- way switches.
5. To make external threads for GI pipes using die and connect the GI pipes as per the given diagram using taps, couplings & bends.
6.
   a. A. To connect the GI pipes as per the given diagram using, couplings, unions, reducer & bends.
   b. To connect the GI pipes as per the given diagram using shower, tap & valves and Demonstrate by giving water connection

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Gandipet, Hyderabad-75

Group- 2

1. To Study the method of Additive Manufacturing process using a 3D printer
2. To create a 3D CAD model of a door bracket using a modeling software
3. To Print a door bracket using an extruder type 3D Printer.
4. To create a 3D CAD model by reverse Engineering
5. To Design an innovative component using the CAD software
6. To Print the selected innovative component by the students using a 3D printer

TEXT BOOKS:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., Elements of Workshop Technology, Vol. I, 2008 and Vol. II, Media promoters and publishers private limited, Mumbai, 2010.
2. Kalpakjian S. And Steven S. Schmid, Manufacturing Engineering and Technology, 4th edition, Pearson Education India Edition, 2002.
3. Sachidanand Jha, 3D PRINTING PROJECTS: 200 3D Practice Drawings For 3D Printing On Your 3D Printer, June 7, 2019.

SUGGESTED READING:

1. Gowri P. Hariharan and A. Suresh Babu, Manufacturing Technology – I, Pearson Education, 2008.
2. Oliver Bothmann , 3D Printers: A Beginner's Guide , January 1, 2015

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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
(AUTONOMOUS)

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

INSTITUTE VISION AND MISSION:

Vision:

To be centre of excellence in technical education and research

Mission:
To address the emerging needs through quality technical education and advanced research

DEPARTMENT VISION AND MISSION:

Vision:

To achieve Academic and Professional Excellence in Teaching and Research in the frontier areas of Electrical and Electronics Engineering Vis-a -Vis serve as a Valuable Resource for Industry and Society.

Mission:

Empowering the Faculty and Student Rendezvous to Nurture Interest for Conceptual Keystone, Applied Multidisciplinary Research, Inspiring Leadership and Efficacious Entrepreneurship culture , Impeccable Innovation in frontier areas to be synergetic with Environmental, Societal and Technological Developments of the National and International community for Universal Intimacy.

M1: Emphasis on providing Strong Theoretical Foundation & Engineering Leadership Eminence, infusion of Creativity and Management skill while maintaining Ethics and Moral for Sustainable Development. **(Individual development**)

M2: Enable the Faculty and Student Interactions to trigger interest for Applied Multidisciplinary Research and Entrepreneurship Culture resulting in Significant Advancement of the field of Specialization with Involvement of Industries and Collaborative Educational Networks. **(Sense of Ownership, Networking and Eco system Development)**

M3: Extend the Conducive Neighborhoods for Innovation in frontier areas to keep pace with Environmental, Societal and Technological Developments of the National and International Community to Serve Humanity. **(Service to Society, Atmanirbhar Bharat)**

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PROGRAMME EDUCATIONAL OBJECTIVES (PEOS):

- **PEO 1-** Graduates will Ennoble in offering Design solutions for Complex Engineering Problems using appropriate modern Software tools, with the specified need of the Industry and Protagonist in transforming the Society into a Knowledge Society.

- **PEO 2-** Graduates will Elevate Engineering Leadership and will be recognized as Experts working in Government, Consulting firms, International organizations with their Creativity in Design of Experiments, Analysis and Interpretation of Data and Synthesis of Information.

- **PEO 3-** Graduates will Exalt in their Professional career by Persistence in Team work, Ethical behavior, Proactive involvement, and Effective Communication.

- **PEO 4-** Graduate will Excel by becoming Researches, Professors and Entrepreneurs who will create and Disseminate new knowledge in the frontier areas of Engineering, Technology and Management

PROGRAM OUTCOMES (POs):

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

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

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

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

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

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

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

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

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

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Gandipet, Hyderabad-75

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long Learning**: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOS):

PSO 1: Evaluate complex Engineering Problems to meet the distinct need of Industry & Society, by utilizing knowledge of Mathematics, Science, Emerging Technologies such as AI, Block chain & IT tools.

PSO 2: Exhibit Latent talent in understanding the Engineering and Administration standards at work place as a team leader to manage Projects in the Multi-Disciplinary Environments.

PSO 3: Establish Engineering Expertise in Power system, Machines and Drives Systems and also Pursue Research in the Frontier areas such as Embedded systems, Renewable Energy, E-Mobility and Smart grid.

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Dept. of EEE, CBIT (A)
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With effect from the Academic Year 2021-22

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Scheme of Instructions of III Semester of B.E. – Electrical & Electronics Engineering as per AICTE Model Curriculum 2021-22

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

SEMESTER-III

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
THEORY									
1	20MTC07	Applied Mathematics	3	1	0	3	40	60	4
2	20 CS C06	Basic Data Structures	2	0	0	3	40	60	2
3	20 EE C03	**Core- 1** Electrical Circuit Analysis	3	0	0	3	40	60	3
4	20 EE C04	**Core- 2** Analog Electronic Circuits	3	1	0	3	40	60	4
5	20 EE C05	**Core- 3** Electrical Measurements and Instrumentation	3	0	0	3	40	60	3
6	20 EE C06	**Core- 4** Signals & System	3	0	0	3	40	60	3
7	20 CE M01	Environmental Science	2	0	0	2	----	50	NC
PRACTICALS									
8	20 EE C 07	Analog Electronic Circuits Lab	0	0	2	3	50	50	1
9	20 EE C08	Electrical Circuits and Measurements Lab	0	0	2	3	50	50	1
10	20 CS C07	Basic Data Structures Lab	0	0	2	3	50	50	1
11	20 EE I01	MOOCs/Training/ Internship-I	2-3 weeks/90 hours				50	-	2
Total			**19**	**2**	**6**	**-**	**440**	**560**	**24**

L: Lecture **T: Tutorial** **P: Practical**

CIE - Continuous Internal Evaluation **SEE - Semester End Examination**

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With effect from the Academic Year 2021-22

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Scheme of Instructions of IV Semester of B.E. – Electrical & Electronics Engineering as per AICTE Model Curriculum 2021-22

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

SEMESTER-IV

S. No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
THEORY									
1	20 EE C09	**Core -5** Digital Electronics	3	0	0	3	40	60	3
2	20 EE C10	**Core -6** Electrical Machines-1	3	0	0	3	40	60	3
3	20 EE C11	**Core -7** Electromagnetic Fields	3	0	0	3	40	60	3
4	20 EE C12	**Core -8** Power Electronics	3	0	0	3	40	60	3
5	20 EE C13	**Core -9 Power systems I**	3	0	0	3	40	60	3
6	20EGM02	Indian Traditional Knowledge	2	0	0	-	----	-	NC
7	20EGM03	Universal Human Values-II: Understanding Harmony	3	0	0	3	40	60	3
PRACTICALS									
8	20 EE C14	Digital Electronics Lab	0	0	2	3	50	50	1
9	20 EE C 15	Electrical Machines-1 Lab	0	0	2	3	50	50	1
10	20 EE C 16	Power Electronics Lab	0	0	2	3	50	50	1
		Total	20	0	6	-	390	510	21

L: Lecture **T: Tutorial** **P: Practical**

CIE - Continuous Internal Evaluation **SEE - Semester End Examination**

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DISTRIBUTION OF CREDITS FROM I TO VIII SEMESTERS

ITEM		CREDITS ALLOTED	% OF CREDITS OUT OF TOTAL CREDITS
S E M E S T E R	I	21	13.13
	II	20	12.5
	III	24	15
	IV	21	13.13
	V	27	16.88
	VI	19	11.88
	VII	17	10.63
	VIII	11	6.88
Total		**160**	**100**
HSC		11.5	7.19
BSC		22	13.75
BESC		21.5	10
PCC		64	40
PEC		15	9.38
OEC		12	7.5
I+P+S		14	9.38

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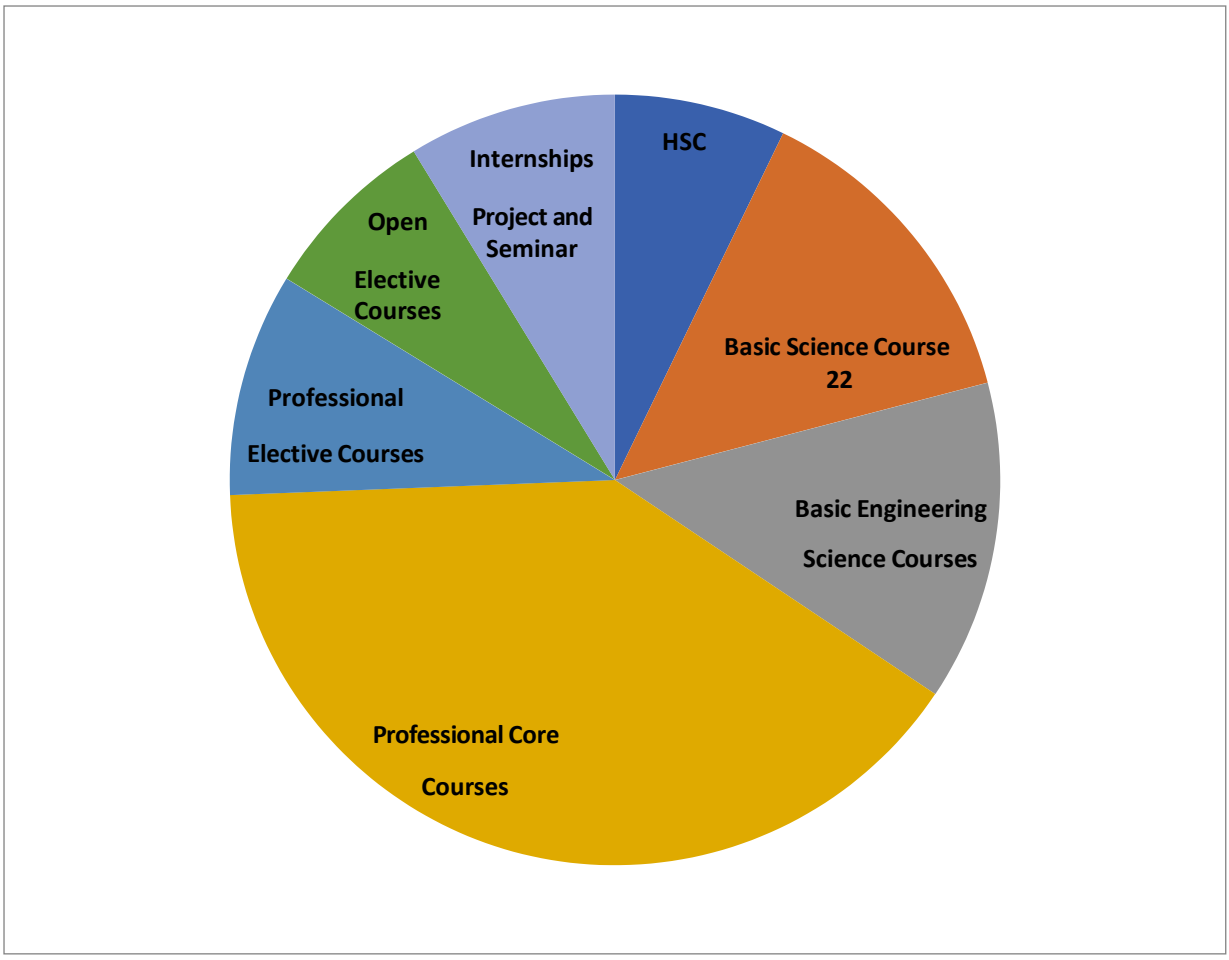
Credit Distribution for the B.E. Electrical & Electronics Engineering Curriculum

	Credits
HSC	11.5
Basic Science Course	22
Basic Engineering Science Courses	21.5
Professional Core Courses	64
Professional Elective Courses	15
Open Elective Courses	12
Internships Project and Seminar	14
Total	**160**



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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

AICTE MODEL CURRICULUM

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

SEMESTER-III

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
THEORY									
1	20MTC07	Applied Mathematics	3	1	0	3	40	60	4
2	20 CS C06	Basic Data Structures	2	0	0	3	40	60	2
3	20 EE C03	**Core- 1** Electrical Circuit Analysis	3	0	0	3	40	60	3
4	20 EE C04	**Core- 2** Analog Electronic Circuits	3	1	0	3	40	60	4
5	20 EE C05	**Core- 3** Electrical Measurements and Instrumentation	3	0	0	3	40	60	3
6	20 EE C06	**Core- 4** Signals & System	3	0	0	3	40	60	3
7	20 CE M01	Environmental Science	2	0	0	2	----	50	NC
PRACTICALS									
8	20 EE C 07	Analog Electronic Circuits Lab	0	0	2	3	50	50	1
9	20 EE C08	Electrical Circuits and Measurements Lab	0	0	2	3	50	50	1
10	20 CS C07	Basic Data Structures Lab	0	0	2	3	50	50	1
11	20 EE I01	MOOCs/Training/ Internship	2-3 weeks/90 hours				50	-	2
		Total	**19**	**2**	**6**	**-**	**440**	**560**	**24**

L: Lecture **T: Tutorial** **P: Practical**

CIE - Continuous Internal Evaluation **SEE - Semester End Examination**

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20MTC07

APPLIED MATHEMATICS(For ECE/EEE)

Instruction	3 L+1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

Course Objectives:

1. To learn the Laplace, Inverse Laplace Transform and Z-Transforms.
2. To learn the Z-Transform& inverse Z-Transform concepts
3. To form PDE and solve Linear and Non-Linear equations.
4. To find roots of equations, and Numerical solutions of Differential Equations.
5. To learn fitting of distribution and predicting the future values.

Course outcomes: On successful completion of this course the students shall be able to

1. Find Laplace, Inverse Laplace and solution of engineering problems.
2. Find the solution of Difference Equation
3. Understand the methods to find solution of linear and non-linear PDE and solution of wave equation.
4. Solve Non-Linear algebraic and transcendental equations and first order differential equations.
5. Understand the methods for analyzing the random fluctuations using probability distribution and also identify the importance of Principles of Least Squares approximations for predictions.

UNIT-I: Laplace Transforms

Laplace Transform of Elementary functions, Linearity property, First Shifting property, Change of scale property. Laplace Transform of Periodic functions, Transforms of derivatives, Transforms of integrals, Multiplication by t^n and division by t. Evaluation of Integrals by Laplace Transforms. Inverse Laplace transforms of elementary functions, Inverse Laplace Transform by Method of partial fractions and Convolution theorem, Solutions of Ordinary Differential Equations by Laplace Transform method. Laplace transform of Unit step and Unit Impulse function.

UNIT-II: Z-Transforms

Z-transforms of standard functions, linearity property, damping rule, shifting theorems, multiplication by 'n', Initial and Final value theorems. Inverse Z-transforms of standard functions, Inverse Z-transform by Convolution theorem and partial fractions method. Z-transform application to difference equations.

UNIT-III: Partial Differential Equations

Formation of Partial Differential Equations, Linear Equations of First Order (Lagrange's Linear Equations), Solution of First Order Non-linear Partial Differential Equation (Standard forms) and Char pits Method. Solutions by method of separation of variables, solution of one dimensional wave equation and its applications.

UNIT-IV: Numerical Methods

Solution of Algebraic and transcendental equations by Bisection method, Regular-False method Newton-Raphson method. Numerical Solutions of First Order Ordinary differential equations by Taylor's series method, Euler's method, Modified Euler's method and Runge-Kutta method of fourth order.

UNIT-V: Probability Distributions

Basic probability, Conditional probability, Bayes theorem. Random variable, discrete probability distribution and Continuous probability distribution. Expectation, properties of expectation, properties of variance. Poisson distribution, MGF and Cumulates of the Poisson distribution, Normal distribution, characteristics of Normal distribution MGF and CGF of Normal distribution, Areas under normal curve.

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Textbooks:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.
2. S.C.Gupta, V.K.Kappoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, 2014.

Suggested Reading:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
2. Veerarajan T, "Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2008.
3. S.S. Sastry, "Introductory methods of numerical analysis", PHI, 4th Edition, 2005

CO-PO & PSO Correlation Articulation Matrix: AM3

	PO 1	P O 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P0 10	PO 1	PO 12	PSO 1	PSO 2	PSO 3
CO-1	3	3	2	2	-	1	-	-	-	-	-	-	2	2	2
CO-2	3	3	2	2	-	3	-	-	-	-	-	2	2	3	2
CO-3	3	3	3	2	-	2	-	-	-	-	-	1	2	2	2
CO-4	3	2	3	2	-	2	-	-	-	-	-	1	2	2	2
CO-5	3	2	2	2	-	1	-	-	-	-	-	-	2	2	2

"Learn from the past, set vivid, detailed goals for the future, and live in the only moment of time over which you have any control now"

-Denis

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20CS C06

Basics of Data Structures

(Common for all Programs except CSE & IT)

Instruction	2 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

Prerequisites:

Basic knowledge of programming language such as C or C++ is preferred (but not mandatory) and some mathematical maturity also will be expected.

Course Objectives: To introduce

1. Basic linear and non-linear data structures.
2. Analyzing the performance of operations on data structures.
3. Different sorting and searching techniques and their complexities.

Course Outcomes: The students will be able to

1. Identify various data structures, searching & sorting techniques and their applications.
2. Describe the linear and non-linear data structures, searching and sorting techniques.
3. Apply suitable data structures to solve problems.
4. Analyze various searching and sorting techniques.
5. Evaluate the linear and non-linear data structures.

UNIT – 1

Introduction: Data Types, Data structures, Types of Data Structures, Operations, ADTs, Algorithms, Comparison of Algorithms- Complexity- Time and space tradeoff.

Recursion: Introduction, format of recursive functions, recursion Vs. Iteration, examples.

UNIT – 2

Linked Lists: Introduction, Linked lists and types, Representation of linked list, operations on linked list, Comparison of Linked Lists with Arrays and Dynamic Arrays.

UNIT – 3

Stacks and Queues: Introduction to stacks, applications of stacks, implementation and comparison of stack implementations. Introduction to queues, applications of queues and implementations, Priority Queues and applications

Searching and Sorting: Linear searching, binary Searching, sorting algorithms- bubble sort, selection sort, quick sort, heap sort

UNIT – 4

Trees: Definitions and Concepts, Operations on Binary Trees, Representation of binary tree, Conversion of General Trees to Binary Trees, Representations of Trees, Tree Traversals, Binary search Tree.

Unit –5

Graphs: Introduction, Applications of graphs, Graph representations, graph traversals, Minimal Spanning Trees

Text Books:

1. Narasimha Karumanchi "**Data Structures and Algorithms Made Easy**", Career Monk Publications, 2017
2. E.Horowitz, S. Sahni and Susan Anderson-Freed, "**Fundamentals of Data structures in C**", Silicon Pr; 2 edition (1 August 2007)
3. ReemaThareja, "**Data Structures using C**", Oxford, 2014

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Suggested Reading:

1. https://www.tutorialspoint.com/data_structures_algorithms/index.htm
2. https://www.edx.org/course/foundations-of-data-structures
3. https://www.cs.usfca.edu/~galles/visualization/Algorithms
4. https://www.coursera.org/specializations/data-structures-algorithms

CO-PO & PSO Correlation Articulation Matrix-BDS

	PO 1	P O 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P0 10	PO 1	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-

"The greatest mistake we humans make in our relationships; We listen half, understand quarter, think zero, and react double."

-Ash Sweeney

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With effect from the Academic Year 2021-22

20 EE C03

ELECTRICAL CIRCUIT ANALYSIS

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

pre-requisite : Basics of Electrical Engineering

Course Objectives:

1. To study the nature of different circuit elements, laws and network theorems.
2. To study transient and steady state response of circuits with initial conditions & forcing functions
3. To learn the Laplace transforms and two-port networks.

Course Outcomes: After completion of this course, students will be able to:

1. Apply various network analysis techniques to find the responses in the circuits with dependent and independent sources.
2. Determine time constant, steady state and transient responses of RL, RC, RLC networks with initial conditions of network elements.
3. Evaluate the response of electrical circuits with Laplace transformation using initial & final value theorems and to obtain the pole-zero diagrams using network functions.
4. Calculate the response of RLC networks with sinusoidal input at steady state & resonance conditions and to analyze three-phase circuits with different loads
5. Find the impedance, admittance, ABCD, h and g- parameters of given two-port network and interconnected two-port networks.

UNIT I

Network Theorems: Node and Mesh Analysis, Analysis with dependent current and voltage sources, Superposition theorem, The venin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation and Milliman's theorems.

UNIT II

Solution of First and Second order networks: Review of solution of first and second order differential equations for Series and parallel RL, RC, RLC circuits, initial and final conditions in network elements, forced and force-free responses, time constant, steady state and transient state responses.

UNIT III

Electrical Circuit Analysis Using Laplace Transforms: Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros.

UNIT IV

Sinusoidal steady state analysis: Review of AC fundamentals, Steady state response of RLC networks with sinusoidal excitations, average power and complex power, series and parallel resonance, three phase circuits with balanced & unbalanced loads,

UNIT V

Two Port Networks: Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

Text Books:

1. M. E. Van Valkenburg, "Network Analysis", 3rd Edition, Prentice Hall, 2015.
2. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits",6th Edition, McGraw Hill Education, 2019.
3. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 8th Edition, 2013.
4. D. Roy Choudhury, "Networks and Systems", 2nd Edition, New Age International, 2010.

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Suggested Reading:

1. Robert L. Boylestad, ", Introductory Circuit Analysis, Pearson Education , 13th Edition, 2011.
2. Sudhakar andSyammohan," Circuits& Networks", Tata McGraw Hill Education, 5th Edition, 2017.
3. Asfaq Hussain, "Networks and Systems", 2nd Edition, Khanna Publishing House, 2021

CO-PO & PSO Correlation Articulation Matrix-ECA

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	1	2	-	-	-	-	-	-	-	-	-	3	-
CO-2	3	3	1	2	-	-	-	-	-	-	-	-	-	3	-
CO-3	2	3	1	2	-	-	-	-	-	-	-	-	-	3	-
CO-4	3	3	1	2	-	-	-	-	-	-	-	-	-	3	-
CO-5	3	2	1	2	-	-	-	-	-	-	-	-	-	3	-

"Injustice anywhere is a threat to justice everywhere."

-Martin Luther King, Jr.

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20EEC04 **ANALOG ELECTRONIC CIRCUITS**

Instruction	3L+1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

Pre-Requisite: Students should have a prior knowledge of semiconductor Physics and basics of circuit theory.

Course Objectives:

1. To understand the V-I characteristics of diodes, BJTs, MOSFETs and also the biasing techniques of transistors and MOSFETs.
2. To understand the functioning, DC & AC characteristics of Operational Amplifiers (Op-Amps).
3. To Study the linear & non-linear applications of Op-Amps.

Course Outcomes: After completion of this course, students will be able to:

1. Comprehend the V-I characteristics of Diode and its applications.
2. Understand the V-I characteristics of BJT & MOSFET and to analyze the significance of operating point in the biasing techniques of BJT & MOSFET.
3. Apply the knowledge of differential amplifiers to understand the basic characteristics of Operational Amplifiers (Op-Amps) and their significance.
4. Design and Analyze linear application circuits of Op-Amp like amplifiers, Integrator, differentiator, filters and regulators .
5. Design and Analyze non-linear application circuits of Op-Amps and to design a stable and mono stablemodes of 555 timer circuit.

UNIT-I

Diode Characteristics and Applications: P-N junction diode, I-V characteristics of a diode, Half-wave and Full-wave rectifiers- their operation, performance characteristics- ripple factor calculations and analysis; Filters (C filter). Zener diodes - Regulator.

UNIT-II

BJT and MOSFET Circuits:

BJTs: Structure and Operation of a BJT, Modes of transistor operation, Early effect, BJT input and output characteristics of CB, CE, CC configuration, BJT as a switch. BJT as an amplifier- common-emitter, small-signal model, biasing circuits.

MOSFET: Structure- Enhancement & Depletion mode MOSFETs and I-V characteristics, MOSFET as a switch, MOSFET as an amplifier- common-source, small-signal model and biasing circuits, gain, input and output impedances, trans-conductance -common source.

UNIT-III

Differential and Operational Amplifiers: Differential amplifier- analysis for dual input balanced output configuration, block diagram of an operational amplifier, ideal Op-Amp- characteristics, non-idealities in an Op-Amps (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product, common mode rejection ratio), Inverting and non-inverting amplifier with ideal Op-Amps, voltage follower.

UNIT-IV

Applications of Op-Amps -I: Summing amplifier, differential amplifier, logarithmic amplifiers, instrumentation amplifier, ideal and practical integrator and differentiators, Active filters- First order RC, Series voltage regulator, oscillators (Wein bridge).

UNIT-V

Applications of Op-Amps -II: Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, Sample and Hold circuit, clamping and clipping circuits.

555 Timer : Functional diagram, Modes of operation- a stable, mono stable

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Text Books:

1. Robert L. Boylestad, "Electronic Devices and Circuit Theory", 11th Edition, PHI, 2015
2. Gayakwad R.A. Op-Amps and Linear Integrated Circuits, PHI, 4th Edition, 2015.
3. A.S.Sedra & K.C.Smith, "Microelectronic Circuits", New York, Oxford University Press, 7th Edition, 2017
4. J. V. Wait, L. P. Huelsman and G. A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S., 2nd Edition, 2013
5. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education, 2nd Edition, 2008.

Suggested Readings:

1. Analog Electronics, A.K. Maini, Varsha Agarwal, Khanna Publishing House, 2018
2. Millman and Halkias, "Electronic Devices and Circuits" 4th Edition, McGraw Hill Publication 2015.
3. Roy Choudhury, Linear Integrated Circuits, Shail B. Jain, New Age Intern. (P) Ltd., 4th Edition 2002.
4. David Bell, "Fundamentals of Electronic Devices and Circuits", 5th Edition, Oxford University Press 2008.

CO-PO & PSO Correlation Articulation Matrix-AEC

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO-1	2	2	2	1	2	-	-	-	-	-	-	-	1	2	1
CO-2	2	2	2	1	2	-	-	-	-	-	-	-	2	2	2
CO-3	2	1	2	1	2	-	-	-	-	-	-	-	1	1	2
CO-4	3	3	2	1	2	-	-	-	-	-	-	-	2	3	2
CO-5	3	3	3	2	2	-	-	-	-	-	-	-	2	3	2

"A pessimist sees the difficulty in every opportunity; an optimist sees the opportunity in every difficulty."

- Sir Winston Churchill

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20EEC05 ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-Requisite: Students should have

1. Fundamental knowledge in calculus and complex algebra,
2. Electromagnetism and circuit theory concepts.

Course Objectives:

1. To understand the principle of operation of various electrical Instruments
2. To measure electrical and magnetic parameters by demonstrating experimental setups
3. To introduce transducers and digital instruments with their working principle

Course Outcomes: After the completion of this course, students will be able to

1. Identify a suitable instrument to measure a given electrical parameter.
2. Analyze the working principle by using suitable torque equations for DC and AC Instruments.
3. Design Bridge Circuits for measuring passive electrical parameters.
4. Distinguish between electrical and magnetic measurements and their instruments.
5. Select an Electrical transducer for a given physical quantity measurement.

UNIT- I

Introduction to Measurements: Objectives of measurement, static and dynamic characteristics, accuracy, precision, Significant figures, errors and their classification, Standard cell and standard resistance

Instruments-1: Types of instruments, classification of instruments based on type of measurement and principle of working (PMMC, MI, Dynamometer, Induction and Electrostatic), types of torques (torque equations for MC, MI and dynamometer type instruments).

UNIT- II

Instruments-2: Single phase Induction type energy meter, concepts of driving torque & braking torque equations, (no derivation) ; Errors and their Compensation, Single phase Dynamometer type Power factor meter, Weston type frequency meter. Construction & theory of Instrument Transformers, Equations for ratio and phase angle error of C.T & P.T (Elementary treatment only).

UNIT- III

Resistance, Inductance and Capacitance parameters: Classification of resistance measuring methods Kelvin's double bridge, Wheatstone bridge and meggar. Measurement of inductance using Maxwell's inductance bridge, Anderson's bridge, Measurement of capacitance using De-Sauty's bridge and Schering bridge, merits and demerits, Q-meter, measurement of relative permittivity, applications and related numerical problems.

UNIT- IV

Measurements of Magnetic and Electric Parameters: Ballistic galvanometer- Principle of operation, construction and applications of Ballistic galvanometer, flux meter its construction and principle of operation. Epstein square bridge for measuring Iron losses, Potentiometers, -Principle - Classification – Salient features related to Practical applicability

UNIT-V

Introduction to Digital Instruments (DVM and Transducers): Introduction to digital Instruments, Digital Voltmeters (DVM), Range extension of DVM, $3\frac{1}{2}$ & $3\frac{3}{4}$ display, Resolution, related numerical problems

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2 4

on DVM. Digital Multi meters.

Transducers: Introduction, Role of Transducers in measurement system, Strain Gauge, Linear variable Differential transformer (LVDT), Piezo electric transducer, Temperature transducers, bimetallic strip, Thermocouples, Resistance Temperature Detectors (RTD), Thermostats, Radiation pyrometers.

Text Books:

1. F.W. Golding and Widdis, Electrical Measurements and measuring Instruments, A.H. Wheeler & Co., Jan-2011
2. A.K. Sawhney, A Course in Electrical and Electronics Measurements and Instrumentation, Dhanapat Rai & Sons, New Delhi, 22nd Edition, 2015.
3. CT. Baldwin, Fundamentals of Electrical measurements, Kalyani publications, 2001.

Suggested Readings:

1. Helfrick, Albert D., Cooper, William D., Modern Electronic Instrumentation and Measurement Techniques, PHI Publications, Jan-2015
2. Stanley Wold, Richard F.M. Smith, Student reference manual for Electronic Instrumentation Laboratories, 2nd Edition, PHI.
3. Alan. S. Morris, Essence of Measurement, PHI, Feb-1996

CO-PO & PSO Correlation Articulation Matrix-EMI

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	2	2	1	-	-	-	-	-	-	-	-	-	2	-	-
CO-2	2	2	2	-	-	-	-	-	-	-	-	-	2	-	-
CO-3	2	1	2	1	2	-	-	-	-	-	-	-	3	-	-
CO-4	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO-5	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-

"Do what you love, but be sure it's Profitable. Don't settle for anything less than passion and profit."

-**Steve Pavlina**

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20 EEC 06

SIGNALS AND SYSTEMS

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: Mathematics -1, Mathematics-3

Course Objectives:

1. To introduce the concepts of continuous time and discrete time systems and analyse systems in complex frequency domain.
2. To study sampling theorem and its applications.
3. To elucidate the techniques of Laplace and Z- transforms and their applications on various systems

Course Outcomes: After completion of this course, students will be able to:

1. Understand the basics of signals and systems, their classification and properties.
2. Determine the DTFT ,DFT of given discrete signals.
3. Analyze the continuous time systems by using Laplace transform.
4. Apply the Z-transform techniques to discrete time systems
5. Analyze the effect of aliasing and reconstruction of signal using sampling theorem.

UNIT-I

Introduction to Signals and Systems: Signals and systems as seen in everyday life, in various branches of engineering and science, Signal properties: periodicity, absolute integrability, deterministic and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability and their examples.

UNIT-II

Behavior of continuous and discrete-time LTI systems: Impulse response and step response, convolution, input-output behavior with a periodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems, System representation through differential equations and difference equations.

UNIT-III

Fourier Transforms: Review of Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients, Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Property of duality in Fourier transform. The Discrete- Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem.

UNIT-IV

Laplace and z-Transforms: Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, **convolution integral** solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis

UNIT-V

Sampling and Reconstruction: The Sampling Theorem and its implications, Spectra of sampled signals, Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects, Relation between continuous and discrete time systems.

Text Books:

1. A.V. Oppenheim, A. S. Willskyand S. H. Nawab, "Signals and systems", Prentice Hall India, 1997
2. J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", Pearson, 2006.
3. Anand Kumar. A, "Signals & Systems",3rd Edition, Prentice Hall India, 2017.

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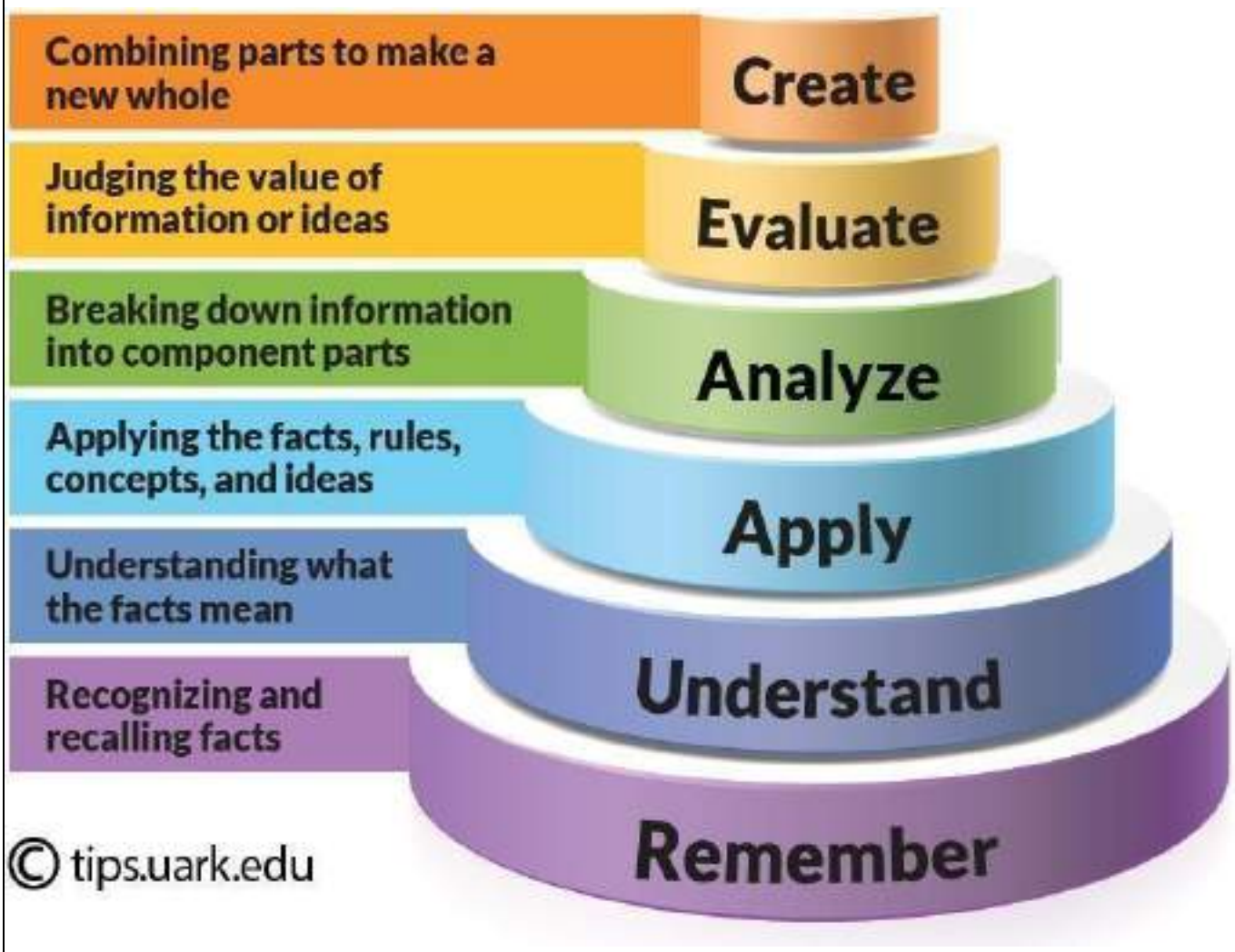
Suggested Reading:

1. H. P. Hsu, "Signals and systems", Schaum's series, McGraw Hill Education, 2010.
2. S. Haykin and B. V. Veen, "Signals and Systems", John Wiley and Sons, 2007.
3. Anand Kumar. A, "Digital Signal Processing", 2nd Edition, Prentice Hall India, 2017

CO-PO & PSO Correlation Articulation Matrix-SIGNALS & SYSTEMS

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO-1	2	1	1	-	-	-	-	-	-	-	-	-	-	1	-
CO-2	3	3	3	2	2	-	-	-	-	-	-	-	-	3	-
CO-3	2	2	1	-	-	-	-	-	-	-	-	-	-	2	-
CO-4	2	2	3	2	1	-	-	-	-	-	-	-	-	2	-



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20 CE M01

ENVIRONMENTAL SCIENCE

Instruction	2 L Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	0 Marks
Credits	0

Course Objectives: To enable the student

1. Identify environmental problems arising due to over utilization of natural resources and understand the importance of use of renewable energy sources
2. Become aware about the importance of eco system and interlinking of food chain.
3. Identify the importance of biodiversity in maintaining ecological balance.
4. Learn about various attributes of pollution management and waste management practices.
5. Contribute for capacity building of nation for arresting and/or managing environmental disasters.

Course Outcomes: At the end of the course, student is able to

1. Identify the natural resources and realize the importance of water, food, forest, mineral, energy, land resources and effects of over utilization.
2. Understand the concept of ecosystems and realize the importance of interlinking of food chains.
3. Contribute for the conservation of bio-diversity.
4. Suggest suitable remedial measure for the problems of environmental pollution and contribute for the framing of legislation for protection of environment.
5. Follow the environmental ethics and contribute to the mitigation and management of environmental disasters.

UNIT- I:

Environmental Studies: Definition, Scope and importance, need for public awareness.

Natural resources: Use and over utilization of Natural Resources - Water resources, Food resources, Forest resources, Mineral resources, Energy resources, Land resources.

UNIT – II:

Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, role of producers, consumers and decomposers, energy flow in an ecosystem, food chains, food webs, ecological pyramids, Nutrient cycling, Bio-geo chemical cycles, Terrestrial and Aquatic ecosystems.

UNIT – III:

Biodiversity: Genetic, species and ecosystem biodiversity, Bio-geographical classification of India, India as a Mega diversity nation. Values of biodiversity, hot-spots of biodiversity, threats to biodiversity, endangered and endemic species of India, methods of conservation of bio diversity.

UNIT – IV:

Environmental Pollution: Cause, effects and control measures of air pollution, water pollution, marine pollution, soil pollution, noise pollution and Solid waste management, nuclear hazards

Environmental Legislations: Environment protection Act, Air, Water, Forest & Wild life Acts, issues involved in enforcement of environmental legislation, responsibilities of state and central pollution control boards

UNIT – V:

Social issues and the environment: Water conservation methods: Rain water harvesting and watershed management, Environmental ethics, Sustainable development and Climate change: Global warming, Ozone layer depletion, forest fires, and Contemporary issues.

Text Books:

1. Y. Anjaneyulu, "Introduction to Environmental Science", B S Publications, 2004.
2. Suresh K. Dhameja, "Environmental Studies", S. K. Kataria& Sons, 2009.

Suggested Reading:

1. C. S. Rao," Environmental Pollution Control Engineering", Wiley, 1991.
2. S. S. Dara, "A Text Book of Environmental Chemistry & Pollution Control", S. Chand Limited, 2006

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CO-PO PSO ARTICULATION MATRIX- ES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	-	3	-	-	-	-	1	-	-	1
CO2	1	-	-	-	-	-	2	1	-	-	-	1	-	-	1
CO3	1	-	-	-	-	-	2	1	-	-	-	1	-	-	1
CO4	1	-	-	-	-	1	2	1	-	-	-	1	-	1	1
CO5	1	-	-	-	-	1	2	1	-	-	-	1	-	1	1
AVG	1	-	-	-	-	1	2.2	1	-	-	-	1	-	1	1

"Any Science or technology which is sufficiently advanced is indistinguishable from magic"

-Atrhur C.Clarke

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With effect from the Academic Year 2021-22

20EEC07 **ANALOG ELECTRONIC CIRCUTS LAB**

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	50Marks
Credits	1

Pre-Requisite: Students should have a prior knowledge of semiconductor Physics and basics of circuit theory.

Course objectives:

1. To understand the V-I Characteristics of diode, Transistor and MOSFET.
2. To understand the frequency response of BJT, FET amplifiers.
3. To design linear and non-linear applications of Op-Amp.

Course Outcomes: After the completion of this course, students will be able to:

1. Demonstrate the working principle of PN junction diode, transistor and MOSFET from their V-I characteristics.
2. Realize Half wave and Full wave rectifiers for C & π section filter combinations.
3. Analyze the significance of choosing a DC operating point for a transistor/MOSFET and to analyze the frequency response of CE amplifier.
4. Design of linear and non-applications of Op-Amps.
5. Design a 555 Timer in A stable mode to produce pulses for Pulse Width Modulation (PWM) Schemes.

LIST OF EXPERIMENTS

Part A

1. V-I characteristics of (Silicon and Germanium) diodes and measurement of static anddynamic resistance.
2. Zener diode characteristics and its application as a voltage regulator.
   (a) Design, realization and performance evaluation of rectifier circuits with and without filters (C & π section) Half wave rectifier.
   (b) Design, realization and performance evaluation of rectifier circuits with and without filters (C & π section) Full wave rectifier.
3. Plotting the characteristics of BJT and MOSFET.
4. Design of Biasing circuits for BJT
5. Design of Biasing Circuits for MOSFET
6. Design and Frequency response of Common Emitter BJT amplifier and measurement of Gain, Bandwidth, Input and Output impedances.

Part B

1. Measurements of Op-Amp parameters
2. Design of integrator and differentiator using Op-Amp.
3. Design of Active filters –LPF & HPF
4. Generation of triangular, sine and square wave using IC's.
5. Design of Clampers using Op-Amps.
6. Design of Clippers using Op-Amps.
7. Analysis of Hysteric comparator using Schmitt Trigger circuit.
8. Design of 555 Timer in A stable mode

Note: At least FOUR experiments from Part-A and SIX from Part-B should be conducted in the semester.

CO-PO & PSO Correlation Articulation Matrix-AEC -Lab

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO-1	2	2	2	1	2	-	-	-	-	-	-	-	2	2	2
CO-2	2	2	2	2	2	-	-	-	-	-	-	-	2	2	2
CO-3	1	2	2	1	2	-	-	-	-	-	-	-	1	2	2
CO-4	3	3	2	1	2	-	-	-	-	-	-	-	2	3	2
CO-5	1	2	2	1	2	-	-	-	-	-	-	-	1	2	2

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20EEC08 ELECTRICAL CIRCUITS AND MEASUREMENTS LAB

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Pre-**Requisite**: Students should have

1. Fundamental knowledge in calculus and complex algebra.
2. Electromagnetism and circuit theory concepts.

Course Objectives:

1. To plot the frequency response & locus diagrams of first and second order circuits
2. To verify various circuit theorems and to determine different parameters of two-port network.
3. To measure the unknown values of different electrical elements.
4. To become familiar with different transducers.

Course Outcomes: After the completion of this course, students will be able to

1. Obtain and plot the frequency response, locus diagrams of RLC circuits.
2. Verify various circuit theorems.
3. Determine various two-port network parameters.
4. Design and validate DC and AC bridges for measuring unknown electrical parameters.
5. Demonstrate the principles of magnetic measurements.
6. Demonstrate the measurement of non-electrical quantity with an appropriate transducer.

PART-A

1. Frequency response of RLC series circuit.
2. Frequency response of RLC Parallel circuit.
3. Locus diagrams of RL & RC circuits.
4. Verification of Maximum power transfer theorem.
5. Verification of Millman's theorem.
6. Verification of Compensation Theorem.
7. Determination of Z, Y, ABCD & h parameters of two-port network
8. Measurement of unknown resistance using Kelvin's double bridge. Measurement of unknown Inductance usingMaxwell's bridge and validating with LCR meter.
9. Measurement of unknown inductance using Anderson's bridge and validating with LCR meter.
10. Measurement of unknown capacitance using Schering bridge and validating with LCR meter.
11. Measurement of iron losses using Epstein's square bridge.
12. Measurement of strain using strain gauge.
13. Measurement of Displacement using LVDT.
14. Measurement of unknown voltage using D.C Crompton's potentiometer.
15. Study of measurements with digital current and potential transformers.

Note: Five experiments from Part-A and Five experiments from Part-B should be conducted in the semester.

CO-PO & PSO Correlation Articulation Matrix-EMI Lab

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO-1	2	2	1	-	-	-	-	-	-	-	-	1	-	3	-
CO-2	2	2	-	-	-	-	-	-	-	-	-	1	-	3	-
CO-3	2	2	-	-	-	-	-	-	-	-	-	1	-	3	-
CO-4	2	2	3	1	-	-	-	-	-	-	-	-	2	1	1
CO-5	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO-6	2	2	-	-	-	-	-	-	-	-	-	-	2		

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With effect from the Academic Year 2021-22

20CS C07

Basics of Data Structures Lab

(Common for all Programs except CSE & IT)

Instruction	2 Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Pre-requisites: Any Programming Language

Course Objectives:

1. Design and construct simple programs by using the concepts of Data structures as abstract data type.
2. To have a broad idea about how efficiently pointers can be used in the implement of data structures.
3. To enhance programming skills while improving their practical knowledge in data structures.
4. To strengthen the practical ability to apply suitable data structure for real time applications.

Course Outcomes: The students will be able to

1. Implement the abstract data type.
2. Demonstrate the operations on stacks, queues using arrays and linked lists
3. Apply the suitable data structures including stacks, queues to solve problems
4. Analyze various searching and sorting techniques.
5. Choose proper data structures, sorting and searching techniques to solve real world problems

List of Experiments

1. Implementation of operations on arrays
2. Implementation of Stack.
3. Implementation of Queue.
4. Implementation of basic operations on Single Linked List.
5. Implementation of Searching techniques.
6. Implementation of Sorting Techniques
7. Case study like Banking System, Students Marks Management, Canteen Management, Library Management etc

Text Books

1. Brian W Kernighan, Dennis Ritchie, C Programming Language, PH PTR, 2nd Edition.
2. Richard M Reese, Understanding and Using C Pointers, O`Reily, 2013.

Web Links

1. https://nptel.ac.in/courses/106102064/
2. https://www.udemy.com/algorithms-and-data-structures-in-python/

CO-PO & PSO Correlation Articulation Matrix-BDS Lab

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P0 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO-2	1	2	1	2	-	-	-	-	-	-	-	-	-	-	-
CO-3	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO-4	2	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CO-5	2	3	2	-	-	-	-	-	-	-	-	-	-	-	-

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20EE I01

MOOCs/Training/Internship

Instruction/Demonstration/Training	3-4 Weeks/90 Hours
Duration of Semester End Presentation	--
Semester End Evaluation	--
Continuous Internal Evaluation	50 Marks
Credits	2

Prerequisite: Knowledge of Basic Sciences and Engineering Sciences

Course Objectives:

This course aims to:

1. Exposing the students to the industrial environment
2. Create awareness with the current industrial technological developments relevant to program domain
3. Provide opportunity to understand the social, economic and administrative considerations in organizations

Course Outcomes

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

1. Understand Engineer's responsibilities and ethics
2. Use various materials, processes, products and quality control
3. Provide innovative solutions to solve real world problems
4. Acquire knowledge in technical reports writing and presentation
5. Apply technical knowledge to real world industrial situations

Mapping of COs with POs & PSOs (Course articulation Matrix):

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO 1	-	-	-	-	-	3	3	-	3	-	3	3	-	-	3
CO 2	1	1	1	3	3	-	2	1	-	-	-	-	3	3	-
CO 3	2	3	3	3	3	2	3	1	1	-	-	-	3	3	-
CO 4	-	-	-	-	-	3	-	1	3	3	-	1	-	-	3
CO 5	1	3	3	3	3	2	3	-	1	-	-	1	3	3	3

For implementation procedures and letter formats, annexure I and III of Internship document may be referred.

Evaluation of Internship: The industrial training/internship of the students will be evaluated in three stages:

a) Evaluation by the Industry (in the scale of 1 to 10 where 1-Unsatisfactory; 10-Excellent)

b) Evaluation by faculty Mentor on the basis of site visit(s) or periodic communication (15 marks)

c) Evaluation through seminar presentation/Viva-Voce at the Institute(This can be reflected through marks assigned by Faculty Mentor (25 marks))

Evaluation through Seminar presentation/Viva-Voce at the institute: Students shall give a seminar before an E*xpert Committee* constituted by college (Director, HoD/Senior faculty, mentor and faculty expert from the same department) based on his/her training/internship carried out

. The evaluation will be based on the following criteria:

- Quality of content presented
- Proper planning for presentation
- Effectiveness of presentation
- Depth of knowledge and skills
- Attendance record, daily diary, departmental reports shall be analyzed along with the internship Report **Monitoring/ Surprise Visits**: During the internship program, the faculty mentor makes a surprise visit to the internship site, to check the student's presence physically. If the student is found to be absent without prior intimation to the concerned industry, entire training/interr canceled. Students should inform through email to the faculty mentor as well as the industry supervisor at least one day

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IV-SEMESTER

"Talent management is about ensuring that the organization attracts, retains, motivates and develops the talented people it needs."

-Josh Bersin

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With effect from the Academic Year 2021-22

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Scheme of Instructions of II Semester of B.E. – Electrical & Electronics Engineering asper AICTE Model Curriculum 2021-22

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

SEMESTER-IV

S. No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
THEORY									
1	20 EE C09	**Core -5** Digital Electronics	3	0	0	3	40	60	3
2	20 EE C10	**Core -6** Electrical Machines-1	3	0	0	3	40	60	3
3	20 EE C11	**Core -7** Electromagnetic Fields	3	0	0	3	40	60	3
4	20 EE C12	**Core -8** Power Electronics	3	0	0	3	40	60	3
5	20 EE C13	**Core -9 Power systems I**	3	0	0	3	40	60	3
6	20EGM02	Indian Traditional Knowledge	2	0	0	-	----	-	NC
7	20EGM03	Universal Human Values-II: Understanding Harmony	3	0	0	3	40	60	3
PRACTICALS									
8	20 EE C14	Digital Electronics Lab	0	0	2	3	50	50	1
9	20 EE C15	Electrical Machines-1 Lab	0	0	2	3	50	50	1
10	20 EE C16	Power Electronics Lab	0	0	2	3	50	50	1
Total			**20**	**0**	**6**	**-**	**390**	**510**	**21**

L: Lecture **T: Tutorial** **P: Practical**
CIE - Continuous Internal Evaluation **SEE - Semester End Examination**

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With effect from the Academic Year 2021-22

20 EEC 09

DIGITAL ELECTRONICS

Instruction	Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: **Basics of number systems, basics of transistors and MOSFETs**

Course Objectives:

1. To demonstrate the working of logic families and logic gates
2. To present design and implementation of combinational and sequential logic circuits.
3. To illustrate the process of A/D and D/A conversions and PLD's in implementing the given logical problems.

Course Outcomes: **After the completion of this course, students will be able to:**

1. Understand the fundamental concepts and techniques used in logical operations.
2. Analyze and design various combinational circuits using k Maps and Q-M method
3. Design and implement Sequential logic circuits like counters shift register sand sequence generators
4. Understand the process of Analog to Digital conversion and Digital to Analog conversion.
5. Implement PLD's to solve the given logical problems

UNIT –I

Fundamentals of Digital Systems and Logic families: Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, and CMOS logic.

UNIT –II

Combinational Digital Circuits: Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, digital comparator, parity checker/generator, code converters, priority encoders, decoders/Seven segment displaydevice, Q-M method of function realization.

UNIT –III

Sequential circuits and systems: A 1-bit memory, the circuit properties of bi-stable latch, the clocked SR flip-flop, J- K-T and D-types flip-flops, applications of flip-flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, **sequence detector,** ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, applications of counters.

UNIT –IV

A/D and D/A Converters: Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, analog to digital converters: parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, specifications of A/D converters.- Significance of size of data on the accuracy of conversion

UNIT –V

Semiconductor memories and Programmable logic devices: Introduction to state diagram- Moore and Mealy machine Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic.

Text Books:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.

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Suggested Readings:

1. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
2. S. Salivahanan “Digital circuits and design”, 4th edition, Vikas Publishing house, 2010

CO-PO & PSO Correlation Articulation Matrix-DE

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	-	-	-	-	-	-	-	1	1	-
CO2	2	3	3	2	1	-	-	-	-	-	-	-	1	2	-
CO3	2	3	3	2	1	-	-	-	-	-	-	-	1	3	1
CO4	2	2	2	2	1	-	-	-	-	-	-	-	1	1	1
CO5	1	2	2	1	1	-	-	-	-	-	-	-	1	1	2

“A person without a sense of humor is like a wagon without springs-jolted by every pebble in the road.”

-Henry Ward Beecher

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With effect from the Academic Year 2021-22

20EE C10 **ELECTRICAL MACHINES-I**

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: Basic Electrical Engineering.

Course Objectives: The objective of this course is to:

1. To inculcate the principles of Electromechanical Energy Conversions.
2. To determine the performance of DC Machines by conducting various tests.
3. To analyze and select a suitable DC Machine based on the application.
4. To impart the knowledge of transformers and evaluate its performance.

Course Outcomes: After completion of this course, students will able to:

1. Identify the various parts of electrical machines and distinguish the nomenclature of electric and magnetic circuits.
2. Elucidate the principle of operation and characteristics of electrical machines.
3. Analyze the starting methods and speed control of DC machine.
4. Determine the performance parameters of a machine for a given data.
5. Explain the parallel operation of DC generators and single-phase transformers.
6. Choose a suitable DC machine and auto transformer for a specific application.

UNIT-I

Electromechanical energy conversion: Introduction to Magnetic circuits, forces and torques in magnetic field system, energy balance, singly excited and multiple excited magnetic systems, co-energy.

UNIT-II

DC Generators: Review of Constructional features and Principle of operation of a DC machine, armature windings diagram (Lap and Wave winding), analysis of EMF equation of a DC generator, Armature reaction and its effects, process of commutation, methods of improving commutation, methods of excitation and classification of DC generators, voltage build-up in a shunt generator, critical field resistance and critical speed, generator characteristics, losses and efficiency, parallel operation and applications of DC generators.

UNIT-III

DC Motors: Review of Principle of operation, back EMF and significance of back EMF, electromagnetic torque, types of DC motors, characteristics, analysis of speed control methods, necessity of starter, three-point starter and four-point starter, soft starters (elementary treatment only) losses and efficiency, applications of DC motors.

Testing of DC machines: Swinburne's test, brake test, Hopkinson's test, fields test, retardation test and separation of losses.

UNIT-IV

Single Phase Transformer: Review of Constructional features, principle of operation, EMF equation and ideal transformer, transformer on no-load and on-load and its phasor diagrams. Detailed study of equivalent circuit, voltage regulation and efficiency. All day efficiency, parallel operation of transformer.

Testing of transformer: Polarity test, analysis of open circuit and short circuit test, Sumpner's test, separation of losses.

Auto transformer: - Construction, principle, applications and comparison with two-winding transformer.

UNIT-V

Three-Phase Transformers: Construction, types of connection and their comparative features, Scott connection. Tap-changing transformers: No-load and on-load tap-changing of transformers, Three-winding transformers, cooling of transformers.

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Text Books:

1. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
2. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
3. H. Cotton, Advanced Electrical Technology, Wheeler & Co, CBS publishers, 7th Edition, 2005.
4. J.B Gupta, Theoryand performance of electrical machines, S.K. Kataria & Sons, 14th Edition, 2014.

Suggested Readings:

6. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
7. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.
8. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
9. Ashfaq Hussain "Electrical Machines" Danpat Rai and sons, 3rd Edition 2012.

CO-PO & PSO Correlation Articulation Matrix- EM1

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	1	2	1	--	--	--	--	--	--	--	1	2	2
CO-2	3	3	2	2	1	--	--	--	--	--	--	--	1	2	2
CO-3	3	3	2	2	1	--	--	--	--	--	--	--	1	2	2
CO-4	3	3	2	2	1	--	--	--	--	--	--	--	1	2	2
CO-5	3	3	2	2	1	--	--	--	--	--	--	--	1	2	2
CO-6	3	3	2	2	1	--	--	--	--	--	--	--	1	2	2

"He that can have patience can have what he will."

-Benjamin Franklin

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With effect from the Academic Year 2021-22

20EEC11 **ELECTRO MAGNETIC FIELDS**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite : Mathematics 1 and mathematics 3

Course Objectives:

1. To understand coordinate systems, vector calculus and their applications to analyze electrostatic and magnetic fields.
2. To figure out Maxwell's equations, uniform plane wave and its propagation through different media.
3. To know the sources, effects & control techniques of EMI & EMC.

Course Outcomes: After the completion of this course, students will be able to

1. Understand the basic concepts of vector calculus, various coordinate systems and apply them appropriately for solving electromagnetic field problems.
2. Obtain the physical quantities like field intensity, flux density and potential due to various types of charge distributions in electric and magnetic fields using fundamental laws.
3. Differentiate between conduction & convections currents, and describe the behaviour of static electric & magnetic fields in different media, boundary conditions and acquire the knowledge about energy storing elements.
4. Illustrate Maxwell's equations and their application to time-harmonic fields, wave propagation in different media and Poynting's power-balance theorem.
5. Recognize what is EMI & EMC, sources & effects of Electromagnetic Interferences in inter and intra systems and various methods to control EMI

UNIT- I

Orthogonal Coordinate Systems: Review of Vector Calculus, Rectangular, Cylindrical, Spherical Coordinate systems; Line, Surface and Volume integrals; Operator Del, Gradient, Divergence, Curl & Laplacian of a field; Divergence and Stokes's theorems.

Electrostatic fields: Various charge configurations, Coulomb's law, Electric field intensity and flux density of different charge distributions, Gauss's law, Integral and Point form of Maxwell's Electrostatic Equation.

UNIT- II

Electrostatic Field in Materials: Electrical Potential, Capacitance of Parallel plate capacitor, Equipotential lines, Properties of materials, convection and conduction currents, conductors, dielectric constant, continuity equation and relaxation time, boundary conditions, Poisson's and Laplace's equations, Uniqueness theorem.

UNIT-III

Magneto Static Fields: Biot-Savart's law, Ampere's law, Displacement current, Magnetic Scalar and Vector Potentials, boundary conditions, Forces in Magnetic fields, Lorentz force equation, Force between parallel conductors, Inductance Calculations (Solenoid, Toroid), Mutual Inductance, Coefficient of Coupling.

UNIT- IV

Time Varying Electromagnetic Fields: Faraday's laws of electromagnetic induction, Final forms of Maxwell's Equations, Power and Poynting theorem, Time-Harmonic Electromagnetic fields, Wave equations (One dimension), Plane Wave, Propagation in perfect and lossy-dielectrics.

UNIT-V

Electromagnetic Interference and Compatibility (Theoretical Aspects only): Introduction to Electromagnetic Interference and Electromagnetic Compatibility (EMI & EMC)- Sources and Characteristics of EMI, Control Techniques of EMI, Grounding, Shielding, Filtering. Introduction to numerical electromagnetics.

Text Books:

1. Hayt, W.H and J.A Buck, Engineering Electromagnetics, Tata McGraw Hill, 8th Edition, 2018.
2. Sadiku, M.N.O, S.V. Kulkarni, Principles of Electromagnetics, Oxford University press, 7th Edition, 2018.

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Suggested Readings:

1. S. P. Seth, Elements of Electromagnetic Fields, Danpat Rai& Co, 2011.
2. David K. Cheng, Field and Wave Electromagnetics, Pearson Education. 2nd Edition 2014.
3. Ashutosh Pramanik, Electromagnetism Theory and Applications, PHI Pvt. Ltd., 3rd Edition, 2015
4. R.L. Yadava, "Electromagnetic Fields & Waves", Khanna Publishing House,
5. R.K. Shevgaonkar, Electromagnetic Waves, , Tata McGraw Hill, India
6. Narayana Rao, Engineering Electromagnetics, PHI Pvt. Ltd

CO-PO & PSO Correlation Articulation Matrix: EMF

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	3	2	1	2	--	2	--	1	1	2	1	--	2	1
CO-2	3	3	2	1	2	--	2	--	1	1	2	1	--	2	1
CO-3	3	3	2	1	2	--	2	--	1	1	2	1	--	3	1
CO-4	3	3	2	1	2	--	2	--	1	1	2	1	--	3	1
CO-5	3	3	2	1	2	1	2	--	1	1	2	1	--	3	1

"The quality, not the longevity, of one's life is what is important."

-Martin Luther King , Jr

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With effect from the Academic Year 2021-22

20EEC12 **POWER ELECTRONICS**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite Analog Electronic Circuits

Course Objective:

1. To identify the characteristics of different static switches and their turn- ON & turn - OFF methods.
2. To know the principles of AC-DC, DC-DC, DC-AC and AC-AC energy conversions.
3. To study various methods of voltage control in power converters.

Course Outcomes: After the completion of this course, students will be able to:

1. Understand the construction, operation and characteristics of various power semiconducting devices and to identify their selection in appropriate application.
2. Comprehend the driver/trigger circuits for various devices & also protection circuit, different turn -OFF methods, series & parallel operation of SCRs.
3. Illustrate the principle of working of AC-DC, AC-AC, DC-DC & DC-AC converters.
4. Analyse the performance for various power converters with different loads and modes of working.
5. Describe various voltage control techniques in power electronic converters with their applications

UNIT-I

Power Switching Devices: Power diode, characteristics, Recovery characteristics, Types of power diodes, General purpose diodes, Fast recovery diodes, their applications. Bipolar Junction Transistors(BJT), Power MOSFET, IGBT Basic structure and working, Steady state and switching characteristics, Gate drive circuits for MOSFET and IGBT, Comparison of BJT, MOSFET and IGBT, Their applications.

UNIT-II

Silicon Controlled Rectifier (SCR): SCR-Static characteristics, Two transistor analogy, Protection of SCRs, Dynamic characteristics, Series and parallel operation of SCRs, SCR trigger circuits-R, RC and UJT triggering circuits, Commutation methods of SCR.

UNIT-III

Thyristors Rectifiers: Study of Single-phase and three-phase half wave and full wave-controlled rectifiers with R, RL, RLE loads, significance of freewheeling diode, Effect of source inductance, Dual converters - circulating and non-circulating current modes.

UNIT-IV

DC-DC Converters: Principles of Step-down, Step-up, Step UP/Down choppers, Time ratio control and current limit control, Types of choppers Type- A, B, C, D and E, Voltage commutated chopper, Introduction to Buck, Boost and Buck-Boost regulators, Basics of flyback and forward converters.

AC-AC Converters: AC Voltage Controller, integral cycle control, phase control, AC Voltage controllers with R and RL loads

UNIT-V

DC-AC Converters: Single-phase Bridge inverters, Voltage control methods, Single pulse width modulation, Multiple pulse width modulation, Sinusoidal pulse width modulation, Three-phase bridge Inverters, 180^0 & 120^0 modes of operation, switch states, instantaneous output voltages, average output voltages for single & three phase inverters, Current source inverters, Comparison of Voltage Source Inverters and Current Source Inverters,

Text Books:

1. Singh. M. D, Khanchandani. K. B, "Power Electronics", Tata McGraw Hill, 2nd Edition, 2017.
2. Rashid. M. H., "Power Electronics Circuits Devices and Applications", 4th Edition, Pearson India, 2017.
3. Bimbra. P. S, "Power Electronics", Khanna Publishers, 3rd Edition, 2013.
4. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science

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Suggested Reading:

1. N. Mohan, T.M. Undeland , "Power Electronics: Converters, Applications and Design", John Wiley & Sons,2007
2. P.C. Sen, "Power Electronics", Tata Mc-Graw Hill, 1st Edition, 2001.
3. L.Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.

CO-PO & PSO Correlation Articulation Matrix: PE

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	2	3	2	2	2	--	2	--	1	2	--	2	2
CO-2	2	2	2	2	1	--	1	--	1	--	1	--	--	2	2
CO-3	3	2	1	2	1	--	1	--	2	1	3	2	--	2	2
CO-4	3	1	1	2	1	--	--	--	1	1	--	--	--	2	2
CO-5	3	2	2	2	--	--	1	--	1	--	1	1	--	2	2

"The poor do not need our sympathy and our pity. The poor need our love & compassion. They give us much more than we give them."

-Mother Teresa

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20 EE C 13

POWER SYSTEMS –I

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisite: Knowledge of energy resources, Mathematics1

Course Objectives:

1. To introduce Generation of power through conventional sources such as: Thermal, Hydro, Nuclear and Renewable energy sources
2. To familiarize mechanical design of transmission lines and cables.
3. To familiarize present practices in tariff calculations and understand the classification and Connection schemes of distribution systems

Course Outcomes: After the completion of this course, students will be able to:

1. Discuss the construction and operation of conventional and non-conventional sources of energy along with financial management
2. Determine the line parameters such as inductance and capacitance for different configurations of transmission line
3. Calculate the sag and tension of given transmission line under different weather conditions
4. Discuss the operation of underground cables, insulators and calculate the capacitance of cables and string efficiency of insulators
5. Discuss the different tariff structures, types of costs and general aspects of distribution systems

UNIT-I

Basic Concepts: Evolution of Power Systems and Present-Day Scenario. Structure of a power system: Bulk Power Grids and Micro-grids.

Generation: Thermal- Hydro -Power Plants: Principles, Choice of site, layout and various parts of generating stations, Brief description of Hydro Power Plant Dam, Spillways, Head works, Surge tank, Penstocks, Line diagram of Thermal Power Station (TPS) showing paths of coal, steam, water, air, ash and flue gasses, Brief description of TPS components: Economizers, Boilers, Super heaters, Turbines, Condensers, Chimney and Cooling towers.

Nuclear Station: Schematic Arrangement of Nuclear Power Station, Advantages and disadvantages, Types of Nuclear reactors

UNIT- II

Solar and Wind Generation: Solar cell fundamentals, Solar Cell characteristics, solar cell classification, solar cell, Module, Panel and Array Construction, Maximizing the solar PV output and load matching, Solar PV Systems, Basic Principles of Wind Energy Conversion, The Nature of the Wind, The Power in the Wind, Forces on the Blades, Wind Energy Conversion, Wind Data and Energy Estimation, Site Selection Considerations

UNIT-III

Line Parameter Calculations: Inductance & Capacitance calculations of Transmission Line, single-phase and three-phase symmetrical composite conductors, GMD, GMR, Transposition of conductors, bundled conductors, effect of earth capacitance.

UNIT-IV

Overhead Transmission Lines and Cables: Overhead line materials, supports, types, Ground wires, **Sag**/Tension calculations, Equal / Unequal supports, Effects of wind, ice / Erection Conditions stringing charts. Insulators, Types, Material for construction, potential distribution over string of insulators, equalizing of potential, Methods.

Underground Cables: Construction of Cables, Insulating Materials for Cables, Classification of Cables, Insulation Resistance of a Single-Core Cable, Capacitance of a Single-Core Cable, Dielectric Stress in a Single-Core Cable, Most Economical Conductor Size in a Cable, Grading of Cables, Capacitance Grading, Inters heath Grading, Capacitance of 3-Core Cables, Measurements of Ce and Cc.

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UNIT- V

Economics of Power Generation: Load curve, Load demand and diversified factors, Base load operation, Types of costs and depreciation calculations; Tariffs, different types of tariffs; Methods of power factor improvement.

General Aspects of Distribution Systems-Types of Distribution, Ring Main & Radial Distribution system, Calculations for Distributor fed at one end, distributor fed at both ends.

Text Books:

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
2. C.L. Wadhwa, "Electric Power Systems Theory", New Academic Science Limited, 2012.
3. B.H. Khan, "Non-Conventional Energy Resources" Mc Graw Hill Education, 2015

Suggested Reading:

1. A.R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.
2. D.P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill, 2003.
3. B.M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012

CO-PO & PSO Correlation Articulation Matrix-PS1

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO-1	1	2	2	1	-	-	2	-	-	-	-	-	1	-	2
CO-2	2	3	2	2	-	-	-	-	-	-	-	-	1	-	2
CO-3	2	3	2	2	-	-	-	-	-	-	-	-	1	-	2
CO-4	2	2	2	2	-	-	-	-	-	-	-	-	-	-	2
CO-5	1	2	2	1	-	-	-						-	-	2

"Ethics is knowing the difference between what you have a right to do and what is right to do."

-Potter Stewart

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20EGM02

INDIAN TRADITIONAL KNOWELDGE

Instruction	2L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	0 Marks
Credits	0

Prerequisite: Knowledge on Indian Culture

Course Objectives:

1. To get a knowledge in Indian Culture
2. To Know Indian Languages and Literature and the fine arts in India
3. To explore the Science and Scientists of Medieval and Modern India

Course Outcomes: After completion of this course, students will be able to:

1. Understand philosophy of Indian culture
2. Distinguish the Indian languages and literature
3. Learn the philosophy of ancient, medieval and modern India
4. Acquire the information about the fine arts in India
5. Know the contribution of scientists of different eras.

UNIT-I

Culture and Civilization: Culture, civilization and heritage, general characteristics of culture, importance of culture in human life, Cultural diversity, Aesthetics, Women seers, Indus culture, Indian cuisine, Martial arts

UNIT-II

Education System: Education in ancient, medieval and modern India, aims of education, subjects, Languages, Science and Scientists of ancient, medieval and modern India

UNIT-III

Linguistic Wealth: Indian Languages and Literature: the role of Sanskrit, Paleography, Significance of scriptures to current society, Indian semantics and lexicography, Bhakti literature, Darsanas

UNIT-IV

Art, Technology & Engineering: Sculpture, Painting and Handicrafts, Indian Music, Dance Drama and Theatre,Introduction to Mayamatam, Iron and steel technology, Use of metals in medicinal preparations

UNIT-V

Science and Logic: Heliocentric system, Sulbasutras, Katapayadi, Hindu calendar, 6 pramanas in Indian logic, Scientific method applied to therapeutics, Fallacies, Tarka – Induction &Deduction, Ayurvedic biology, Definition of health

Essential Readings:

1. Kapil Kapoor, **Text and Interpretation: The Indian Tradition,** ISBN: 81246033375, 2005
2. Samskrita Bharati, **Science in Samskrit**, ISBN 13: 978-8187276333, 2007
3. Satya Prakash, **Founders of sciences in Ancient Indi**a, Govindram Hasanand, ISBN-10: 8170770009, 1989
4. Brajendranath Seal, **The Positive Sciences of the Ancient Hindus**, Motilal Banarasidass, ISBN-10: 8120809254, 1915
5. Kancha Ilaiah, Turning the Pot, Tilling the Land: Dignity of Labour in Our Times

Suggested Readings:

- Swami Vivekananda, *Caste, Culture and Socialism*, Advaita Ashrama, Kolkata ISBN-9788175050280
- Swami Lokeswarananda, *Religion and Culture*, Advaita Ashrama, Kolkata ISBN-9788185843384
- Kapil Kapoor, *Language, Linguistics and Literature: The Indian Perspective*, ISBN-10: 8171880649, 1994.
- Karan Singh, *A Treasury of Indian Wisdom: An Anthology of Spiritual Learn*, ISBN: 978-0143426158, 2016
- Swami Vivekananda, *The East and the West*, Advaita Ashrama, Kolkata 9788185301860

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- Srivastava R.N., *Studies in Languages and Linguistics*, Kalinga Publications ISBN-13: 978-8185163475
- Subhash Kak and T.R.N. Rao, Computation in Ancient India, Mount Meru Publishing ISBN-1988207126
- R.N Misra, *Outlines of Indian Arts Architecture, Painting, Sculpture, Dance and Drama,* IIAS, Shimla & Aryan Books International, ISBN 8173055149
- S. Narain, *Examinations in ancient India*, Arya Book Depot, 1993
- M. Hiriyanna, Essentials of Indian Philosophy, Motilal Banarsidass Publishers, ISBN-13: 978-8120810990, 2014
- Ravi Prakash Arya, Engineering and Technology in Ancient India, Indian Foundation for Vedic Science, ISBN-10: 1947593072020
- Shashi Tharoor, The Hindu Way
- Amartya Sen, Argumentative Indian

SWAYAM/Nptel:

History of Indian Science and Technology - https://onlinecourses.swayam2.ac.in/arp20_ap35/preview
Introduction to Ancient Indian Technology – https://onlinecourses.nptel.ac.in/noc19_ae07/preview
Indian Culture & Heritage -https://onlinecourses.swayam2.ac.in/nos21_sc11/preview
Language and Society- https://nptel.ac.in/courses/109/106/109106091/
Science, Technology & Society - https://nptel.ac.in/courses/109/103/109103024/
Introduction to Indian Philosophy- https://nptel.ac.in/courses/109/106/109106059/
Introduction to Indian Art - An appreciation -https://onlinecourses.nptel.ac.in/noc20_hs09/preview

"A truth that's told with bad intent Beats all the lies you can invent."

-william Blake

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20 EE C 14

DIGITAL ELECTRONICS LAB

Instruction	2 Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Pre-requisites: Basic knowledge on logical operations, basics of logic gates, basics of flip-flops

Course Objectives:

1. To explain Demorgan's Theorem, SOP, POS forms
2. To demonstrate implementation of Full/Parallel Adders, Subtractors and Magnitude Comparators, multiplexers, de-multiplexers and decoders using logic gates
3. To illustrate various flip-flops, shift registers and design different counters.

Course outcomes: After the completion of this course, the students will be able to:

1. Demonstrate the truth table of various expressions and combinational circuits using logic gates.
2. Design, test and implement various combinational circuits such as adders, subtractors, comparators.
3. Apply knowledge of logic gates to design complex logic circuits like multiplexers and demultiplexers.
4. Design, test and implement various sequential circuits using flip-flops
5. Design various logic circuits using shift registers

LIST OF EXPERIMENTS

1. Verify(a) Demorgan's Theorem for 2 variables.
2. The sum-of product and product-of-sum expressions using gates.
3. Design and implement (a) Full Adder using basic logic gates. (b) Full subtractor using basic logic gates
4. Design and implement 4-bit Parallel Adder/ subtractor using IC 7483.
5. Design and Implementation of 4-bit Magnitude Comparator using IC 7485.
6. Realize (a) 4:1 Multiplexer using gates.
   (b) 3-variable function using IC 74151(8:1MUX).
7. Realize 1:8 Demux and 3:8 Decoder using IC74138.
8. Realize the following flip-flops using NAND Gates. (a) Clocked SR Flip-Flop (b) JK Flip-Flop
9. Realize the following shift registers using IC7474 (a) SISO (b) SIPO (c) PISO (d) PIPO.
10. Realize the Ring Counter and Johnson Counter using IC7476.
11. Realize the Mod-N Counter using IC7490.
12. Design of synchronous counters using flip-flops.
13. Design of Asynchronous counters using flip-flops.

Note: At least **TEN** experiments should be conducted in the Semester

CO-PO & PSO Correlation Articulation Matrix-DE lab

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	-	-	-	-	-	-	-	1	1	-
CO2	2	3	3	2	1	-	-	-	-	-	-	-	1	2	-
CO3	2	3	3	2	1	-	-	-	-	-	-	-	1	3	1
CO4	2	2	2	2	1	-	-	-	-	-	-	-	1	1	1
CO5	1	2	2	1	1	-	-	-	-	-	-	-	1	1	2

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20EEC15 **ELECTRICAL MACHINES-I LAB**

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course objectives:

To understand the practical connections of the machines.

1. To draw the characteristics of different types of DC generators.
2. To test the DC machines and single-phase transformer under different loading conditions for their performance.

Course Outcomes: After completion of this course, students will be able to:

1. Make the connections for DC machines and single-phase transformer for their applications.
2. Choose the meter ratings for various applications of DC machines and single-phase transformer.
3. Control the speed of the DC motor by different methods.
4. Obtain the characteristics of the given DC generator.
5. Determine the performance of DC machines and single-phase transformer.

LIST OF EXPERIMENTS

1. OCC and load characteristics of separately excited DC generator.
2. OCC and load characteristics of DC shunt generator.
3. Load characteristics of DC compound generator.
4. Swinburne's test on DC shunt machine to predetermine the efficiency at any given load.
5. Brake test on DC series motor.
6. Hopkinson's test on two identical DC shunt machines.
7. Separation of stray losses of DC shunt machine.
8. Load test on single phase transformers.
9. Sumpner's test on two identical single-phase transformers.
10. Separation of Magnetic losses of transformer.
11. Study of three-phase transformer connections.
12. Demonstration of three-point starter and four-point starter.
13. Study of excitation phenomenon of three-phase transformer.
14. Parallel operation of two single-phase transformers.

Note: At least **TEN** experiments should be conducted in the semester.

CO-PO & PSO Correlation Articulation Matrix: EM-I Lab

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	1	2	1	--	--	--	--	--	--	--	1	2	2
CO-2	3	3	2	2	1	--	--	--	--	--	--	--	1	2	2
CO-3	3	3	2	2	1	--	--	--	--	--	--	--	1	2	2
CO-4	3	3	2	2	1	--	--	--	--	--	--	--	1	2	2
CO-5	3	3	2	2	1	--	--	--	--	--	--	--	1	2	2

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With effect from the Academic Year 2021-22

20EEC16 **POWER ELECTRONICS LAB**

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

1. To obtain and plot the characteristics of different static switches.
2. To analyze the triggering and commutation circuits for SCR.
3. To familiarize and simulate the conversion principles of AC-DC, DC-DC, DC-AC and AC-AC conversion circuits.

Course Outcomes: After completion of the course, students will be able to:

1. Plot the characteristics of various controlled switches and identifies effect of variation of control signal on the regions of switching operation.
2. Demonstrate the effect of delay angle and nature of load on the performance of various power converters and able to plot the output voltage and current waveforms.
3. Simulate various types of power converters and discriminate between simulation models and practical models of various power converters.
4. Understand various voltage control techniques in different power converters.
5. Select proper equipment, precautions, implement connections keeping technical, safety and economic issues.

List of Experiments

PART-A

1. Study of static characteristics of S.C.R. and to measure latching & holding currents.
2. Study the characteristics of BJT, MOSFET and IGBT.
3. R, RC and UJT triggering circuits for SCR
4. Study of forced commutation techniques of SCR.
5. Single-phase half-controlled bridge rectifier with R and RL loads.
6. Single-phase fully controlled converter with R, RL & RLE loads and freewheeling diode
7. Three-phase half-controlled bridge rectifier with R and RL loads.
8. Three-phase fully controlled bridge rectifier with R and RL loads.
9. DC voltage control using Buck and Boost choppers.
10. Voltage and Current commutated choppers with R&RL loads.
11. Single-phase step down Cyclo-converter with Rand RL loads.
12. Single-phase A.C voltage controller with R and RL loads
13. Half and Full bridge inverters with R&RL loads.

PART-B

1. Simulation of Single-phase Full converter and Semi converter with R & RL loads and freewheeling diode.
2. Simulation of Three-phase Full converter and Semi converter with R & RL loads.
3. Simulation of Single-phase AC voltage controller with R & RL loads
4. Simulation of single-phase half-bridge & full-bridge inverters.
5. Simulation of three-phase bridge inverter in different modes.
6. Simulation of Single-phase Inverter with single, multiple and sinusoidal pulse width modulations.

Note: At least **SEVEN** experiments from PART-A and **THREE** from PART-B should be conducted in the semester.

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Gandipet, Hyderabad-75

CO-PO & PSO Correlation Articulation Matrix: PE Lab

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	--	1	1	--	--	--	2	1	2	1	--	3	2
CO-2	3	3	1	2	2	--	1	--	2	1	2	1	2	3	3
CO-3	3	3	--	2	2	--	1	--	2	1	2	1	3	3	3
CO-4	3	1	1	2	1	--	--	--	1	1	2	1	--	2	2
CO-5	1	2	1	2	--	1	--	--	1	1	2	1	--	2	2

"Success is not final, failure is not fatal: it is the courage to continue, that counts."

-Sir Winston Churchill

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Syllabus of the Courses offered to the other Departments

20 EE M01	Basic Electrical Engineering
20 EE M02	Basic Electrical Engineering Lab
20 EE O01	Engineering Materials
20 EE O02	Energy Management Systems
20 EE O03	Energy Auditing
20 EE O04	Energy Conservation
20 EE O05	Waste Management

"Efficiency is intelligent Laziness."

- David Dunham

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20EEC01 **BASIC ELECTRICAL ENGINEERING**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To understand the behavior of different circuit elements R, L & C, and the basic concepts of electrical AC circuit analysis
2. To understand the basic principle of operation of AC and DC machines
3. To know about different types of electrical wires and cables, domestic and industrial wiring. safety rules and methods of earthing

Course Outcomes: After the completion of this course, the student will be able to

1. Understand the concepts of Kirchhoff's laws and to apply them in superposition, Thevenin's and Norton's theorems to get the solution of simple dc circuits
2. Obtain the steady state response of RLC circuits with AC input and to acquire the basics, relationship between voltage and current in three phase circuits.
3. Understand the principle of operation, the emf and torque equations and classification of AC and DC machines
4. Explain various tests and speed control methods to determine the characteristic of DC and AC machines.
5. Acquire the knowledge of electrical wiring, types of wires, cables used and Electrical safety precautions to be followed in electrical installations.
6. Recognize importance of earthing, methods of earthing and various low-tension switchgear used in electrical installations

UNIT-I

DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff current and voltage laws, analysis of simple circuits with dc excitation, Superposition, Thevenin and Norton Theorems, Time-domain analysis of first-order RL and RC circuits.

UNIT-II

AC Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L, C, RL, RC. Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT-III

Transformers: Construction, Working principle, EMF Equation, Ideal and Practical transformer, Equivalent circuit of Transformer, OC and SC tests on a transformer, Efficiency and Regulation

UNIT-IV

DC and AC Machines: DC Generators: Construction, Principle of operation, EMF equation, Classification, Characteristics of shunt, series and compound generators.

DC Motors: Classification, Torque equation, Characteristics, Efficiency, Speed Control of Series and Shunt Motors.

Three - Phase Induction Motors: Principle of operation, Applications,

UNIT-V

Electrical Installations: Electrical Wiring: Types of wires and cables, Electrical Safety precautions in handling electrical appliances, electric shock, first aid for electric shock, safety rules.

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, Earthing (Elementary Treatment only), Elementary calculations for energy consumption

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Text Books:

1. L. S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011.
2. E. Hughes, Electrical and Electronics Technology, Pearson, 2010.

Suggested Reading:

1. D. P. Kothari & I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989
3. D.C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill,2009
4. P.V. Prasad, S. sivanagaraju, R. Prasad, "Basic Electrical and Electronics Engineering" Cengage Learning, 1st Edition, 2013

CO-PO Mapping for BEE Theory

Course Outcome	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO-1	PSO-2	PSO-3
C01	3	3	2	3	3	-	3	-	1	2	2	3	2	3	2
C02	3	3	2	3	2	-	3	-	1	2	2	3	2	3	2
C03	3	3	2	1	3	-	2	-	1	2	2	3	2	3	2
C04	2	3	-	1	3	-	2	-	1	2	1	3	2	3	2
C05	2	-	-	1	1	2	2	1	1	1	2	3	2	3	2
C06	2	-	-	1	3	1	2	1	1	1	2	3	2	3	2

"You cannot be a leader, and ask other people to follow you, unless you know how to follow, too."

-Sam Rayburn

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With effect from the Academic Year 2020-2021

20EEC02

BASIC ELECTRICAL ENGINEERING LAB

Instruction	2 Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

1. To acquire the knowledge of different types of electrical elements and to verify the basic electrical circuit laws and theorems.
2. To determine the parameters and power factor of a coil, calculate the time and frequency responses of RLC circuits and to familiarize with measurement of electric power &energy.
3. To determine the characteristics of Transformers, dc, ac machines and switchgear components

Course Outcomes: **At the end of the course, the students are expected to**

1. Get an exposure to common electrical components, their ratings and basic electrical measuring equipment.
2. Make electrical connections by wires of appropriate ratings and able to measure electric power and energy.
3. Comprehend the circuit analysis techniques using various circuital laws and theorems.
4. Determine the parameters of the given coil and calculate the time response of RL & RC series circuits.
5. Recognize the basic characteristics of transformer and components of switchgear.
6. Understand the basic characteristics of dc and ac machine by conducting different types of tests on them.

List of Laboratory Experiments/Demonstrations:

1. Demonstration of Measuring Instruments and Electrical Lab components.
2. Verification of KCL and KVL.
3. Time response of RL and RC series circuits.
4. Determination of parameters of a choke or coil by Wattmeter Method
5. Verification of Thevenin's and Norton's theorems
6. Turns ratio /voltage ratio verification of single phase Transformers
7. Open Circuit and Short Circuit tests on a given single phase Transformer
8. Observation of Excitation Phenomenon in Transformer
9. Measurement of three phase power in a balanced system using two Wattmeter method.
10. Measurement of 3-Ph Energy by an Energy Meter (Demonstration of Principle)
11. Load test on DC Shunt motor
12. Speed control of DC Shunt motor
13. Demonstration of Low Tension Switchgear Equipment/Components
14. Demonstration of cut - out section of Machines like DC Machine, Induction Machine etc.

Note: TEN experiments to be conducted from the above list.

CO-PO Mapping for BEE Theory

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO-1	PSO-2	PSO-3
CO-1	2	2	1	1	-	-	1	1	2	1	-	1	1	3	2
CO-2	2	1	1	1	-	-	1	1	2	1	-	1	1	3	2
CO-3	3	3	2	1	-	-	1	-	2	1	-	1	1	3	2
CO-4	3	1	2	1	-	-	1	-	2	1	-	1	1	3	2
CO-5	3	3	2	3	-	-	1	-	2	1	-	1	1	3	2
CO-6	3	3	2	2	-	-	1	-	2	1	-	1	1	3	

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20EGMO3

UNIVERSAL HUMAN VALUES-II: UNDERSTANDING HARMONY

(**B.E/B.Tech II/III Year** -Common to all Branches)

Instruction	3L Hours per Week
Duration of SEE	3 Hours
SEE	60Marks
CIE	40 Marks
Credits	3

Introduction

This course discusses the role of human values in one's family, in society and in nature. In the Induction Program, students would get an initial exposure to human values through Universal Human Values–I. This exposure is to be augmented by this compulsory full semester foundation course.

Course Objectives

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in human being, family, society and nature/existence.
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

Course Outcomes

By the end of the course,

1. Students are expected to become more aware of themselves, and their surroundings (family, society, nature)
2. They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
3. They would have better critical ability.
4. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
5. It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

The course has 28 lectures and 14 practice sessions:

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

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

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

Unit 2: Understanding Harmony in the Human Being - Harmony in Myself

- Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
- Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
- Understanding the Bodyas an instrument of 'I' (I being the doer, seer and enjoyer)
- Understanding the characteristics and activities of 'I' and harmony in 'I'

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- Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
- Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

Unit 3: Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship

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

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

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

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

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

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

- Natural acceptance of human values
- Definitiveness of Ethical Human Conduct
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
- Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
- Case studies of typical holistic technologies, management models and production systems
- Strategy for transition from the present state to Universal Human Order:
  a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
  b. At the level of society: as mutually enriching institutions and organizations

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

Mode of Conduct (L-T-P-C 2-1-0-3)

- Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them. Tutorial hours are to be used for practice sessions.
- While analyzing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

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- In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self- exploration.
- Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.
- Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical's are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignments and/or activities are included.
- The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely be having and working based on basic human values.

Assessment:

This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self- assessment, peer assessment etc. will be used in evaluation.

Example:

Assessment by faculty mentor: 10 marks

Self-assessment/Assessment by peers: 10
M

Socially relevant project/Group Activities/Assignments: 20 marks

Semester End Examination: 60 marks

The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

Text Books

The Text Book

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

The teacher's manual

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

Reference Books

1. A Nagaraj Jeevan Vidya: Ek Parichaya, Jeevan Vidya Prakashan, Amar kantak, 1999.
2. N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, 2004.
3. Cecile Andrews, Slow is Beautiful
4. Gandhi - Romain Rolland (English)
5. Dharampal, "Rediscovering India"
6. E. FSchumacher. "Small is Beautiful"
7. J. C. Kumarappa "Economy of Permanence"
8. Pandit Sunderlal "Bharat Mein Angreji Raj"
9. Mohandas Karamchand Gandhi "The Story of My Experiments with Truth"
10. 10.Mohandas K. Gandhi, "Hind Swaraj or Indian Home Rule"
11. Maulana Abdul Kalam Azad, India Wins Freedom -
12. Vivekananda - Romain Rolland (English)
13. The Story of Stuff (Book)

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With effect from the Academic Year 2021-2022

20EGM01

INDIAN CONSTITUTION AND FUNDAMENTAL PRINCIPLES

(BE/BTech III/IV Semester - Common to all branches)

Instruction	2L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	0 Marks
Credits	0

Course Objectives

The course will introduce the students to:

1. History of Indian Constitution and how it reflects the social, political and economic perspectives of the Indian society.
2. Growth of Indian opinion regarding modern Indian intellectuals constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. Various Organs of Governance and Local Administration.

Course Outcomes

After successful completion of the course the students will be able to:

1. Understand the making of the Indian Constitution and its features.
2. Identify the difference among Right To equality, Right To freedom and Right to Liberty.
3. Analyze the structuring of the Indian Union and differentiate the powers between Union and States.
4. Distinguish between the functioning of Lok Sabha and Rajya Sabha while appreciating the importance of Judiciary.
5. Differentiate between the functions underlying Municipalities, Panchayats and Co-operative Societies.

Unit-I

Constitution of India: Constitutional history-Govt of India Act 1909, 1919 and 1935, Constitution making and salient features. Directive Principles of State Policy - Its importance and implementation.

Unit-II

Scheme of the Fundamental Rights & Duties: The Fundamental Rights - To Equality, to certain Freedom under Article 19, to Life and Personal Liberty Under Article 21. Fundamental Duties - the legal status.

Unit III

Union Government and its Administration - Structure of the Indian Union: Federalism, distribution of legislative and financial powers between the Union and the States.

Parliamentary form of government in India: Executive-President's role, power and position.

Unit IV

Legislature and Judiciary: Central Legislature-Powers and Functions of Lok Sabha and Rajya Sabha. Judiciary: Supreme Court-Functions, Judicial Review and Judicial Activism

Unit V

Local Self Government - District's Administration Head (Collector): Role and Importance.

Municipalities: Introduction, Mayor and Role of Elected Representative, CEO of Municipal Corporation. Panchayati Raj: Introduction, Zilla Panchayat, Elected Officials and their roles, CEO Zilla Panchayat: Position and Role. Block level: Organizational Hierarchy (Different departments). Village level: Role of Elected and Officials.

Text Books:

1. **Indian Government & Politics**, Ed Prof V Ravindra Sastry, Telugu Akademy, 2nd edition, 2018.
2. **Indian Constitution at Work,** NCERT, First edition 2006, Reprinted- January 2020.

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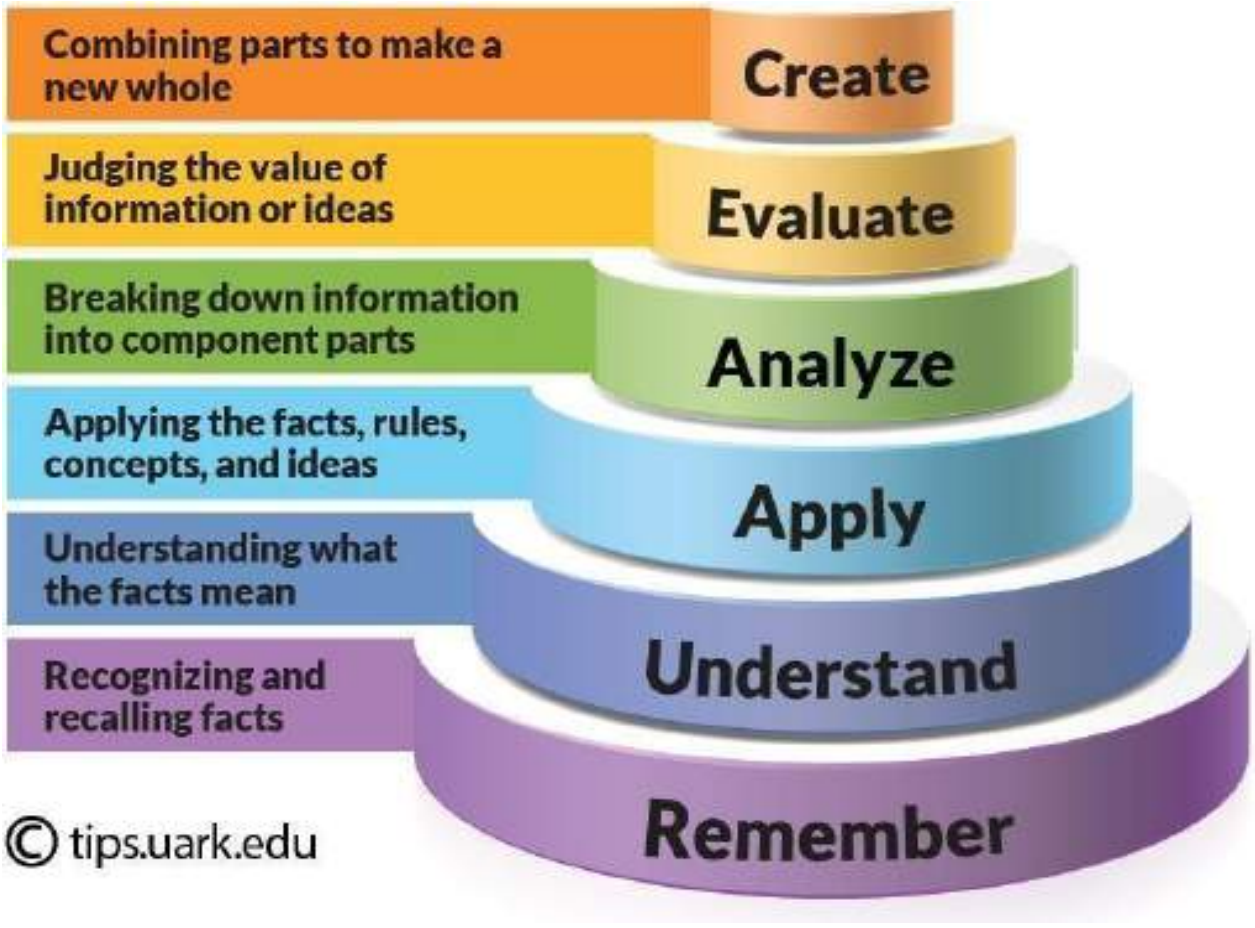
Suggested Reading:

1. **The Constitution of India**, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, **Framing of Indian Constitution**, 1st Edition, 2015.
3. M. P. Jain, **Indian Constitution Law**, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu**, Introduction to the Constitution of India**, Lexis Nexis, 2015.

Online Resources:

1. http://www.nptel.ac.in/courses/103107084/Script.pdf



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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
(AUTONOMOUS)

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

INSTITUTE VISION AND MISSION:

Vision:

To be centre of excellence in technical education and research

Mission:
To address the emerging needs through quality technical education and advanced research

DEPARTMENT VISION AND MISSION:

Vision:

To achieve Academic and Professional Excellence in Teaching and Research in the frontier areas of Electrical and Electronics Engineering Vis-a -Vis serve as a Valuable Resource for Industry and Society.

Mission:

Empowering the Faculty and Student Rendezvous to Nurture Interest for Conceptual Keystone, Applied Multidisciplinary Research, Inspiring Leadership and Efficacious Entrepreneurship culture , Impeccable Innovation in frontier areas to be synergetic with Environmental, Societal and Technological Developments of the National and International community for Universal Intimacy.

M1: Emphasis on providing Strong Theoretical Foundation & Engineering Leadership Eminence, infusion of Creativity and Management skill while maintaining Ethics and Moral for Sustainable Development. **(Individual development**)

M2: Enable the Faculty and Student Interactions to trigger interest for Applied Multidisciplinary Research and Entrepreneurship Culture resulting in Significant Advancement of the field of Specialization with Involvement of Industries and Collaborative Educational Networks. **(Sense of Ownership, Networking and Eco system Development)**

M3: Extend the Conducive Neighborhoods for Innovation in frontier areas to keep pace with Environmental, Societal and Technological Developments of the National and International Community to Serve Humanity. **(Service to Society, Atmanirbhar Bharat)**

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PROGRAMME EDUCATIONAL OBJECTIVES (PEOS):

- **PEO 1-** Graduates will Ennoble in offering Design solutions for Complex Engineering Problems using appropriate modern Software tools, with the specified need of the Industry and Protagonist in transforming the Society into a Knowledge Society.

- **PEO 2-** Graduates will Elevate Engineering Leadership and will be recognized as Experts working in Government, Consulting firms, International organizations with their Creativity in Design of Experiments, Analysis and Interpretation of Data and Synthesis of Information.

- **PEO 3-** Graduates will Exalt in their Professional career by Persistence in Team work, Ethical behavior, Proactive involvement, and Effective Communication.

- **PEO 4-** Graduate will Excel by becoming Researches, Professors and Entrepreneurs who will create and Disseminate new knowledge in the frontier areas of Engineering, Technology and Management

PROGRAM OUTCOMES (POs):

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
4. **Conduct Investigations of Complex Problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

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10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long Learning**: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOS):

PSO 1: Evaluate complex Engineering Problems to meet the distinct need of Industry & Society, by utilizing knowledge of Mathematics, Science, Emerging Technologies such as AI, Block chain & IT tools.

PSO 2: Exhibit Latent talent in understanding the Engineering and Administration standards at work place as a team leader to manage Projects in the Multi-Disciplinary Environments.

PSO 3: Establish Engineering Expertise in Power system, Machines and Drives Systems and also Pursue Research in the Frontier areas such as Embedded systems, Renewable Energy, E-Mobility and Smart grid.

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AICTE Model Curriculum with effect from AY 2022-23

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

SEMESTER – V

S.no	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
THEORY									
1	20 EE C17	**Core – 10** Electrical Machines-II	3	-	-	3	40	60	3
2	20 EE C18	**Core -11** Power Systems -II	3	-	-	3	40	60	3
3	20 EE C19	**Core -12** Microcontrollers and Applications	3	-	-	3	40	60	3
4	20 EE C20	**Core -13** Control Systems	3	-	-	3	40	60	3
5	20 EE Exx	**PE- I**	3	-	-	3	40	60	3
6	20 EE Exx	**PE-2**	3	-	-	3	40	60	3
7	20 xx Oxx	**OE-1**	3	-	-	3	40	60	3
PRACTICALS									
8	20 EE C21	Control Systems Lab	-	-	2	3	50	50	1
9	20 EE C22	Electrical Machines- II Lab	-	-	2	3	50	50	1
10	20 EE C23	Microcontrollers and Applications Lab	-	-	2	3	50	50	1
11	20EGCO3	Employability Skills	-	-	2	3	50	50	1
12	20 EE I02	Industrial / Rural Internship	3-4 Weeks/90 Hours				50	--	2
Total			**21**	**-**	**08**	**-**	**530**	**620**	**27**
Clock Hours Per Week: 29									

L: Lecture **P: Practical/Project Seminar/Dissertation** **CIE: Continuous Internal Evaluation**

T: Tutorial **SEE: Semester End Examination**

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AICTE Model Curriculum with effect from AY 2022-23

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

SEMESTER – V

List of Courses Offered in Program Elective-I		List of Courses Offered in Program Elective-II	
Course code	**Title of the Course**	**Course code**	**Title of the Course**
20 EE E11	Electrical Distribution Systems	20 EE E21	High Voltage Engineering
20 EE E12	Advanced Power Converters	20 EE E22	Switch Mode Power Converters
20 EE E13	Simulation Techniques in Electrical Engineering	20 EE E23	Optimization Techniques
20 EE E14	Electronic Instrumentation	20 EE E24	Renewable Energy Technologies
20 EE E15	Electrical Machine Design	20 EE E25	Special Electrical Machines
20EE E16	Computer Architecture and Organization	20EE E26	Basic VLSI Design

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DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

SEMESTER – VI

S.no	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
THEORY									
1	20 EE C24	**Core -13** Power System Protection	3	-	-	3	40	60	3
2	20 EE C25	**Core -14** Power System Operation and Control	3	-	-	3	40	60	3
3	20 EE C26	**Core -15** Electrical Drives	3	-	-	3	40	60	3
4	20 EE C27	**Core -16** IoT for Electrical Engineering	3	-	-	3	40	60	3
5	20 EE Exx	**PE- 3**	3	-	-	3	40	60	3
6	20 EG M01	Indian Constitution& Fundamental Principles	2	-	-	2	-	-	NC
PRACTICALS									
7	20 EE C28	Power Systems Lab	-	-	2	3	50	50	1
8	20 EE C29	Electrical Simulation Lab	-	-	2	3	50	50	1
9	20 EE C30	Electrical Drives Lab	-	-	2	3	50	50	1
10	20 EE C31	IoT Lab	-	-	2	3	50	50	1
Total			**17**	**-**	**08**	**30**	**440**	**510**	**19**
Clock Hours Per Week: 25									

L: Lecture **T: Tutorial** **P: Practical/Project Seminar/Dissertation**

CIE: Continuous Internal Evaluation **SEE: Semester End Examination**

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SEMESTER – VI

List of Courses offered in Program Elective-III	
Course code	**Title of the Course**
20 EE E31	Advanced power System Protection
20 EE E32	Power Electronics for Renewable Energy Systems
20 EE E33	Utilization of Electrical Energy
20 EE E34	Power Quality Engineering
20 EE E35	Advanced Electrical Drives
20 EE E36	Digital Signal Processing

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DISTRIBUTION OF CREDITS FROM I TO VIII SEMESTERS

ITEM		CREDITS ALLOTED	% OF CREDITS OUT OF TOTAL CREDITS
S E M E S T E R	I	21	13.13
	II	20	12.5
	III	24	15
	IV	21	13.13
	V	27	16.88
	VI	19	11.88
	VII	17	10.63
	VIII	11	6.88
Total		**160**	**100**
HSC		11.5	7.19
BSC		22	13.75
BESC		21.5	10
PCC		64	40
PEC		15	9.38
OEC		12	7.5
I+P+S		14	9.38

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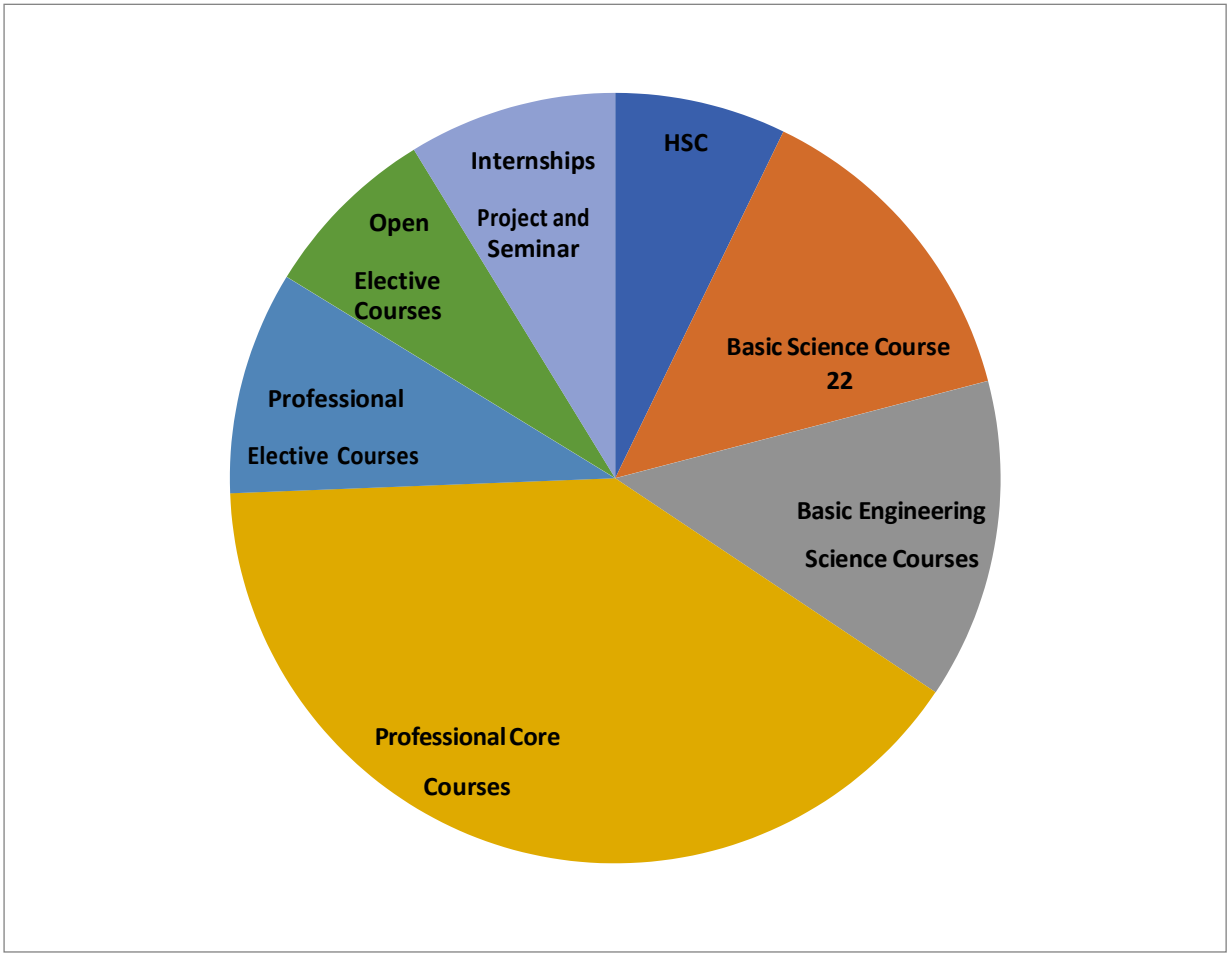
Credit Distribution for the B.E. Electrical & Electronics Engineering Curriculum

	Credits
HSC	11.5
Basic Science Course	22
Basic Engineering Science Courses	21.5
Professional Core Courses	64
Professional Elective Courses	15
Open Elective Courses	12
Internships Project and Seminar	14
Total	**160**



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V-SEMESTER

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DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

SEMESTER – V

S.no	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
THEORY									
1	20 EE C17	**Core – 10** Electrical Machines-II	3	-	-	3	40	60	3
2	20 EE C18	**Core -11** Power Systems -II	3	-	-	3	40	60	3
3	20 EE C19	**Core -12** Microcontrollers and Applications	3	-	-	3	40	60	3
4	20 EE C20	**Core -13** Control Systems	3	-	-	3	40	60	3
5	20 EE Exx	**PE- I**	3	-	-	3	40	60	3
6	20 EE Exx	**PE-2**	3	-	-	3	40	60	3
7	20 xx Oxx	**OE-1**	3	-	-	3	40	60	3
PRACTICALS									
8	20 EE C21	Control Systems Lab	-	-	2	3	50	50	1
9	20 EE C22	Electrical Machines- II Lab	-	-	2	3	50	50	1
10	20 EE C23	Microcontrollers and Applications Lab	-	-	2	3	50	50	1
11	20EGCO3	Employability Skills	-	-	2	3	50	50	1
12	20 EE I02	Industrial / Rural Internship	3-4 Weeks/90 Hours				50	--	2
Total			**21**	**-**	**08**	**-**	**530**	**620**	**27**
Clock Hours Per Week: 29									

L: Lecture **P: Practical/Project Seminar/Dissertation** **CIE: Continuous Internal Evaluation**

T: Tutorial **SEE: Semester End Examination**

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AICTE Model Curriculum with effect from AY 2022-23

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

SEMESTER – V

List of Courses offered in Program Elective-I		List of Courses offered in Program Elective-II	
Course code	**Title of the Course**	**Course code**	**Title of the Course**
20 EE E11	Electrical Distribution Systems	20 EE E21	High Voltage Engineering
20 EE E12	Advanced Power Converters	20 EE E22	Switch Mode Power Converters
20 EE E13	Simulation Techniques in Electrical Engineering	20 EE E23	Optimization Techniques
20 EE E14	Electronic Instrumentation	20 EE E24	Renewable Energy Technologies
20 EE E15	Electrical Machine Design	20 EE E25	Special Electrical Machines
20EE E16	Computer Architecture and Organization	20EE E26	Basic VLSI Design

"Job satisfaction is any combination of Psychological, Physiological and environmental circumstances that cause a person truthfully to say I am satisfied with my job."

-Hoppock

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ELECTRICAL MACHINES - II

(Semester-V)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic knowledge of Electrical Engineering, Machines and Circuit analysis.

Course Objectives: This course aims to:

1. To understand the construction and operation of AC machines.
2. To analyze the performance aspects of induction motor and Synchronous generator.
3. To discuss about Synchronous Motor performance and its starting methods.

Course Outcomes: After completion of this course, students will be able to:

1. Acquire the knowledge of Constructional and operational features of ac machines.
2. Understand the various starting methods and speed control of ac machines.
3. Explain the concepts of ac machines.
4. Describe the applications of ac machines.
5. Analyze the performance characteristics of ac machines.

UNIT-I

Fundamentals of AC machine windings: Slots for windings, Harmonics (slot and teeth Harmonics),Suppression of Harmonics, full-pitch and short pitch coils, concentrated winding, distributed winding, pitch factor, distribution factor - Numerical problems.

UNIT-II

Three phase Induction Machines: Review of Construction and Operational features, equivalent circuit, torque expression, starting torque, maximum torque, torque-slip characteristics, parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency), cogging and crawling, power flow, losses and efficiency, no load and blocked rotor test-Numerical predetermination of performance characteristics using circle diagram, Doubly fed induction generator(DFIG). Starting methods: primary resistors, auto transformer, star-delta and DOL starting. Speed control methods from stator and rotor side.

UNIT-III

Single-phase induction motors : Constructional features double field revolving theory, Split phase, Shaded pole and Capacitor type motors, equivalent circuit, applications.

UNIT-IV

Synchronous generators: Constructional features, cylindrical and salient pole rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, open circuit, short circuit and zero power factor characteristics, voltage regulation by EMF, MMF and ZPF method, Salient pole alternators two reaction theory, Phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division. Analysis of short circuit current wave form – determination of sub-transient, transient and steady state reactance's.

UNIT-V

Synchronous motor : Theory of Operation, methods of starting, variation of current and power factor with excitation. on no load and on load-V and inverted V curves. Hunting and its prevention. Synchronizing power, Synchronous condenser.

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Text Books:

1. I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010.
2. P. S. Bimbhra,“Electrical Machinery”, Khanna Publishers, 2011.
3. J.B Gupta , S.K. Kataria &Sons, “Theoryand performance of electrical machines”, 14th Edition, 2014.
4. Ashfaq Hussain “Electrical Machines” Danapatrai and sons, 3rd Edition 2012.

Suggested Reading:

1. A.E. Fitzgerald and C. Kingsley, "Electric Machinery”, McGraw Hill Education, 2013.
2. M. G. Say, “Performanceand design of AC machines”, CBS Publishers, 2002.
3. A. S. Langsdorf, “Alternating current machines”, McGraw Hill Education, 1984.
4. P. C. Sen, “Principles of ElectricMachines and Power Electronics”, John Wiley& Sons, 2007.
5. Juha Pyrhonen, Tapani Jokinen, Valeria Hrabovcova, “Design of Rotating Electrical Machines”, John Wiley& Sons, Ltd. 2008.

CO-PO & PSO Correlation Articulation Matrix

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO	PSO3
CO1	3	2	1	2	1	--	--	--	--	--	--	--	1	2	2
CO2	3	3	2	2	1	--	--	--	--	--	--	--	1	2	2
CO3	3	3	2	2	1	--	--	--	--	--	--	--	1	2	2
CO4	3	3	2	2	1	--	--	--	--	--	--	--	1	2	2
CO5	3	3	2	2	1	--	--	--	--	--	--	--	1	2	2

"There are two primary choices in life: to accept conditions as they exist, or accept the responsibility for changing them."

-Denis Waitley

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20 EE C18

POWERSYSTEMS -II

(Semester-V)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Power Systems-I

Course Objectives:

1. To understand the modeling of transmission lines and their performance calculations
2. To understand per unit representation of power systems and fault calculation analysis
3. To understand the causes of over voltages and power flow analysis of given power system.

Course Outcomes: After completion of this course, students will be able to:

1. Analyse the performance of different types of transmission lines and evaluate the corona effect on transmission lines
2. Understand the application of per unit quantities in power systems
3. Classify different types of faults and apply symmetrical components to solve the power system problem when subjected to different fault conditions
4. Describe the causes of over voltages and analyse reflection and refraction coefficients of overhead lines and cables
5. Apply Gauss Seidel method and Newton-Raphs on method to find power flows and voltages of the given power system.

UNIT-I

Modelling of Transmission Lines: Short, medium, long lines, Line calculations, Tuned Lines, Surge impedance loading, Travelling wave equations, series and shunt compensation of Transmission lines, numerical problems; Corona: Causes, Disruptive and Visual Critical Voltages, Power loss, minimization of Corona effects.

UNIT-II

Per Unit Representation: Use of per unit quantities in power systems, Advantages of per unit system. Symmetrical Faults: Typical waveform under balanced terminal short circuit conditions: steady state, transient and sub transient equivalent circuits, Reactance of Synchronous Machines, fault calculations, Short circuit capacity of a bus.

UNIT-III

Unsymmetrical Faults: Symmetrical components of unsymmetrical Phasors, Power in terms of symmetrical components, sequence impedance and sequence networks. Sequence networks of unloaded generators, Sequence impedances of circuit elements, Single line to ground, line-to-line and double line to ground faults on unloaded generator, Unsymmetrical faults of power systems.

UNIT-IV

Transients in Power Systems: Generation of Over-voltages: Causes of over voltages, lightning and Switching Surges, Reflection and refraction coefficients, Junction of cable and overhead lines, Junction of three lines of different natural impedances, Bewley Lattice diagram.

UNIT-V

Power Flow Analysis: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and Generator Specifications. Application of numerical methods for solution of non-linear algebraic equations- Gauss Seidel and Newton-Raphson methods for the solution of the power flow equation.

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Text Books:

1. J.J Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education, 1994.
2. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995.
3. C.L. Wadhwa, “Electric Power Systems Theory”, New Academic Science Limited, 2012

Suggested Reading:

1. A.R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc., 1999.
2. D.P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2003.
3. B.M. Weedy, B.J. Cory, N. Jenkins, J. Ekanayake & G. Strbac, “Electric Power Systems”.

CO-PO & PSO Correlation Articulation Matrix

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	-	3	--	--	--	--	--	--	--	2	3	1
CO2	3	3	2	2	2	--	--	--	--	--	--	--	2	3	2
CO3	3	3	1	--	3	--	--	--	--	--	--	--	2	3	--
CO4	3	3	2	2	3	--	--	--	--	--	--	--	3	3	2
CO5	3	3	2	3	3	--	--	--	--	--	--	--	3	3	2

"It is he who must first sell himself. The product itself is secondary"

-George Matthew Adams

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20EE C19

MICROCONTROLLERS AND APPLICATIONS

(Semester-V)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Students should have basic knowledge of Digital Electronics and programming in C language.

Course Objectives: This course aims to:

1. To Understand the fundamentals and Programming using 8051 Microcontroller
2. To Understand Programming and interfacing using 8051 Microcontroller.
3. To understand the fundamentals and programming using ARM 7 controller

Course Outcomes: After completion of this course, students will be able to:

1. Understand the internal architecture of 8051 Microcontroller
2. Do Assembly Language Programming using 8051 Microcontroller.
3. Interface Application devices to 8051 Microcontroller and Communication Protocols
4. Understand the internal architecture of ARM controller
5. Programming using ARM controller LPC 2148

UNIT – I

Fundamentals of processors controllers and the 8051 Architecture::

Fundamentals of Microprocessor, Basic Block Diagrams of Microprocessor and Microcontroller, Role of Microcontrollers in embedded Systems. 8051 microcontroller- Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles, timers, counters.

UNIT – II

Instruction Set and Programming: Instruction syntax, Data types, Addressing modes. 8051 Instruction set, Instruction timings, Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs, C language programs. Assemblers and compilers. Programming and debugging tools

UNIT – III

External Communication and Application Interface: Interfacing Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, memory devices. LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, sensor interfacing.

Communication protocols: Brief overview on RS232, I2C, SPI, CAN, Blue-tooth and Zig-bee..

UNIT – IV

ARM: Introduction to RISC Processors, ARM Design Philosophy, ARM Processor families, Architecture- Revisions, Registers, Program status register, Pipeline, Introduction to Exceptions.

ARM 7 Microcontroller (LPC2148): Salient features of LPC 2148, Pin description of 2148, Architectural Overview. ARM 7(LPC2148) Peripherals: Description of General-Purpose Input/output (GPIO) ports, Pin control Block. Features, Pin description, Register description and operation of PLL, Timers, PWM, ADC, DAC.

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UNIT – V

ARM Instruction Set : ARM data types, Data processing instructions, Branch instructions, Load-Store instructions, Software interrupt instruction, Program Status Register instructions, Loading constants, and Conditional executions. Introduction to THUMB instructions: Differences between Thumb and ARM modes, Register usage.

Text Books:

1. M . A.Mazidi, J. G. Mazidi and R. D. McKinlay, "The8051Microcontroller and Embedded Systems: Using Assemblyand C",Pearson Education, 2007.
2. Andrew N.Sloss, Domonic Symes, Chris Wright, "ARM System Developers Guide Designing and Optimizing system software", 1/e, Elsever, 2004.
3. AndewN.Sloss, Dominic Symes, Chris Wright, "ARM system developers Guide - Designing and optimizing system".

Suggested Reading:

1. K. J. Ayala, "8051 Microcontroller", Delmar Cengage Learning,2004.
2. Lyla B. Das, "Architecture, Programming and Interfacing of Low-power Processors-ARM 7, Cortex-M", CENGAGE,2017.
3. David E Simson, "Embedded system Primer", Pearson Publication

CO-PO & PSO Correlation Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	-	-	-	-	-	-	-	1	1	-
CO2	2	3	3	2	1	-	-	-	-	-	-	-	1	2	-
CO3	2	3	3	2	1	-	-	-	-	-	-	-	1	3	1
CO4	2	2	2	2	1	-	-	-	-	-	-	-	1	1	1
CO5	1	2	2	1	1	-	-	-	-	-	-	-	1	1	2

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20EEC20

CONTROL SYSTEMS

(Semester-V)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Students should have a prior knowledge of Newton's laws, Circuit theory, Vector Calculus &Differential Equations, Laplace transform and their properties and linear algebra**.**

Course Objectives:

1. To understand different types of linear control systems and their mathematical modeling.
2. To study the stability analysis both in time and frequency domains.
3. To study the concepts of State space representation of Linear Time invariant systems (LTI).

Course Outcomes: After completing this course, students will be able to:

1. Understand different mathematical models for any electro mechanical LTI systems.
2. Determine the Transfer function of an LTI system using block diagram & signal flow graph approach.
3. Analyze the given first and second order systems based on their performance parameters &PID controllers
4. Analyze absolute and relative stability of an LTI system using time and frequency domain techniques.
5. To understand the concepts of compensators and be able to draw its frequency response
6. Develop various state space models for LTI systems and to determine its Controllability and Observability.

UNIT-I

Introduction to Control Systems: Open loop, closed loop System with illustrations and other classification of control systems, Impulse response and Transfer Function, Mathematical modeling of Mechanical and Electrical Systems, Analogous systems, Feedback control characteristics - effects of feedback.

UNIT-II

Mathematical Models of Physical Systems: Introduction of servo motors & Synchro pair, Modeling of armature and field-controlled D.C motors, Block diagram algebra, Signal flow graphs and problems on conversion from block diagram to signal flowgraph.

UNIT-III

Time Response Analysis: Standard test signals, Time response of first and second order systems for standard test inputs, Application of initial and final value theorem, Static error coefficients and steady state error (for standard test input signals), Performance parameters of a second-order systems based on the time-response. Concept of Stability, Routh-Hurwitz Criteria, Relative Stability analysis, root locus technique, Typical systems analyzed by root locus technique, Response with P, PI & PID controllers

UNIT- IV

Frequency Response Analysis: Introduction, Frequency domain specifications for a second order system, Relationship between time and frequency response, Bode plots, Polar plots, Nyquist stability criterion, Relative stability using Nyquist criterion. Stability analysis of plots based on gain and phase margin, Introduction to Lag and Lead networks and their Transfer functions.

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UNIT-V

State Variable Analysis and Introduction to Discrete Control Systems: Concepts of state, state variable, State models of linear time invariant systems, Derivation for state models from transfer functions and differential equations, State transition matrix and its properties, Solution of state equations in time & Laplace domain, Eigen values and Stability Analysis, Concept of Controllability and Observability. Introduction to discrete control systems.

Text Book:

1. I.J. Nagrath, M. Gopal, Control System Engineering, New Age International (P) Limited Publishers, 5th Edition, 2008.
2. B.C. Kuo, Automatic Control Systems, John Wiley and son's Publishers, 9th edition, 2009
3. K. Ogata, Modern Control Systems, 5th Edition.PHI publication, 2010.
4. A. Anand Kumar, Control Systems, 2nd Edition, PHI publications, 2014.

Suggested Readings:

1. M.Gopal, Control Systems Principles and Design- Tata McGraw Hill, 2nd Edition, 2003.
2. N.C Jagan-control Systems, 2nd Edition, BS Publications, 2008
3. N. Nise, Control Systems Engineering, 6th edition, Willey Publications, 2011

CO-PO& PSO Correlation Articulation Matrix:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	2	2	2	-	-	-	-	-	-	-	2	-	2
CO-2	3	2	2	1	1	-	-	-	-	-	-	-	1	-	1
CO-3	3	2	1	3	2	-	-	-	-	-	-	-	1	-	2
CO-4	3	3	2	3	3	-	-	-	-	-	-	-	2	-	2
CO-5	3	2	2	2	3	-	-	-	-	-	-	-	2	-	2
CO-6	3	3	3	3	3	-	-	-	-	-	-	-	3	-	3

"If my mind can conceive it, my heart can believe it , I know I can achieve it!"

-Jesse Jackson

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20EE E11

ELECTRICAL DISTRIBUTION SYSTEMS

(Semester-V- Program Elective-1)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Power systems-II, Switchgear and Protection

Course Objectives: The Objectives of the Course are:

1. To study the load characteristics of distribution systems and understand the substation schemes, voltage drop calculation of different service areas.
2. To know about primary and secondary distribution systems and their characteristics.
3. To study different voltage control methods and applications of capacitors in distribution systems

Course Outcomes: After Completion of the Course, Student will be able to:

1. Solve the problems on load factor, loss factor, coincidence factor and discuss the characteristic so floads along with load growth
2. Illustrate the substation bus schemes and determine the rating, voltage drop of substations
3. Describe types and characteristics of primary and secondary distribution system and find voltage drop and power losses.
4. Find voltage drop and power loss of three-phase & non-three phase lines and analyze the distribution costs and voltage control methods in the distribution system
5. Calculate there active power requirements of the distribution system and summarize the functions and communications used in distribution automation

UNIT-I

Load Characteristics: Demand,demandcurve,loaddurationcurve,Diversifieddemand,Non-coincident Demand, Coincidence factor, Contribution factor problems, Relationship between load and loss factors load growth, Rate structure, Customer billing, Classification of loads (residential, commercial, agricultural, and industrial) and their characteristics.

UNIT-II

Sub-Transmission Lines and Substations: Types of sub-transmission lines, Distribution substations, Substation bus schemes, Rating of distribution substation, Service area with multiple feeders, Percent voltage drop calculations.

UNIT-III

Primary and Secondary Feeders: Types of primary systems, Radial type, Loop type and Primary network, Primary feeder loading, Radial feeder with uniformly distributed load, Secondary voltage levels, Secondary banking, Secondary networks.

UNIT-IV

Voltage Drop and Power Loss Calculations: Voltage drop and power loss calculations, 3-phase, Non 3-phaseprimary lines, Single phase two-wire laterals with ungrounded neutral, Single phase two wire ungrounded laterals, two phase plus neutral lateral, Method to analyze distribution costs, Voltage control methods, Feeder voltage regulators.

UNIT-V

Application of Capacitors to Distribution Systems: Effects of series and shunt capacitors, Power factor correction, Economic justification for capacitors, Location and sizing of capacitors in distribution system.

Distribution System Automation: Definitions, control functions, Level of penetration of DA, Types of communication systems, Supervisory control and data acquisition.

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Text Books:

1. Turan Gonen, Electric Power Distribution Engineering,TMH,3rdEdition,2016.
2. A.S.Pabla,ElectricPowerDistribution,TMH,6thEdition,2012.

Suggested Readings:

1. M.K.Khed Kar, G.M.Dhole, Electric Power Distributionautomation,LaxmiPublications,2010.
2. William Kersting, Distribution System Modelling and Analysis,3rdEdition CRCPress,2015.
3. S.Sivanagaraju, and V.Sankar, Electric Power Distribution and Automation, Dhanpat Rai& Co,2012

CO-PO & PSO Correlation Articulation Matrix:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	1	-	-	-	-	-	-	-	-	-	-	-	1
CO-2	3	2	1	-	-	-	-	-	-	-	-	-	-	-	1
CO-3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	1
CO-4	3	2	1	-	-	-	-	-	-	-	-	-	-	-	1
CO-5	3	2	1	-	-	-	-	-	-	-	-	-	-	-	1

"Tact: the ability to describe others as they see themselves."

-Abraham Lincoln

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20EE E12 With effect from the academic year 2022-2023

ADVANCED POWER CONVERTERS

(Semester-V- Program Elective-I)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Power Electronics

Course Objectives:

1. To study various modern power electronic devices and different power factor improvement techniques in converters.
2. To study the concepts of Multi pulse and Multilevel power electronic circuits.
3. To understand different applications of power converters.

Course Outcomes: After the completion of the course, students will be able to:

1. Outline various features and electrical specifications for a chosen modern power electronic device.
2. Understand different power factor improvement techniques in converters.
3. Comprehend the operation of Multi-Pulse converters and design its performance parameters.
4. Apply the concepts of different Multilevel Inverters that suits for industrial applications.
5. Recognize the applications of power converters.

UNIT 1:

Modern Power Semiconductor Devices: Gate Turn Off- SCR(GTO-SCR), MOS Turn off Thyristor (MTO), Emitter Turn Off Thyristor (ETO), Integrated Gate Commutated Thyristor (IGCTs), MOS-controlled Thyristors (MCTs), symbol, structure and equivalent circuit, comparison of their features.

UNIT 2:

Power factor Improvement Techniques: Power factor improvements – extinction angle control- symmetrical angle control- PWM control- SPWM control.

UNIT 3:

Multi-Pulse converters: Review of transformer phase shifting, generation of 6-phase ac voltage from 3-phase ac, 6-pulse converter and 12-pulse converters with inductive loads, steady state analysis, commutation overlap, notches during commutation

UNIT 4:

Multilevel Inverters: Multilevel concept, Classification of multilevel inverters, Diode clamped Multilevel inverter, principle of operation, main features, improved diode Clamped inverter, principle of operation, flying capacitors multilevel inverter, principle of operation, main features, cascaded multilevel inverter, principle of operation, main features, Multilevel inverter applications.

UNIT 5:

Applications of Power converters: AC power supplies, classification, switched mode AC power supplies, online and offline Uninterruptible Power supplies applications. DC circuit breakers

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Text Books:

1. Mohammed H. Rashid, "Power Electronics, Devices, circuits and applications", Pearson Education, 4th Edition, 2017.
2. Ned Mohan Tore M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley& Sons, 3rd Edition, 2007.

Suggested Reading:

1. H. W. Whittington, B. W. Flynn and D. E. MacPherson, "Switched Mode Power Supplies, Design and Construction", Universities Press, 2009 Edition.
2. Uman and L., Bhat S.R., "Design of Magnetic Components for Switched Mode Power Converters", Wiley Eastern Ltd., 1992
3. Robert. W. Erickson, D. Maksimovic, "Fundamentals of Power Electronics", Springer InternationalEdition,2013

CO-PO & PSO Correlation Articulation Matrix:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	-	-	-	-	-	-	2	3	3	1
CO2	3	3	1	-	-	-	-	-	-	-	-	2	3	3	1
CO3	3	2	1	-	-	-	-	-	-	-	-	2	3	3	1
CO4	3	2	1	-	-	-	-	-	-	-	-	2	3	3	1
CO5	2	1	1	-	-	-	-	-	-	-	-	2	3	3	1

"Advance Planning is bringing the future into the present so that you can do something about it now."

-Alan Lakein

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20EE E13

SIMULATION TECHNIQUES IN ELECTRICAL ENGINEERING

(Semester-V-Program Elective-I)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Students should have prior knowledge on basic programming languages

Course Objectives: This course aims to:

1. To introduce basics of MATLAB
2. To build knowledge about matrices and plots
3. To introduce various simulation techniques and computational methods using MATLAB

Course Outcomes: After completion of the course, students will be able to:

1. Understand the basics of MATLAB programming
2. Apply matrix mathematics and functions for solution of linear and nonlinear equations
3. Understand the use of plots for visualization of the numerical solution. Develop and run them-files
4. Analyse the basic electrical and networks applications in MATLAB environment
5. Analyse the computational Intelligence Techniques in MATLAB environment

UNIT-I

Basics: MATLAB environment, variables, Basic data types, Relational and Logic operators, Conditional statements, Input and Output, Loops and bracing.

UNIT-II

Matrices: Creating and Manipulating matrices, Matrix mathematics and Matrix functions, Colon operator, Line space, Cross product, Dot product, Logical functions, Logical indexing, 3 – dimensional arrays, Cell arrays, Structures.

UNIT-III

Plotting and M –file Scripts: Plotting: 2-D and 3-D plots: Basic plots, subplots, Histograms, Bar graphs, Pie charts, Creating saving and running an M–file, creating and running of a function, function definition line, H1 and help text lines, Function body, Sub – functions, File I/O handling

UNIT-IV

Basic Electrical and Networks Applications: Analysis of electrical networks-solution of series-parallel circuits, solution of mesh and nodal analysis, Network theorems-validation of Maximum power transfer theorem and verification of super position theorem, solution of linear differential equations-solution of First-Order differential equation-AC signal waveform analysis- resonance-Frequency response of a low-pass filter

UNIT-V

Computational Intelligence Techniques: Introduction to optimization- Teaching Learning Based Optimization (TLBO) - Particle Swarm Optimization (PSO) -Artificial Bee Colony (ABC) Algorithm- Implementation of TLBO, PSO and ABC algorithms using MATLAB for Sphere function-Booth function-Himmelblau's functions.

Text Books:

1. D Hanselman and Blittle field, "Mastering MATLAB 7", Pearson Education, 2005.
2. Y Kirani Singh and B B Chaudhari, "MATLAB Programming", Prentice Hall of India, 2007.
3. Dr. Shailendra Jain, "Modeling and Simulation using MATLAB-Simulink, Wiley publication, second edition, 2015

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Suggested Reading**:**

1. Xin-She Yang, "Engineering Optimization An Introduction with Meta heuristic Applications", Wiley publications, 2010
2. A Gilat, "MATLAB: An Introduction with Applications", John Wiley and Sons, 2004

CO-PO & PSO Correlation Articulation Matrix:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	-	-	-	-	-	-	-	1	1	-
CO2	3	3	1	2	2	-	-	-	-	-	-	-	1	2	-
CO3	3	3	2	1	2	-	-	-	-	-	-	-	2	2	-
CO4	3	3	2	2	3	-	-	-	-	-	-	-	2	2	-
CO5	3	3	2	2	3	-	-	-	-	-	-	-	2	2	-

"Constancy is the complement of all other human virtues"

-Giuseppe Mazzini

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20EE E14

ELECTRONIC INSTRUMENTATION

(Semester-V-Program Elective-I)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Students should have a prior knowledge of Electrical Measurements and Instrumentation.

Course Objectives: This course aims to:

1. To impart a basic knowledge of International Standards for various physical quantities and to provide a basic understanding of measurement systems.
2. To expose the students to many varieties of transducers, measuring instruments, their Operating principles and construction.
3. To introduce students to various types of spectrum analyzers, virtual instrumentation techniques and their applications and an exposure to some of the prominent bio-medical Instrumentation systems.

Course Outcomes: After completion of this course, students will be able to:

1. Understand the various standards available for the measurement process.
2. Evaluate and perform accurate measurements for any engineering system with clear idea of the potential errors
3. Understand the working principles of various transducers
4. Analyse the working principles of instruments like spectrum analyzer, DSO and other virtual instrumentation techniques for appropriate measurements.
5. Understand the fundamentals of various biomedical instrumentation systems.

UNIT– I

Introduction to Instrumentation: Accuracy and Precision - Conformity and Significant figures, Resolution and Sensitivity, Types of Errors, loading effect, Absolute errors and Relative errors, Measurement of error combinations, Statistical analysis, Probable error and Limiting errors, Calibration, IEEE standards, Elements of ISO 9001, Quality management standards.

UNIT–II

Transducers-I: Classification of transducers, factors for selection of a transducer, Passive electrical transducers: Strain gauges - gauge factor, types of strain gauges - bonded and un-bonded, rosettes, LVDT - construction and displacement measurement, Capacitive transducer and thickness measurement. Active electrical transducers: Piezo-electric transducer and different modes of operation, photo-conductive, photo-voltaic and photo - emissive transducers, semiconductor stain gauges.

UNIT–III

Transducers-II: Characteristics of sound, pressure, power and intensity levels. Microphones and their types. Temperature measurement, Resistance wire thermometers, semiconductor thermometers and thermocouples. Introduction to Micro- Electro-Mechanical Systems (MEMS)

UNIT – IV

Digital Instruments: Block diagram, specification and design considerations of different types of DVMs. Spectrum analyzers. Delayed time base oscilloscope, Digital storage oscilloscope. Introduction to Virtual Instrumentation, SCADA. Data Acquisition System- block diagram

UNIT–V

Applications of Instrumentation: Human physiological systems and related concepts. Bio-potential electrodes Bio- potential recorders - ECG, EEG, EMG and CT scanners, magnetic resonance and imaging systems, Ultrasonic Imaging systems.

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Text Books:

1. Albert D. Helfric, and William D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", PHI, 2010.
2. HS Kalsi, "Electronic Instrumentation", 3/e, TMH, 2011.
3. Nakra B.C and Chaudhry K.K., "Instrumentation, Measurement and Analysis", TMH, 2004

Suggested Readings:

1. David A. Bell, "Electronic Instrumentation & Measurements" PHI, 2nd Edition, 2003.
2. Khandpur. R.S., "Handbook of Bio-Medical Instrumentation", TMH, 2003.
3. Leslie Cromwell and F.J. Weibell, E.A. Pfeiffer, "Biomedical Instrumentation and Measurements", PHI, 2nd Ed, 1980

CO-PO & PSO Correlation Articulation Matrix:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	1	1	-	-	-	-	-	-	1	-	1	1	1	1
CO-2	3	2	1	-	-	-	-	-	-	1	-	1	1	2	1
CO-3	3	2	1	-	-	-	-	-	-	1	-	1	1	1	1
CO-4	3	2	2	-	-	-	-	-	-	1	-	1	1	2	1
CO-5	3	2	2	-	-	1	-	-	-	1	-	1	1	2	-

HEAD
Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

20EE E15

ELECTRICAL MACHINE DESIGN
(Semester-V-Program Elective-I)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic knowledge of Electrical Engineering, Machines and Circuit analysis.

Course Objectives: This course aims to:

1. To understand the design parameters of various electrical machines.
2. To analyze the electrical and mechanical characteristics of electrical machines.
3. To become familiar with CAD usage

Course Outcomes: After completion of this course, students will be able to:

1. Calculate the various parameters required for designing.
2. Acquire the knowledge of Output equation and cooling methods.
3. Obtain the Main dimensions of AC machines.
4. Design the AC electrical machine for a given power rating.
5. Gain the concept of CAD

UNIT-I

Basics of Machine design aspects: Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

UNIT-II

Design of Transformers: Sizing of a transformer, main dimensions, KVA output for single and three-phase transformers, window space factor, overall dimensions, design of cooling tank, methods for cooling of transformers.

UNIT-III

Design of Induction Motors: Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, magnetizing current.

UNIT-IV

Design of Synchronous Machines: Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape ofpole face, armature design, armature parameters, estimation of air gap length, design of rotor.

UNIT-V

Computer aided Design (CAD): Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation.

Text Books:

1. A.K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, 1970.
2. K. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 2008.

Suggested Reading:

1. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing, 2006.
2. V. N. Mittle and Arvind Mittal "Design Of Electrical Machines" Standard Publishers Distributors, NewDelhi, 2009.

HEAD
Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

CO-PO & PSO Correlation Articulation Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	--	1	--	--	--	--	--	--	2	3
CO2	3	2	3	1	1	--	--	--	--	--	--	--	--	2	3
CO3	3	2	3	--	--	--	2	1	--	--	--	--	--	--	1
CO4	2	1	1	2	3	1	--	--	--	--	--	2	3	1	1
CO5	1	2	2	--	1	--	--	--	--	--	--	1	3	1	1

HEAD
Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

20 EE E 16 With effect from the academic year 2022-23

COMPUTER ARCHITECTURE AND ORGANIZATION

(Semester-V-Program Elective-I)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Students should have basic knowledge of Digital Electronics

Course Objectives: This course aims:

1. To provide knowledge on overview of IAS computer function and addressing modes.
2. Hardware and software implementation of arithmetic unit to solve addition, subtraction, multiplication and division.
3. To provide knowledge of memory technologies, interfacing techniques and sub system devices.

Course Outcomes: After completion of this course, students will be able to:

1. Provide fundamentals on machine instructions and addressing modes.
2. Comprehend the various algorithms for computer arithmetic.
3. Analyse the performance of various memory modules in memory hierarchy.
4. Compare and contrast the features of I/O devices and parallel processors.
5. Outline the evaluation of memory organization

UNIT-I:

Introduction to Computer Architecture: Functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU: Registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Outlining instruction sets of some common CPUs.

UNIT-II :

Data representation and Computer arithmetic: Signed number representation, fixed and floating-point representations, character representation. Integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift- and add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic, IEEE 754 format

UNIT-III:

CPU control unit design Hardwired and micro-programmed design approaches, design of a simple hypothetical CPU. Memory system design: Semiconductor memory technologies, memory organization.

UNIT-IV:

Peripheral devices and their characteristics : Input-output subsystems, I/O device interface, I/O transfers – program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes – role of interrupts in process state transitions, I/O device interfaces – SCII, USB.

UNIT-V:

Pipelining and Memory organization: Basic concepts of pipelining, throughput and speedup, pipeline hazards. Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency. Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.

HEAD
Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

Text Books:

1. M. M. Mano, Computer System Architecture, 3rd ed., Prentice Hall of India, 1993.
2. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, 4th Edition,Elsevier, 2012. 4.
3. Carl Hamacher, Zvonko Vranesic, Safwa tZaky, Naraig Manjikian, Computer Organization and Embedded Systems, McGraw-Hill Publishing, 2011

Suggested Reading:

1. John P. Hayes, Computer Architecture and Organization, McGraw-Hill, 1998
2. William Stallings, Computer Organization and Architecture: Designing for Performance, 8th Edition, Prentice Hall, 2006.

CO-PO & PSO Correlation Articulation Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	-	-	-	-	-	-	-	1	1	-
CO2	2	2	2	2	1	-	-	-	-	-	-	-	1	2	-
CO3	2	2	2	2	1	-	-	-	-	-	-	-	1	3	1
CO4	2	2	2	2	1	-	-	-	-	-	-	-	1	1	1
CO5	1	2	2	1	1	-	-	-	-	-	-	-	1	1	2

HEAD
Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

HIGH VOLTAGE ENGINEERING
(Semester-V-Program Elective-II)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Fundamentals of Electromagnetic 2. Electric Power systems 3. Electrical Measurements

Course Objectives: This course aims to:

1. To know the breakdown mechanism in gases, liquids and solid dielectrics.
2. To understand the methods of generation and measurement of high voltages and currents.
3. To study the testing methods of HV electrical equipment and know about High Voltage laboratories.

Course Outcomes: After completion of the course, students will be able to:

1. Understand various breakdown processes in solid, liquid and gaseous insulating materials.
2. Acquire the knowledge about generation of DC, AC and impulse voltage and currents.
3. Know the measurement of DC, AC and impulse voltage & currents.
4. Gain knowledge about testing of HV equipment.
5. Explain about HV laboratories and safety precautions in HV labs.

UNIT-I
Breakdown in Gases: Mechanism of breakdown, Types of collisions, Ionization processes, Townsend's First and second Ionization coefficients, Townsend's breakdown mechanism, Streamer theory of breakdown, Paschen's Law, Corona discharges.

UNIT-II
Breakdown in liquid and solid insulating materials: Pure liquids and commercial liquids, Breakdown in pure and commercial liquid, Solid dielectrics and Composite dielectrics, Intrinsic breakdown, Electro-mechanical breakdown, Thermal breakdown, Breakdown due to treeing and tracking, Breakdown due to internal discharges.

UNIT-III
Generation of High Voltages and Currents: Generation of high DC voltages, Generation of high AC voltages, Generation of Impulse voltages and currents, Tripping and control of impulse generators.

UNIT-IV
Measurement of High Voltage and Currents: Measurement of Peak voltage, Impulse voltages and high Direct current measurements, Cathode Ray Oscillographs for Impulse voltage and current measurement, Measurement of dielectric constant and loss factor, Partial discharge measurements.

UNIT-V
High Voltage testing of Electrical Apparatus: Testing of Insulators, bushings, isolators, circuit breakers, Cables, Power capacitors and Power transformers. High Voltage laboratory, Indoor and Outdoor laboratories, Safety precautions in HV labs.

Text Books:
1. M.S.Naidu and V.Kamaraju, "High Voltage Engineering", McGraw Hill Education, 2013.
2. C.L. Wadhwa, "High Voltage Engineering", New Age International Publishers, 2007.

HEAD
Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

Suggested Reading:

1. E.Kuffel, W.S.Zaengl and J.Kuffel, “High Voltage Engineering Fundamentals”, Newness Publication, 2000.
2. M. Khalifa, “High Voltage Engineering: Theory and Practice”, Dekker, 1990.

CO-PO & PSO Correlation Articulation Matrix

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	1	-	-	-	-	-	1	1	2	3	1	2	3
CO2	2	-	1	-	-	-	-	-	1	1	2	3	1	2	3
CO3	2	-	1	-	2	-	-	-	1	1	2	3	1	2	3
CO4	2	-	1	-	2	-	-	-	1	1	2	3	1	2	3
CO5	2	-	1	-	2	-	-	-	1	1	2	3	1	2	3

HEAD
Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

20EE E22

SWITCH MODE POWER CONVERTERS

(Semester-V-Program Elective-II)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Students should have a prior knowledge of Power Electronics core course theory.

Course Objectives:

1. To study the design aspects of DC-DC converters and SMPS.
2. To comprehend the basic concepts of resonant converters.
3. To familiarize with the design of inductor, transformer for power converter circuits and to know various voltage control techniques in inverters.

Course Outcomes: After the completion of the course, students will be able to:

1. Design different types of DC-DC converters.
2. Comprehend different types of SMPS for electrical applications.
3. Understand the operation of different resonant converters.
4. Design a suitable filter along with the suitable selection of transformer and switches that are used in power electronic converter circuits.
5. Compare different voltage control techniques in inverters.

UNIT-I

Basic Converter Circuits: Design of critical inductance and capacitance of Buck, Boost and Buck Boost Regulators,Cuk Converter Choice of Switching Frequency-Design Aspects

UNIT-II

Isolated SMPS: Flyback Converters, Forward Converters, Half Bridge and Full Bridge Converters, Push Pull Converters and SMPS with multiple outputs, Choice of Switching Frequency-Design Aspects

UNIT-III

Resonant Converters: Classification, Basic resonant circuit concepts, load resonant, Resonant switch converters, Resonant D.C Link Inverters with Zero Voltage Switching, High frequency Link Integral Half-Cycle converters.

UNIT-IV

Design of Inductor and Transformer: Selection of Output Filter Capacitor, Selection of EnergyStorage Inductor, Design ofHigh Frequency Inductor and High Frequency Transformer, Selection of Switches, Snubber Circuit Design.

UNIT-V

Voltage Control in Inverters: Voltage control Techniques in inverters, Bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage, three-phase sinusoidal modulation

Text Books:

1. Mohan N. Undeland . T & Robbins W, Power Electronics Converters, Application and Design. John Wiley, 3rd edition, 2007.
2. Mohammed H. Rashid, “Power Electronics, Devices, circuits and applications”, Pearson Education, 4th Edition, 2017
3. H. W. Whittington, B. W. Flynn and D. E. MacPherson, Switched Mode Power Supplies, Design and Construction, Universities Press, 2009.

HEAD
Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

Suggested Reading:

1. Umanand L., Bhat S.R., Design ofmagnetic components for switched Mode Power Converters., WileyEastern Ltd.,1992
2. V. Ramanarayanan, Course Material on Switched Mode Power Conversion

CO-PO&PSO Correlation Articulation Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	2	2	2	--	--	--	--	--	--	--	2	2	2
CO-2	2	2	2	2	2	--	--	--	--	--	--	--	1	2	2
CO-3	3	2	1	2	1	--	--	--	--	--	--	--	1	2	2
CO-4	3	2	2	2	2	--	--	--	--	--	--	--	2	2	2
CO-5	2	2	1	2	2	--	--	--	--	--	--	--	2	2	2

HEAD
Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

20 EE E 23

OPTIMIZATION TECHNIQUES

(Semester-V-Program Elective-II)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic mathematics

Course Objectives:

1. To study about classical optimization techniques which include single variable and multi-variable optimization with equality constraints
2. To study about linear programming and non-linear programming methods
3. To study about Genetic algorithms.

Course Outcomes: After completion of the course, students will be able to:

1. Solve the single variable and multi variable problems with and without constraints using classical optimization techniques
2. Determine the solution of linear programming problem using graphical method, simplex algorithm and revised simplex algorithm
3. Calculate the optimum of a nonlinear function using various elimination and search methods
4. Apply Steepest Descent, Conjugate Gradient, Newton method, David-Fletcher-Powell methods in finding the optimum of given non linear function
5. Discuss the different operators, selection techniques in genetic algorithm and apply the suitable selection technique for finding the maximization of function .

UNIT-I

Introduction: Classical optimization techniques: Statement of optimization problem, Objective function, Classification of optimization problems, Single-variable & Multi-variable Optimization without constraints.
Multi-variable optimization with equality Constraints, Lagrange multiplier method, Multi-variable optimization with inequality constraints, Kuhn- Tucker conditions

UNIT-II

Linear Programming: Standard form, Formulation of the LPP, Solution of simultaneous equations by Pivotal condensation, Graphical method, Simplex algorithm, Revised simplex method

UNIT-III

Non-Linear Programming-I: Unimodal function, Elimination methods: Fibonacci method, Golden Sectionmethod.
Direct Search methods: Univariate Search method, Hook and Jeeve's method, Powell's method.

UNIT-IV

Non-Linear Programming-II:

Gradient methods: Steepest Descent, Conjugate Gradient, Newton method, David-Fletcher-Powell method

UNIT-V

Genetic Algorithms: Introduction, Encoding, Fitness Function, Basic Operators, Single Point cross over, two-point cross over, uniforms cross over, mutation operator, Selection Techniques, Tournament Selection, Roulette wheel selection.

HEAD
Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

Text Books:

1. S.S.Rao, "Engineering Optimization Theory and Applications", New Age International, 3 rd Enlarged Edition (in two colour), 2013
2. Jasbir S. Arora, "Introduction to Optimum Design", Academic Press, 4th Edition, 2016.

Suggested Readings:

1. Kalyamoy, Deb, "Multi Objective Optimization using Evolutionary Algorithms", Wileypublications, 2013.
2. S. Rajasekharam, G.A. Vijaya Lakshmi, "Neural networks, Fuzzy logic and Genetic Algorithms Synthesis andApplications", PHI publications, 2010

CO-PO& PSO Correlation Articulation Matrix:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	3	2	2	1	-	-	-	-	-	-	-	2	-	1
CO-2	3	3	3	3	1	2	-	-	-	-	-	-	2	-	1
CO-3	3	3	2	3	2	2	-	-	-	-	-	-	3	-	2
CO-4	3	3	3	3	3	2	-	-	-	-	-	-	3	-	2
CO-5	3	2	1	2	3	2	-	-	-	-	-	-	3	-	2

HEAD
Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

20EE E24

RENEWABLE ENERGY TECHNOLOGIES

(Semester-V-Program Elective-II)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: Students should have prior knowledge on non-conventional sources of energy

Course Objectives:

1. To Know the different types of Non-Conventional Energy Sources.
2. To Understand the working of wind and solar renewable energy sources
3. To Explore the issues with grid integration of renewable energy sources

Course Outcomes: After completion of this course, the student will be able to

1. Know the benefits of different renewable energy sources
2. Understand the generation of Wind Power
3. Model the generator, turbine and converter suitable for a specific wind-generation topology.
4. Understand the Solar PV generation and grid interconnection technologies
5. Understand and apply the remedies for network integration issues

UNIT-I:

Fundamentals of Energy: Introduction, Classification of energy resources, Merits and Demerits of non-conventional energy sources over conventional energy sources. , Conventional and renewable sources of energy, Distributed and central station generation, DG technologies, Advantages, introduction to hydro, tidal, wave, Geothermal and biomass energy

UNIT-II

Physics of Wind Power: History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tipspeed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions. Review of modern wind turbine technologies,. Types of wind turbines, Fixed and Variable speed wind turbines Components of wind mill, operation of wind turbines

UNIT-III

Wind Generator Topologies: Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Power electronics converters, Generator-Converter configurations, Converter Control, Wind farm Interface with grid Power quality issues, Power system interconnection experiences in the world, Hybrid and isolated operations of wind systems.

UNIT-IV

The Solar Resource: Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability. Solar thermal power generation: Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis

Solar Photovoltaic: Technologies-Amorphous, mono crystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms, Converter Control, Solar PV behavior during grid disturbances, Power quality issues, Hybrid and isolated operations of solar PV.

UNIT-V

Network Integration Issues: Overview of grid code technical requirements, Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits,. Interface with grid, direct and power electronics coupling, Impact of type of interface, Power Quality issues

HEAD
Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

Text Books:

1. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005
2. G. M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley and Sons, 2004.
3. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.
4. Math.H.Bollen, Fainan Hassan, "Integration Of Distributed Generation In The Power System" Wiley IEEE Press, July2011

Suggested Reading:

1. H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd., 2006
2. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications, 2004
3. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley& Sons, 1991

CO-PO & PSO Correlation Articulation Matrix

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	2	-	-	-	-	1	1	1	1	-
CO2	2	1	3	2	1	2	-	-	-	-	1	1	1	2	-
CO3	2	1	3	2	1	2	-	-	-	-	2	2	1	2	1
CO4	2	1	2	2	1	2	-	-	-	-	2	2	1	1	1
CO5	1	1	2	1	1	2	-	-	-	-	2	2	1	1	2

HEAD
Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

20EE E25

SPECIAL ELECTRICAL MACHINES

(Semester-V-Program Elective-II)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic knowledge of Electrical Engineering, Machines, Control systems and Circuit analysis.

Course Objectives:

1. To study the operating principles different special machines
2. To make the learner to be aware of latest special machines which are in vogue.
3. To be familiar with salient features of special electrical machines

Course Outcomes: After completion of this course, students will be able to:

1. Recognize application specific special electrical machines
2. Explain the working principle of various special electrical machines.
3. Develop equivalent circuit of a given special electrical machine.
4. Classify the special electrical machine based on construction
5. Choose the type of armature winding suitable for a given SEM.
6. Analyze the various control methods of a given Special Electric machine.

UNIT-I

Stepper Motors: Introduction, classification, single phase, Disc Magnet and Claw-tooth stepper motors, inference from Torque equation, (no derivation) static and dynamic characteristics, open loop and closed loop control, concepts of Microprocessor based control, comparison of conventional stepper motors with permanent magnet stepper motor, VR Stepper motor and Hybrid stepper motor and applications

UNIT-II

Switched Reluctance Motor (SRM): Construction, Principle of working, constraints on pole arc and tooth arc, Inference from torque equation and Characteristics, Control of SRM, features of Microprocessor based control of SRM, Introduction to Synchronous Reluctance Motor (SyR M)

UNIT-III

PMDC and BLDC motor: PMDC Motor: Construction, Principle of working Minor hysteresis loops and recoil line, Equivalent circuit of PM, Inference from Torque equation, performance Characteristics, moving coil motors Printed Circuit Motor

BLDC Motor: Construction, principle of working, types, and control types and differences among various controls such as Microprocessor based, DSP- based control and sensor less control,

UNIT-IV

Linear Electric Machines: Construction, equivalent circuit, characteristics, design aspects and control, Types such as – linear synchronous motor, DC Linear motor, Linear Reluctance motor and Linear Levitation Machines (elementary treatment only)

UNIT-V

Permanent Magnet Axial Flux (PMAF) Machines: Construction, Armature windings – Toroidal stator, Trapezoidal stator, Rhomboidal Stator winding, salient features of torque equation, EMF equations and Output equation [No derivations], Phasor diagram, Applications; Introduction to Permanent Magnet Synchronous Motor,

HEAD
Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

Text Books:

1. E.G. Janardhan, "Special Electrical Machines", Prentice Hall India, 2014.
2. K. Venkatarathnam, "Special Electrical Machines", Universities Press (India) Pvt. Ltd., 2013

Suggested Reading:

1. H. Bülent Ertan, M. Yildirim Üçtug, Ron Colyer, Alfio Consoli, "Modern Electrical Drives" Springer Science Bussiness Media, 2000.

CO-PO & PSO Correlation Articulation Matrix

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	2	1	-	-	-	-	3	1	1	3
CO2	3	3	3	2	1	-	-	-	-	-	-	2	1	1	2
CO3	3	3	3	2	1	-	-	-	-	-	-	-	-	-	-
CO4	3	2	2	2	-	2	1	-	-	-	2	3	1	2	3
CO5	3	3	2	2	-	2	1	-	-	-	-	-	-	-	-
CO6	3	3	3	2	1	-	-	-	-	-	2	3	1	2	3

HEAD
Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

20EE E26

BASIC VLSI DESIGN

(Semester-V-Program Elective-II)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Students should have basic knowledge of Basic Electronics and Digital Electronics

Course Objectives: This course aims to:

1. To understand the MOSFET structures and operations
2. To learn to design logic circuits using pMOS and nMOS
3. To learn to design concepts of CMOs and HDL Programming.

Course Outcomes: After completion of this course, students will be able to:

1. To design logic circuits using pMOS and nMOS technologies
2. To design cMOS logic circuits.
3. To simulate logical circuits using HDL programming
4. To understand different modeling strategies
5. To understand FPGA design strategies.

UNIT-I

MOS CIRCUIT DESIGN PROCESS: Introduction of MOSFET: Symbols, Enhancement mode-Depletion mode transistor operation – Threshold voltage derivation–bodyeffect–DraincurrentVsvoltagederivation–channellength modulation .nMOS and pMOS inverter–Determination of pull upto pull down ratio–Stick diagrams–VLSI Circuit Design Flow.

UNIT-II

MOSTECHNOLOGY: Chip Design Hierarchy–IC Layers–Photolithography and Pattern Transfers– Basic MOS Transistors–CMOS Fabrication :n - well – p- well– twin tub – Latchup and prevention(SOI)–Submicron CMOS Process- Masks and Layout- CMOS Design Rules : Lambda based layout.

UNIT-III

LOGIC DESIGNUSING nMOS and cMOS: Gate delays–Logical Effort-CMOS Static Logic – Transmission Gate Logic – Tri- State Logic – Pass Transistor Logic–Dynamic CMOS Logic–Realization of logic gates–using nMOS and CMOS technologies– Stick diagrams of logic gates-Simple full adder – four input Encoder-Decoder.

UNIT-IV

VERILOG HDL: Hierarchical modeling concepts – Basic concepts: Lexical conventions–Data types–Modules and ports. Gate level modeling–Dataflow modeling–Behavioral modeling–Design examples of Combinational and Sequential circuits – Switch level modeling.

UNIT-V

VLSIIMPLEMENTATION STRATEGIES : Introduction–Design of Adders: carry look ahead-carry select-carry save. Design of multipliers Introduction to FPGA – Full custom and Semi custom design, Standard cell design and cell libraries, FPGA building block architectures.

HEAD
Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

Text Books:

1. Douglas A.Pucknell & Kamran Eshraghian,"BasicVLSI Design",3rdedition, Prentice Hall India, 2001.
2. Wayne Wolf, "Modern VLSI Design: System-on-chip design", Pearson Education,3rd edition,2002.

Suggested Reading:

1. David A.Johns& Ken Martin, "Analog Integrated Circuit Design", John Wiley& Sons,2004.
2. Neil.H.E.Weste&Kamran Eshraghian, "Principles of CMOSVLSI" Design: Asystemsperspective",2nd edition, PearsonEducation,2004.

CO-PO & PSO Correlation Articulation Matrix

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	-	-	-	-	-	1	1	1	1	-
CO2	2	3	3	2	1	-	-	-	-	-	1	1	1	2	-
CO3	2	3	3	2	1	-	-	-	-	-	2	2	1	3	1
CO4	2	2	2	2	1	-	-	-	-	-	2	2	1	1	1
CO5	1	2	2	1	1	-	-	-	-	-	2	2	1	1	2

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With effect from the academic year 2022-23

20EE C21

CONTROL SYSTEMS LAB

(Semester-V)

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Students should have a prior knowledge of Newton's laws, Circuit theory, Vector Calculus & Differential Equations, Laplace transform and their properties and linear algebra.

Course Objectives:

1. To understand the characteristics of DC, AC Servo Motors, synchro pair and the frequency response of compensating networks.
2. To study the closed loop performance for given plant using i) P, PI and PID controllers, ii) ON/OFF controller.
3. To understand the effect of damping on the given plant using D.C position control system.

Course Outcomes: After completion of this course, students will be able to:

1. Demonstrate the characteristics of DC, AC Servo motors and Synchro Pair.
2. Analyze the performance parameters of a given second order plant in time domain.
3. Analyze the performance of different compensators through its frequency response.
4. Design P, PI, PID and ON/OFF controller of a given system and to distinguish the merits and demerits of these controllers.
5. Analyze the characteristics of magnetic amplifier for series and parallel connections.
6. Demonstrate the effect of damping on the plant using D.C position control system

LIST OF EXPERIMENTS

1. Characteristics of D.C Servo motor.
2. Characteristics of A.C. Servo motor.
3. Characteristics of Synchro Pair.
4. Performance parameters of a second order system excited with step input for different damping ratios.
5. Frequency response of lag and lead compensating networks.
6. Performance of a temperature control system using P, PI and PID Controllers.
7. Temperature control of a system using relay(ON/OFF Control).
8. Characteristics of magnetic amplifier for series and parallel connections with different values of resistive load.
9. Measurement of step angle for stepper motor.
10. Response of different components of a control system using Linear System Simulator.
11. Demonstration of damping effect on the plant using DC position control system.
12. Study of closed loop speed control of BLDC motor with the effect of PI controller

Note: At least TEN Experiments should be conducted in the semester from the above list of experiments

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CO-PO & PSO Correlation Articulation Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	1	1	1	-	-	-	-	-	-	-	-	-	-	1
CO-2	3	3	2	2	2	-	-	-	-	-	-	-	1	-	1
CO-3	3	2	3	2	2	-	-	-	-	-	-	-	2	-	2
CO-4	3	3	2	3	2	-	-	-	-	-	-	-	3	-	2
CO-5	3	1	1	1	-	-	-	-	-	-	-	-	-	-	-
CO-6	3	2	2	1	-	-	-	-	-	-	-	-	-	-	1

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20EE C22

ELECTRICAL MACHINES-II LAB

(Semester-V)

Instruction	2 P Hours per Week
Duration of SEE	3Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Basic knowledge of Electrical Engineering, Machines and Circuit analysis.

Course Objectives:

1. To understand the practical connections of the machines.
2. To calculate the various parameters of induction motor and synchronous machine by performing the experiment.
3. To analyze the performance of the induction motor and synchronous machine by conducting suitable experiments.

Course outcomes: After completing this course, students will be able to:

1. Make the connections for any given AC machine based on applications.
2. Design the meter ratings for various applications of induction and synchronous machines.
3. Control the speed of the induction motor by different methods.
4. Determine the efficiency and regulation of the given alternator using various methods.
5. Test the induction motor for their no-load and load characteristics.

LIST OF EXPERIMENTS

1. Three phase to two phase conversion of transformer (Scott connection)
2. Performance characteristics of Single-phase induction motor
3. Speed control of 3 phase induction motor by rotor resistance control and stator voltage control
4. Speed control of 3 phase induction motor by V/f control method.
5. No- load test of slip ring induction motor to determine the relationship between
   i) Applied voltage and speed, ii) Applied voltage and rotor current, iii) Applied voltage and stator current, iv) Applied voltage and power factor, v) Applied voltage and power input.
6. No-load test, blocked rotor test and load test on 3-phase squirrel cage induction motor.
7. Power Factor Improvement of Induction motor using capacitors.
8. Line excited induction generator characteristics.
9. Voltage regulation of alternator by
   a) Synchronous impedance method
   b) Ampere-turn method.
10. Voltage regulation of alternator by zero power factor(ZPF) method.
11. Measurement of Xd and Xq of 3 phase salient pole synchronous machine by conducting slip test.
12. Synchronization of 3phase alternator to bus bar using dark lamp method.
13. Observation of change in the active and reactive power of an alternator connected to an infinite bus by (a) varying excitation, (b) varying mechanical-power input.
14. V and Inverted V-curves of a given synchronous motor.
15. a) Grid Synchronization of DFIG. b) Active and reactive power control of DFIG

Note: At least TEN experiments should be conducted in the semester.

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CO-PO & PSO Correlation Articulation Matrix:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	--	--	--	--	--	--	--	1	2	2
CO2	3	3	2	2	1	--	--	--	--	--	--	--	1	2	2
CO3	3	3	2	2	1	--	--	--	--	--	--	--	1	2	2
CO4	3	3	2	2	1	--	--	--	--	--	--	--	1	2	2
CO5	3	3	2	2	1	--	--	--	--	--	--	--	1	2	2

"People Often say that motivation does not last. Well, neither does bathing-That's why we recommend it daily."

-Zig Ziglar

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20EE C23

MICROCONTROLLERS AND APPLICATIONS LAB

(Semester-V)

Instruction	2 P Hours per Week
Duration of SEE	3Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Students should have basic knowledge of programming in C language.

Course Objectives: This course aims to:

1. Develop and understand the 8051 and ARM7 C programming
2. Understand the usage of Integrated Development Environment (Keil)
3. Control the operation of various peripherals using 8051 and ARM7 microcontroller

Course Outcomes: After completion of this course, students will be able to:

1. Develop the programs of 8051 and ARM using their respective instruction set.
2. Understand the usage of various debugging tools available to program different microcontrollers
3. Build code for 8051 and ARM7 to interface various input/output modules
4. Analyze the hardware and software interaction and integration.
5. Design and develop the 8051 and ARM 7 based embedded systems for various applications

LAB EXPERIMENTS

I. 8051 Programming (Any 5 experiments. are to be conducted in each cycle)

1. Familiarity and use of 8051 microcontroller trainer kit, Keil IDE and simple programs under different addressing modes.
2. Assembly programming using instruction set
3. Timer and counter operations and programming using 8051.
4. Interfacing applications using LED, switch, relay and buzzer.
5. Generation of waveforms using DAC by interfacing it with 8051.
6. Stepper motor interfacing.
7. LCD interfacing.
8. Development of Embedded 'C' Code based on the module specifications. (under Structured enquiry)

II. ARM7 Programming

1. Study and use of LPC214x Microcontroller trainer kit and simple programs using its instruction set
2. Interfacing applications using LED, switches
3. Interfacing applications using relay and buzzer.
4. DC Motor interfacing.
5. Programming on-chip ADC.
6. Waveform generation using internal DAC.
7. Development of Embedded 'C' Code based on the module specifications

III. Design an experiment related to the Embedded Application of your choice using 8051/ARM based architectures. (under Open ended enquiry)

Suggested Reading:

1. Mazidi M.A, Mazidi JG &Rolin D. Mckinlay, "The 8051 Microcontroller & Embedded Systems using Assembly and C", 2/e, Pearson Education, 2007.
2. Philips semiconductors, "ARM 7 (LPC 214x) user manual", 2005

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CO-PO & PSO Correlation Articulation Matrix

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	-	-	-	-	-	-	-	1	1	-
CO2	2	3	3	2	1	-	-	-	-	-	-	-	1	2	-
CO3	2	3	3	2	1	-	-	-	-	-	-	-	1	3	1
CO4	2	2	2	2	1	-	-	-	-	-	-	-	1	1	1
CO5	1	2	2	1	1	-	-	-	-	-	-	-	1	1	2

"There's nothing more dangerous than a resourceful idiot"

-Scott Adams

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20EGC03

EMPLOYABILITY SKILLS

(BE/B.Tech V&VI semester-Common to all Branches)

Instruction	2 P Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	50 Marks
Credits	01

Course Objectives: To help the students

1. Learn the art of communication, participate in group discussions and case studies with confidence and to make effective presentations.
2. With- resume packaging, preparing them to face interviews.
3. Build an impressive personality through effective time management, leadership qualities, self-confidence and assertiveness.
4. Understand professional etiquette and to make them learn academic ethics and value system.
5. To be competent in verbal aptitude.

Course Outcomes: By the end of the course, the students will be able to

1. Become effective communicators, participate in group discussions with confidence and be able to make presentations in a professional context.
2. Write resumes, prepare and face interviews confidently.
3. Be assertive and set short term and long term goals, learn to mange time effectively and deal with stress.
4. Make the transition smoothly from campus to work, use media with etiquette and understand the academic ethics.
5. Enrich their vocabulary, frame accurate sentences and comprehend passages confidently.

UNIT I

Verbal Aptitude: Error Detection, Articles, Prepositions, Tenses, Concord and Transformation of Sentences-Jumbled Words/Sentences- Vocabulary, Synonyms, Antonyms, One Word Substitutes, Idioms and Phrases, Word/Sentence/Text Completion- Reading Comprehension.

UNIT II

Group Discussion & Presentation Skills: Dynamics of Group Discussion-Case Studies- Intervention, Summarizing, Modulation of Voice, Body Language, Relevance, Fluency and Accuracy, Coherence. Elements of Effective Presentation – Structure of a Presentation – Presentation tools – Body language - Preparing an Effective PPT

UNIT III

Behavioural Skills: Personal strength analysis-Effective Time Management- Goal Setting- Stress management-Corporate Culture – Grooming and etiquette-Statement of Purpose (SOP).

UNIT IV

Mini Project: Research-Hypothesis-Developing a Questionnaire-Data Collection-Analysis-General and Technical Report - Writingan Abstract –Technical Report Writing-Plagiarism-Project Seminar.

UNIT V

Interview Skills: Cover Letter and Résumé writing – Structure and Presentation, Planning, Defining the Career Objective, Projecting ones Strengths and Skill-sets – Interviews: Concept and Process, Pre-Interview Planning, Opening Strategies, Answering Strategies, Mock Interviews.

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Suggested Reading:

1. Leena Sen, “Communication Skills”, Prentice-Hall of India, 2005
2. Dr. Shalini Verma, “Body Language - Your Success Mantra”, S Chand, 2006
3. Edgar Thorpe and Showick Thorpe , “Objective English”, 2nd edition, Pearson Education, 2007
4. Ramesh, Gopalswamy, and Mahadevan Ramesh, “The ACE of Soft Skills”, New Delhi: Pearson, 2010
5. Gulati and Sarvesh, “ Corporate Soft Skills”, New Delhi: Rupa and Co. , 2006
6. Van Emden, Joan, and Lucinda Becker, “Presentation Skills for Students”, New York: Palgrave Macmillan, 2004
7. A Modern Approach to Verbal & Non-Verbal Reasoning by R S Aggarwal, 2018
8. Coveyand Stephen R, “The Habits of Highly Effective People”, New York: Free Press, 1989

"There is a difference between interest and commitment. When you're interested in something, you do it only when it's convenient. When you're committed to something, you accept no excuses, only results."

-Ken Blanchard

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20EEI02

Industrial Internship/ Rural Internship

Instruction	3-4 Weeks/90 Hours
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	2

Prerequisite: Knowledge of Basic Sciences and Engineering Sciences/Knowledge about rural environment

Course Objectives: This course aims to:

1. Exposing the students to the industrial environment/ rural environment
2. Create awareness with the current industrial technological developments relevant to program domain
3. Provide opportunity to understand the social, economic and administrative considerations in organizations/rural areas

Course Outcomes: After completion of this course, students will be able to:

1. Understand Engineer's responsibilities and ethics
2. Use various materials, processes, products and quality control
3. Provide innovative solutions to solve real world problems
4. Acquire knowledge in technical reports writing and presentation
5. Apply technical knowledge to real world industrial/rural situations

For implementation procedures and letter formats, annexures I and III of Internship document maybe referred.

Evaluation of Internship: The industrial training/internship of the students will be evaluated in three stages:

a) Evaluation by the Industry(in the scale of 1 to 10 where 1-Unsatisfactory; 10-Excellent)

b) Evaluation by faculty Mentor on the basis of site visit(s) or periodic communication (15 marks)

c) Evaluation through seminar presentation/Viva-Voce at the Institute by the constituted committee (25 marks)

Evaluation through Seminar presentation/Viva-Voce at the institute: Students shall give a seminar before an Expert Committee constituted by college (Director, HoD / Senior faculty, mentor and faculty expert from the same department) based on his/her training/internship carried out

. The evaluation will be based on the following criteria:

- Quality of content presented
- Proper planning for presentation
- Effectiveness of presentation
- Depth of knowledge and skills
- Attendance record, daily diary, departmental reports shall be analyzed along with the internship Report

Monitoring/ Surprise Visits: During the internship program, the faculty mentor makes a surprise visit to the internship site, to check the student's presence physically. If the student is found to be absent without prior intimation to the concerned industry, entire training/internship may be canceled. Students should inform through email to the faculty mentor as well as the industry supervisor at least one day prior to avail leave.

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CO-PO & PSO Correlation Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	3	3	-	3	-	3	3	-	-	3
CO2	1	1	1	3	3	-	2	1	-	-	-	-	3	3	-
CO3	2	3	3	3	3	2	3	1	1	-	-	-	3	3	-
CO4	-	-	-	-	-	3	-	1	3	3	-	1	-	-	3
CO5	1	3	3	3	3	2	3	-	1	-	-	1	3	3	3

"A business absolutely devoted to service will have only one worry about profit. That would be embarrassingly large."

-Henry Ford

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VI-SEMESTER

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AICTE Model Curriculum with effect from AY 2022-23

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

SEMESTER – VI

S.no	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
THEORY									
1	20 EE C24	**Core -13** Power System Protection	3	-	-	3	40	60	3
2	20 EE C25	**Core -14** Power System Operation and Control	3	-	-	3	40	60	3
3	20 EE C26	**Core -15** Electrical Drives	3	-	-	3	40	60	3
4	20 EE C27	**Core -16** IoT for Electrical Engineering	3	-	-	3	40	60	3
5	20 EE Exx	**PE- 3**	3	-	-	3	40	60	3
6	20 EG M01	Indian Constitution& Fundamental Principles	2	-	-	2	-	-	NC
PRACTICALS									
7	20 EE C28	Power Systems Lab	-	-	2	3	50	50	1
8	20 EE C29	Electrical Simulation Lab	-	-	2	3	50	50	1
9	20 EE C30	Electrical Drives Lab	-	-	2	3	50	50	1
10	20 EE C31	IoT Lab	-	-	2	3	50	50	1
Total			**17**	**-**	**08**	**30**	**440**	**510**	**19**
Clock Hours Per Week: 25									

L: Lecture **T: Tutorial** **P: Practical/Project Seminar/Dissertation**

CIE: Continuous Internal Evaluation **SEE: Semester End Examination**

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AICTE Model Curriculum with effect from AY 2022-23

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

SEMESTER – VI

List of Courses offered in Program Elective-III	
Course code	**Title of the Course**
20 EE E31	Advanced power System Protection
20 EE E32	Power Electronics for Renewable Energy Systems
20 EE E33	Utilization of Electrical Energy
20 EE E34	Power Quality Engineering
20 EE E35	Advanced Electrical Drives
20 EE E36	Digital Signal Processing

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20EE C24

POWER SYSTEM PROTECTION

(Semester-VI)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic knowledge of Electrical Engineering and Circuit analysis.

Course Objectives: This course aims to:

1. To analyze principles of operation of the different Protection Devices.
2. To understand the different protection schemes employed in the protection ofpower system
3. To acquire knowledge of Numerical Protection Algorithm

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

1. Understand basic terminology of relays and types of over current protection of power system.
2. Distinguish the type of distance protection with principle & their application to three phase transmission lines.
3. Choose suitable differential scheme for the protection of various equipment in electrical power system.
4. Describe the principle of operation, and able to calculate the ratings of circuit breakers.
5. Familiarize with different protection methods against over-voltages.
6. Identify various elements of numerical relays, their functions and different techniques used in their design.

UNIT-I

Introduction to Protection Schemes: Need for protection, Backup protection, Zones of protection, Definitions of relay pickup, dropout and reset values, Classification of relays, Operating principles and construction of electromagnetic and induction relays.

Over-current Protection: Time-current characteristics, current settings, time settings, over-current protection schemes, direction relay, applications of Definite Time, IDMT and Directional relays distribution feeders, Earth fault and phase fault protection schemes, directional earth fault relay, static over current relay, fuse characteristics, types of fuses

UNIT-II

Distance Protection: Introduction, Impedance relay, reactance relay, MHO relay, effect of arc resistance and Power Swings on the performance of Distance Relaying, Selection of distance relays, Three-stepped Distance protection, Comparison of different distance protection schemes, Distance protection of three-phase lines.

UNIT-III

Differential protection: Introduction, simple differential protection, zone of differential protection, Percentage differential relay, Earth-leakage protection, Percentage Differential Protection of Transformers, Differential protection of transformer against Inrush phenomenon, Inter-turn faults in transformer. Differential protection of Bus- bars, Internal and External faults, Protection of Three-phase bus bars. Introduction to the Basic protection of Generator and Induction Motors

UNIT-IV

Circuit Breakers: Arc interruption, restriking voltage, recovery voltage, RRRV, current chopping, resistances witching, classification of circuit breakers, selection of circuit breaker Over voltage protection: causes for over voltages, protection of transmission lies against direct lightning strokes, ground wires, arcing horns, lightning arrestors, surge absorbers, Peterson coils, insulation coordination

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UNIT–V

Basics of Numerical Protection: Block diagram of numerical relay, Sampling theorem, Least Error Square Technique, Digital Filtering, Numerical Relaying for over current, Differential and distance protection (Elementary Treatment).

Text Books:

1. Badriram Viswakarma, "Power System Protection and Switchgear", Tata McGrawHill, 2011
2. Y.G. Paithankar, S.R. Bhide, "Fundamentals ofpower system protection", Prentice Hall, India, 2010.

Suggested Reading:

1. T.S.Madhava Raao, Power System Protection: StaticRelays, Tata McGraw-Hill Education 1989
2. P.M.Anderson, Power System Protection, John Wiley, 2012
3. ElectricityTraining Association, Power System Protection. Vol.2.: Systems and Methods, Institute of engineering and Technology, 1995

CO-PO & PSO Correlation Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	1	-	-	-	-	1	-	2	3	3	1
CO2	3	1	2	-	1	-	-	-	-	1	-	3	3	3	1
CO3	3	2	2	-	1	-	-	-	-	1	-	2	3	3	1
CO4	3	2	2	-	1	-	-	-	-	1	-	2	3	3	1
CO5	3	2	2	-	1	-	-	-	-	1	-	2	3	3	1
CO6	3	1	1	-	2	-	-	-	-	1	-	2	3	3	1

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20EE C25

Power System Operation and Control

(Semester-VI)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Power Systems, Control Systems, Synchronous Machines

Course Objectives:
1. To understand the importance of Economic Operation of power system
2. To understand the load frequency control of Power Systems
3. To gain the knowledge of power system stability

Course Outcomes: After completion of this course, students will be able to:

1. Demonstrate the Economic operation of power system without and with Losses
2. Illustrate the concept of Unit Commitment
3. Analyze the Load Frequency Control for single and two area systems
4. Examine the rotor angle stability of a power system under any disturbance.
5. Identify and Explain the Voltage Stability problems.

UNIT-I

Economic Operation of Power System: Input-Output curves, Heat rate and Incremental Cost curves, Economic Operation neglecting Transmission Losses, with and without Generator Limits, Derivation of Bmn Coefficients, Economic Operation including transmission losses, Numerical problems.

UNIT-II:

Unit Commitment (UC): Introduction, Constraints in UC, Thermal unit constraints and other constraints, Solution Methods: Priority-list method, Dynamic Programming solution, Lagrange Relaxation Solution, Numerical problems.

UNIT-III:

Control of Frequency: Introduction to Automatic Generation Control (AGC), Frequency control, Concept of Single-area Load Frequency control, Modeling of Single-area control, Steady state and Dynamic Analysis on Single-area, PI Control for Single- area, Introduction to Two-Area Load Frequency control, Modeling of Two-area control.

Control of Voltage:

Conventional Methods for Reactive power Generation and Absorption, Automatic Voltage Regulators, Flexible AC Transmission Systems.

UNIT-IV

Rotor Angle Stability: Introduction to Rotor Angle Stability, Classification, Steady state stability, Steady state stability Limit, Factors affecting the Steady state stability, Introduction to Transient Stability, Swing Equation, Equal-area Criterion, Critical Clearing Angle, Critical Clearing Time, Application of equal area criterion, Factors affecting the Transient stability.

UNIT-V

Voltage Stability: Introduction to Voltage Stability, comparison between Angle stability and voltage stability, Mathematical formulation of Voltage Stability, Modeling requirements to carryout Voltage stability analysis, Prevention of Voltage Instability

Text Books:
1. I. J. Nagrath & D.P. Kothari, Modern Power System Analysis,4th Edition TMHPublication,2011
2. Allen J. Wood, Bruce. F.Woolenberg, Power Generation, Operation & Control, WileyPublishers, 2006
3. K. R. Padiyar, Power system dynamics: stabilityand control, Second Edition, BS Publications, 2008

Suggested Reading:
1. O. Elgard, Electric Energy Systems Theory, 2nd Edition. TMH Publication,2001
2. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012

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CO-PO& PSO Correlation Articulation Matrix:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		2	1	-	-	-	1	2	1	2	3	1	-
CO2	3	3	2	2	1	-	-	-	2	2	2	3	3	2	1
CO3	3	2	1	2	1	-	-	-	1	1	1	2	1	1	1
CO4	3	2	1	2	1	-	-	-	1	1	1	2	1	1	-
CO5	3	1	1	1	-	-	-	-	1	1	1	1		2	-

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20EE C26

ELECTRICAL DRIVES

(Semester-VI)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Power Electronics, Electrical Machines

Course Objectives:

1. To Understand the characteristics of various Electric Drives and its control using different power electronic converter circuits
2. To apply and analyse the concept of speed control DC motor drives with single phase, three-phase converters and choppers.
3. To apply and analyse the concept of speed control induction motor by using AC voltage controller, VSI, CSI and cyclo-converter.

Course Outcomes: After completion of this course, students will be able to:

1. Acquire the knowledge about classification, choice, dynamics and stability of Electric Drives.
2. Analyse 1-Φ & 3-Φ converters fed DC motors.
3. Understand the operational variance between single and multi-quadrant operation of various Electric Drives
4. Analyse chopper fed DC motors.
5. Comprehend the speed control of a converter fed induction motor drives and synchronous motor drives.
6. Differentiate the features of closed loop operation of DC and AC electric drive and their controllers.

UNIT-I

Electric Drive: Introduction, Block diagram and parts of electric drive.

Dynamics of Electrical Drives: Types of Load- Types and Characteristics of load torque – Dynamics of motor- load combination – steady state & transient stability of an electrical drive.

Phase control converters fed DC drivers: Review of speed control techniques of DC motors, Single Phase and Three- phase semi and fully controlled converters connected to DC separately excited and DC series motors– continuous current mode of operation, output voltage and current waveforms, Speed and Torque expressions, Speed- Torque Characteristics. Problems on Converter fed DC motors.

UNIT –II

Four quadrant operation of DC drive: Introduction to four quadrant operation, motoring operation, electric braking – Plugging, Dynamic and regenerative braking operations. Four quadrant operation of D.C motors by dual converters – Closed loop operation of DC motor

UNIT –III

Chopper fed DC drives: Single, two and four quadrant chopper fed dc separately excited and series excited motors– continuous current operation, output voltage and current wave forms, speed torque expressions, speed torque characteristics, Problems on Chopper fed DC Motors, closed loop operation.

UNIT-IV

Induction Motor Drives: Variable voltage characteristics – Control of Induction Motor by AC Voltage Controllers – Wave forms – Speed torque characteristics, Variable Voltage, Variable Frequency control of induction motor by voltage source inverter (VSI), current source inverter (CSI) and cyclo-converters, Comparison of VSI and CSI. Static
control,closed loop speed control with static rotor resistance control, Slip power recovery schemes–Static S
Static Kramer Drive and their performance, speed torque characteristics, closed loop operation of induction

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Gandipet, Hyderabad-75

UNIT-V

Synchronous Motor Drives: Operations from fixed frequency supply, Synchronous Motor variable speed drives, Variable frequency control of Multiple Synchronous Motors, Self–controlled Synchronous Motor Drive Employing Load Commutated Thyristor Inverter, Self-controlled Synchronous Motor Drive Employing a Cyclo-converter, closed loop operation of Synchronous Motor Drive.

Text Books:

1. G. K. Dubey, "Power Semiconductor Controlled Drives", Prentice Hall, 1989.
2. R. Krishnan, "Electric Motor Drives: Modeling, Analysis and Control", Prentice Hall, 2001.
3. M.H.Rashid, "Power Electronic Circuits, Devices and applications", PHI.

Suggested Reading:

1. G. K. Dubey, "Fundamentals of Electrical Drives", CRC Press, 2002.
2. W. Leonhard, "Control of Electric Drives", Springer Science & Business Media, 2001.

CO-PO & PSO Correlation Articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	--	--	--	--	--	--	--	--	--	2	2
CO2	3	3	2	3	--	--	--	--	--	--	--	--	1	3	3
CO3	3	2	2	3	--	--	--	--	--	--	--	--	1	2	3
CO4	3	2	2	3	--	--	--	--	--	--	--	--	1	2	3
CO5	3	2	2	3	--	--	--	--	--	--	--	--	1	2	2
CO6	3	2	2	3	--	--	--	--	--	--	--	--	1	2	2

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Gandipet, Hyderabad-75

20EE C27

IoT for Electrical Engineering

(Semester-VI)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Students should have prior knowledge on basic programming knowledge and networking

Course Objectives:

1. To provide knowledge of basic IoT Network Architectures, IoT Processing, Connectivity and Communication technologies
2. To provide knowledge of Arduino boards and basic components and Develop skills to design and implement various smart system application.
3. To provide knowledge of programming skills, application development and prototyping using Python.

Course Outcomes: After completion of this course, students will be able to:

1. Understand the basic principles and terminologies of computer networking, network security, WSN, M2M, CPS, sensors and actuators.
2. Describe various data types in IoT applications, connectivity protocols in IoT, communication protocols in IoT.
3. Understand basic concepts of Arduino UNO and Design smart system applications using Arduino UNO.
4. Apply Python programming for Problem solving and application development.
5. Understand the working of RaspberryPi and develop IoT applications.

UNIT-I

Introduction to IoT: Introduction-Network types-IoT Protocol and Architecture-Network Security- Wireless Sensor Networks (WSN)- Machine-to-Machine (M2M) Communications- Cyber Physical Systems (CPS)- Differentiate between WSN, M2M, and CPS- IoT Sensors and Actuators-Advantages and Disadvantages of IoT.

UNIT-II

IoT Processing, Connectivity and Communication: Data format- Importance of Processing in IoT- Processing Topologies- IoT Device Design and Selection Considerations- IEEE 802.15.4-Thread- ISA100.11A- Wireless HART- RFID- LoRa-Wi-Fi- Bluetooth- Infrastructure Protocols- Discovery Protocols- Data Protocols- Identification Protocols

UNIT-III

Introduction to Arduino Programming: Introduction-Features of Arduino-Types of Arduino board-Arduino UNO- Arduino IDE overview-Sketch Structure-Data types-Function libraries-Operators in Arduino-Control statement-Loops- Arrays-String- Math Library-Random number-Interrupts-Example program: Blink LED-Traffic Control system- Pulse Width Modulation- Analog to Digital Conversion- Wireless Connectivity to Arduino- Integration of Sensors with Arduino-Integration of Actuators with Arduino

UNIT-IV

Introduction to Python Programming: Introduction to Python- Variables and Data types- Operators-NumPy-matplotlib-Array- Pandas-Lists- Loops- Conditional statements-Functions-Strings-Tuples- Sets-Dictionaries- Array- Data Visualization- File handling.

UNIT-V

Introduction to Raspberry Pi and IoT Applications: Introduction to Raspberry Pi-Basic architecture- Working of Raspberry Pi-Pin configuration- Example program: Blink LED- Capture Image using Raspberry Pi -Implementation of IoT with Raspberry Pi: Sensor and actuator interfaced with Raspberry Pi-IoT application-Speed control of DC and AC machines- Measuring parameters of DC machine, AC machine and solar panel.

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Text Books:

1. S. Misra, A. Mukherjee, and A. Roy, “Introduction to IoT”, Cambridge University Press, 2020
2. S. Misra, C. Roy, and A. Mukherjee, “Introduction to Industrial Internet of Things and Industry4.0”, CRC Press, 2020
3. Adeel Javed, ”Building Arduino Projects for the Internet of Things Experiments with Real-World Applications”, Apress, 2016
4. Allen B. Downey, “Think Python”, O'Reilly, 2016
5. John Zelle, “Python Programming an introduction to computer science”, Tom Sumner, 2012
6. Rajkumar Buyaa and Amir V Dastjerdi, Internet of things: Principles and Paradigms, Morgan Kaufmann
7. A Bahga& V Madisetti, Internet of Things: A Hands On Approach, Universities Press

Suggested Readings:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, Cisco Press, 2017
2. Mark Lutz, “Learning Python”, O'Reilly, 2009.
3. Adrian McEwen and Hakim Cassimally, Designing the Internet of Things, Wiley
4. Olivier Hersent, David Boswarthick and Omar Elloumi, The Internet of Things: Keyapplications and Protocols, Wiley

CO-PO & PSO Correlation Articulation Matrix

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	3	-	-	-	-	-	-	-	1	1	-
CO2	3	3	2	2	3	-	-	-	-	-	-	-	1	2	-
CO3	3	3	2	2	3	-	-	-	-	-	-	-	2	3	-
CO4	3	3	2	2	3	-	-	-	-	-	-	-	3	2	-
CO5	3	3	2	2	3	-	-	-	-	-	-	-	2	3	-

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

20EE E31

ADVANCED POWER SYSTEM PROTECTION

(Semester-VI - Program Elective-III)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Power System Protection

Course Objectives:

1. To study the operating principles and application aspects of static relays
2. To study the architecture and the required mathematical background for the design and development of digital relays
3. To understand the application of various algorithms for the digital protection of practical power system.

Course Outcomes: After completion of this course, students will be able to:

1. Remember the basic terminology and components of static relays and grounding methodologies
2. Recognize the need and architecture of digital relays
3. Comprehend the application of mathematics in power system protection
4. Distinguish various mathematical algorithms used for the estimation of power system parameters.
5. Explain various algorithms used for the digital protection of power system.

UNIT-I

Static Relays: Comparators, Amplitude and Phase comparison schemes, Duality between Amplitude and phase comparators, General equation for comparators for different types of relays, Static comparators, Coincidence circuits, Phase splitting methods, Hall effect comparators, Operating principles, Use of level detectors, Time delay circuits, Filters, Thyristors, Triggering circuits and DC power supplies, Advantages and Disadvantages of static relays

UNIT-II

Basic Elements of Digital Protection: Signal conditioning: transducers, surge protection, analog filtering, analog multiplexers, Conversion subsystem: the sampling theorem, signal aliasing Error, sample and hold circuits, multiplexers, analog to digital conversion, Digital relay subsystem, filtering concepts.

UNIT-III

Sinusoidal-Wave-Based Algorithms: sample, first, second derivative techniques, two-sample and three-sample techniques, Fourier-analysis-based algorithms, walsh-function-based techniques

UNIT-IV

Algorithms based on Least Squares: Least Squares-based Algorithm: Integral LSQ fitting, Power series LSQ fitting, Multi-variable series LSQ

Differential Equation-based Algorithm: Representation of Transmission line, differential equation protection, simultaneous equation techniques.

UNIT-V

Digital Protection: Digital Protection of Transformers: Principles of protection, FIR-filter based algorithms, Least-square curve fitting based algorithms, Fourier-based Algorithms, Digital Protection Transmission Lines: current-based differential Protection, composite voltage and current based protection schemes

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Text Books:

1. Badriram and Viswakarma D.N.,'Power System Protection and Switchgear',TataMcGrawHill,April,2001.
2. MadhavaraoT.S.,'Power System Protection Staticrelays with microprocessor applications', Tata Mc Graw Hill,2001.
3. A.T.Johns and S.K.Salman,'Digital protection for power systems', IEE series,1989.
4. S.R.Bhide "Digital Power System Protection" PHI Learning Pvt. Ltd.2014

Suggested Reading:

1. Warrington A.R.Van C,'Protective Relays', VolI & II Chapman & Hall,John Wiley& Sons,1977.
2. Bhuvanesh AOZA, Nirmalkumar C.Nair, Rashesh P Mehta,Vijay H.M.,'Power system protection and Switch gear', TataMcGraw Hill,2010.
3. J.Lewis Black burn,Thomas J Domin, 'Protective relaying Principles and Applications',CRCpress,2014.
4. L.P.Singh,'Digital Protection: Protective Relaying from Electromechanical to Micro processor', John Wiley& Sons,1994.
5. StanleyH Horowitz,A.G.Phadke,'Power system relaying',4th Edition, Wiley publications, 2014.

CO-PO & PSO Correlation Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	-	-	-	-	-	1	1	3	3	2
CO2	3	3	2	1	-	-	-	-	-	-	1	1	3	3	2
CO3	3	3	2	1	-	-	-	-	-	-	1	1	3	3	2
CO4	3	3	2	1	-	-	-	-	-	-	1	1	3	3	2
CO5	3	3	2	1	-	-	-	-	-	-	1	1	3	3	2

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Gandipet, Hyderabad-75

20EE E32

POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS

(Semester-VI - Program Elective-III)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Power Electronics

Course Objectives:

1. To Understand the different types of Non-Conventional Energy Sources.
2. To Explore the issues with grid integration of Renewable Energy Sources.
3. To Familiarize concepts on Fuel-Cell and Hybrid Energy Storage Systems

Course Outcomes:

1. Acquaint with different renewable energy sources
2. Understand different techniques of Power extraction from Solar and Wind energy systems
3. Modelling of generator, turbine and suitable converters for a RES and energy storage systems.
4. Understand the concepts and working with fuel-cell for efficient energy system.
5. Understand necessity and functioning of Hybrid Energy storage system.

UNIT-I:

Introduction to Renewable Energy Systems: Wind power, Hydropower, Solar energy-Biomass, Bio-fuel, Geothermal Heat energy, Solar-thermal plants, Applications.

UNIT-II:

Solar Energy: Introduction to PV-Cells, Array, Solar power extraction using PV-Cells, I-V Characteristics, PV-Inverters without D.C. to D.C. converters, Grid interfacing-with isolation, without isolation, Maximum power point tracking - Methods, PV- Inverters with D.C. to D.C. converters-on low frequency side and high frequency side with isolation, without isolation.

UNIT-III:

Wind Energy: Sources and potentials, Evaluation of Wind Intensity, Topography, General Classification of Wind Turbines and Technologies, Speed control methods Wind Power, Fixed speed with capacitor bank, Rotor resistance control, Synchronous Generator-external magnetized, Synchronous Generator-permanent magnets.

UNIT-IV:

Fuel Cells: Fuel cells, Commercial Technologies for Generation of Electricity, Constructional Features ofSolid Oxide Fuel Cells, Constructional Features of Proton Exchange Membrane Fuel Cells, Advantages and Disadvantages of Fuel Cells, Application of DC Converters in Fuel Cell Systems: Single stage topology, Multi-stage topology.

UNIT-V:

Hybrid Energy Systems: Need for Hybrids systems, range and type of hybrid systems, hybridization of solar, wind and fuel cell, battery manage system. Conventional and recent developments in Energy/battery management schemes.

Text Books:

1. S. N. Bhadra, D. Kastha, S. Banerjee, “Wind Electrical Systems”, Oxford University Press, 2005.
2. D. Yogi Goswami , “Principles of Solar Engineering” 3rd Edition, , CRC Press, 2015.
3. Yves Brunet, “Energy Storage", Wiley-ISTE, 1st Edition, 2010

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Suggested Reading:

1. Nikos Hatziargyiou, "Microgrids: Architectures and Control" ISBN: 978-1-118-720684,Wiley-IEEE Press, December2013.
2. Roger Messenger, Amir Abtahi, "Photovoltaic Systems Engineering", 3rd edition, CRC Press, 2010
3. B. H. Khan Non-conventional Energy sources Tata Mc-Graw-hill Publishing Company, New Delhi,2009.
4. Robert A.Huggins, "Energy Storage", Springer, 2nd Edition, 2015.

CO-PO & PSO Correlation Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	-	-	-	-	-	1	1	3	3	2
CO2	3	3	2	1	-	-	-	-	-	-	1	1	3	3	2
CO3	3	3	2	1	-	-	-	-	-	-	1	1	3	3	2
CO4	2	2	2	1	-	-	-	-	-	-	1	1	3	3	2
CO5	2	2	2	1	-	-	-	-	-	-	1	1	3	3	2

"Think like a wise man but communicate in the language of the people."

-William Butler Yeats

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20EE E33

With effect from the academic year 2022-23

UTILIZATION OF ELECTRICAL ENERGY

(Semester-VI - Program Elective-III)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. Understand the adaptability of heating and welding concepts for a given application
2. Know the necessity of illumination for specified requirement
3. Know selection of proper traction system and its corresponding drive for industrial applications

Course Outcomes: After completion of this course, students will be able to:

1. Acquire knowledge about electric heating concepts for a given application
2. Understand principles of welding concepts for a given application
3. Familiar with principles of illumination concepts
4. Identify the necessity of illumination and luminaries for specified requirement
5. Select proper traction system and its corresponding drive for industrial applications
6. Able to estimate energy consumption levels at various modes of operation.

UNIT-I

Electric Heating: Introduction, Classification of electric heating Advantages of electrical heating, Properties of good heating material, Different types of heating material, Causes of failure of heating element, Design of heating element, Numerical Problems

Power frequency heating Methods: Resistance heating- Direct resistance heating, Indirect resistance heating, Infrared or radiant heating, Electric arch eating- Direct arch eat, Indirect arc heating

High frequency heating Methods: Induction heating- Direct induction heating, indirect induction heating - Di electric heating.

UNIT-II

Electric Welding: Introduction, Classification of Welding Processes, Formation and Characteristics of Electric Arc, Electrodes for Metal Arc Welding, Advantages of Coated Electrodes, Types of Joints

Principle of Electric Arc welding: Advantages and disadvantages of electric welding, Electric Arc welding methods:Carbon Arc Welding, Submerged Arc Welding, Atomic Hydrogen Welding.

Principle of Resistance Welding: Advantages and disadvantages of Resistance Welding, Spot Welding, Seam Welding, Projection Welding, Butt Welding, Flash Butt Welding, Upset Welding, Electron Beam Welding, Laser Welding

UNIT-III

Illumination: Introduction, Terms used in illumination, laws of illumination, Polar Curves of C.P. Distribution – Determination of M.S.C.P. and M.H.C.P. from Polar Diagrams- Rousseau's construction, Design of Lighting Schemes for different applications- Numerical Problems

Electric Lamps: Incandescent lamps, Fluorescent lamps, CFL, LED, Mercury vapor lamps

UNIT-IV

Electric Traction-I: Introduction, Systems of electric traction and track electrification- DC system, single phase and 3- phase low frequency and high frequency system, composite system, k and o system, comparison between AC and DC systems- Train Movement-Typical Speed/Time Curve - Factors affecting scheduled speed - Simplified Speed/Time Curve - Average and Schedule Speed- Tractive Effort for Propulsion of a Train - Power Output from Driving Axles - Energy Output from Driving Axles - Numerical Problems.

UNIT-V

Electric Traction-II: Specific Energy Output - Evaluation of Specific Energy Output - Energy Consumption - Energy Consumption - Adhesive Weight – Coefficient of Adhesion – Mechanism of Train Movement – Num Problems

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Text Books:

1. C L Wadhwa, Generation, Distribution and Utilization of Electrical Energy- 3 rd Edition New age international publishers,2015.
2. B.L. Theraja, A Textbook of Electrical Technology Volume-III Transmission and Distribution S. Chand Limited, 23rd Edition, 2013.
3. Partab H, Art and Science of Utilization of Electric power, Dhanpatrai & Sons, 2014

Suggested Reading:

1. J.B.GUPTA, Utilization of Electric Power and Electric Traction- S.K.Kataria & Sons, 2013.
2. R K. Rajput, Utilization of Electrical Power-, 2 nd Edition, Laxmi Publications (p) Ltd, 2016.

CO-PO & PSO Correlation Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	1	-	-	-	-	-	-	-	-	-
CO2	3	2	-	1	-	1	-	-	-	-	-	-	-	-	1
CO3	2	2	-	-	-	2	-	-	-	-	-	-	-	1	-
CO4	2	2	-	1	-	2	-	-	-	-	-	-	-	1	-
CO5	3	2	1	1	-	2	-	-	-	-	-	1	-	-	2
CO6	3	2	2	2	-	2	-	-	-	-	-	1	-	1	2

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Gandipet, Hyderabad-75

20 EE E34

POWER QUALITY ENGINEERING

(Semester-VI - Program Elective-III)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic knowledge in power systems and power electronics

Course Objectives:

1. Understand the Power Quality(PQ) standards and its monitoring concepts
2. Understand PQ issues and sources of harmonics in Industrial systems and its mitigation.
3. Understand the problems and solutions to wiring and Grounding

Course Outcomes: After completion of this course, students will be able to:

1. Illustrate the basic concepts of power quality issues and power quality monitoring, standards and measuring instruments.
2. Determine the voltage sag magnitude in radial, Non-radial and Meshed systems
3. Analyze voltage sags effect on three-phase AC- Adjustable speed drive (ASD), DC- Adjustable speed drive (ASD) for industrial applications.
4. Identify the sources of harmonics and its mitigation techniques in industrial systems.
5. Discuss the protection devices for transient over voltages and solutions for Wiring and Grounding problems

UNIT-I

Power Quality problems in distribution systems: Voltage Sag, Swells, Interruptions, and Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations, flicker and its measurement. Tolerance of Equipment: CBEMA curve. Power quality monitoring, standards and measuring instruments.

UNIT-II

Voltage Sags-Characterization: Voltage Sag Magnitude, Sag Magnitude in Radial and Non-Radial Systems, Voltage sag Calculations in Meshed Systems.

UNIT-III

PQ Consideration in Industrial Power Systems: Adjustable speed drive (ASD) systems and applications, Characterization of voltage sags experienced by three-phase AC-ASD, DC-ASD systems, Effects of momentary voltage dips on the operation of induction and synchronous motors.

UNIT-IV

Harmonics: Sources of power system harmonics, Harmonic distortion, Harmonic Indices, Odd and Even Order Harmonics, Causes of Voltage and Current Harmonics, Locating Harmonic sources, Effect of Harmonics on Power System Devices, Mitigation of harmonics.

UNIT-V

Transient Over-voltages & Wiring and Grounding: Sources of Transient Overvoltage's, Principles of Overvoltage Protection Devices, Definitions, Reasons for Grounding and wiring, Typical Wiring and Grounding Problems, Solutions to Wiring and Grounding Problems.

Text Books:

1. C.Sankaran, 'Power Quality', CRC Press, 2001.
2. R. SastryVedam, M. Sarma, "Power Quality- Var Compensation in Power Systems ", CRC Press, 2009.

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Suggested Reading:

1. Math H.J. Bollen, 'Understanding Power Quality Problems', IEEE Press, 2000.
2. Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H. Wayne Beaty, 'Electrical Power Systems Quality', 3rd Edition,Tata McGraw-Hill, 2012.

CO-PO-PSO Correlation Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1
CO2	3	2	3	1	1	-	-	-	1	2	2	-			
CO3	3	3	2	-	3	1	1	2	1	2	2	-	-	3	3
CO4	3	3	3	3	1	1	1	1	1	1	-	-	-	2	1
CO5	3	2	3	1	1	-	1	1	1	1	-	-		2	1

"Whenever you see a successful business, know that someone once made a courageous decision."

-Peter F.Drucker

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20EE E35

ADVANCED ELECTRICAL DRIVES

(Semester-VI - Program Elective-III)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Electrical Drives, Microprocessors, Control Systems

Course Objectives::

1. To understand the principles of commutation in converters and study the performance, stability and control aspects of DC motors and Induction motors.
2. To understand the microprocessor-based control of electric drives
3. To study the working principles and control aspects of special motors: Brushless DC motor, Switched Reluctance Motor drives.

Course Outcomes: After completion of this course, students will be able to:

1. Identify and consider the requirement of power converters for a given application.
2. Illustrate the digital methods of DC motor speed control techniques.
3. Show how the changes effect in different speed control schemes of Induction motor.
4. Analyse the performance of Synchronous motor with and without sinusoidal supply.
5. Recognize and formulate problems encountered by special motor drives for a particular application.

UNIT-I

Review of Power Converters: Overview of Power converters in Electric Drives, Commutation in Thyristor power converters, Principle of natural commutation and forced commutation, Discontinuous conduction in converters, DC choppers, Force commutated inverters, Frequency conversion. Inverter voltage control, Harmonic neutralization, Voltage controller.

UNIT-II

DC Drives: General considerations, Evaluation of a dc drive performance Forced commutation schemes to improve the performance of the drives, Steady-State Analysis of the Three-Phase Converter Controlled rectifiers, Steady-state analysis of chopper-controlled dc motors, Closed-loop control of solid-state DC drives, DC motor speed control using ma microprocessor (Block Diagram and Flowchart Approach only)

UNIT-III

Induction Motor Drive: Speed control of IM, Analysis of IM on non-sinusoidal voltage waveforms, Scalar and vector control of induction motor, Direct torque and flux control of induction motor, Analysis of CSI fed IM, Performance of CSI fed IM, Static slip energy recovery schemes employing Converter cascades in the rotor circuit Dynamic behavior and stability of Variable frequency IM, Induction motor speed control using a microprocessor (Block Diagram and Flowchart Approach only).

UNIT-IV

Synchronous Motor Drive: Analysis of SM fed from non-sinusoidal supplies, Performance of SM on non-sinusoidal voltages, Performance of CSI fed SM, Marginal angle control of SM, stability of SM on non-sinusoidal supplies, Self-controlled synchronous motor drive, Vector control of the synchronous motor, Synchronous motor speed control using a microprocessor (Block Diagram and Flowchart Approach only).

UNIT-V

Special Motor Drives: Introduction to various special motor drives. Switched reluctance motor-drive construction, Working principle, Normalized torque-speed characteristics, Speed Control Schemes, Brushless DC Motor–construction, Working principle, Torque-speed characteristics, Speed Control Schemes, Permanent magnet motor drives, Solar Powered Drive-motors suitable for pump drives, solar-powered pump drives, Battery Powered Drives-battery powered current status and scope for growth.

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Text Books:

1. Vedam Subramanyam, 'Thyristor Control of Electric Drives', Tata McGraw Hill Publishing Co., New Delhi,1987.
2. G.K.Dubey, Fundamentals of Electrical Drives; Narosa Publishing House, 1995.
3. P.S.Bimbra, Generalised theory of Electrical Machines, Khanna Publication, 2006.

Suggested Reading:

1. R. Krishnan, 'Electric Motor Drive: Modeling, Analysis and Control' Prentice Hall of India, 2001.
2. B.K.Bose, 'Power Electronics and AC Drives', Prentice Hall, 2002

CO-PO-PSO Correlation Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	1	2	1	2	-	1	-	2	1	2
CO2	3	3	2	1	2	1	-	-	-	-	-	-	-	1	2
CO3		1	1	2	-	-	1	-	-	-	-	-	-	1	1
CO4	3	3	1	1	-	-	-	-	-	-	-	-	1	2	2
CO5	3	2	3	3	2	1	1	-	-	-	-	-	-	2	3

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20EE E36

DIGITAL SIGNAL PROCESSING

(Semester-VI - Program Elective-III)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Students should have basic knowledge of Signals and Systems.

Course Objectives:

1. To understand the re presentation of signals mathematically in continuous, discrete time and frequency domain
2. To analyse the discrete time systems using Z-transforms, Discrete-Fourier Transform (DFT) and the FFT algorithms
3. To design IIR and FIR digital filters for various applications.

Course Outcomes: After completion of this course, students will be able to:

1. Represent signals mathematically in continuous and discrete-time, and in the frequency domain
2. Analyse discrete-time systems using z-transform
3. Analyse the Discrete-Fourier Transform (DFT) and FFT algorithms
4. Design digital IIR filters
5. Design digital FIR filters.

UNIT-I

Discrete-time signals and systems: Sequences, representation of signals, classification of discrete time systems, Representation of discrete systems using difference equations, Sampling and reconstruction of signals, aliasing, Sampling theorem and Nyquist rate.

UNIT-II

Z-transform: Region of Convergence, Analysis of Linear Shift Invariant systems using z-transform, Properties of Z-transform for causal signals, Interpretation of stability in z-domain, Inverse z-transforms. Implementation of Discrete Time Systems (Direct Form-I, Direct Form-II, Cascade and Parallel).

UNIT-III

Discrete Fourier Transform: Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform (FFT) Algorithm, Parseval's Identity..

UNIT-IV

IIR Filters: Design of Butterworth and Chebyshev filters, IIR filter design by Impulse Invariant and Bilinear Transformation Techniques, Step Invariance Method.

UNIT-V

FIR Filters: Characteristics of FIR Digital Filters. Frequency response, comparison of FIR and IIR filters, Window techniques, Design of these filters using Rectangular, Hamming, Bartlet, Kaiser windows, Architecture and features of TMS 320F/2047 and ADSP signal processing chips, Applications of DSP.

Text Books:

1. S. K. Mitra, "Digital Signal Processing: A computer based approach", McGraw Hill, 2011.
2. A.V. Oppenheim and R. W. Schafer, "Discrete Time Signal Processing", Prentice Hall, 1989.
3. J. G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", Prentice Hall,1997.
4. B. Venkataramani, M. Bhaskar, "Digital Signal Processo1; Architecture, Programming & Application", Tata McGrawHill-2004

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Suggested Reading:

1. Anand kumar A, Digital Signal Processing, Second edition PHI learing, 2015
2. L. R. Rabiner and B. Gold, "Theory and Application of Digital Signal Processing", Prentice Hall,1992.
3. J. R. Johnson, "Introduction to Digital Signal Processing", Prentice Hall, 1992.
4. D. J. DeFatta, J. G. Lucasand W. S. Hodgkiss, "Digital Signal Processing", John Wiley& Sons,1988.

CO-PO & PSO Correlation Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	-	-	-	-	-	1	1	1	1	-
CO2	2	3	3	2	1	-	-	-	-	-	2	1	1	2	-
CO3	2	3	3	2	1	-	-	-	-	-	2	2	2	3	1
CO4	2	2	2	2	1	-	-	-	-	-	2	2	2	1	2
CO5	2	2	2	1	1	-	-	-	-	-	2	2	2	1	2

"Happiness and moral duty are inseparably connected."

-George Washington

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20EG M01

INDIAN CONSTITUTION & FUNDAMENTAL PRINCIPLES

(Semester-VI)

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	--
CIE	--
Credits	NC

Course Objectives : The course will introduce the students to:

1. History of Indian Constitution and howit reflects the social, political and economic perspectives of the Indian society.
2. Growth of Indian opinion regarding modern Indian intellectuals constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism
3. Various Organs of Governance and Local Administration.

Course Outcomes : After successful completion of the course the students will be able to:

1. Understand the making of the Indian Constitution and its features.
2. Identify the difference among Right To equality, Right To freedom and Right to Liberty.
3. Analyze the structuring of the Indian Union and differentiate the powers between Union and States.
4. Distinguish between the functioning of Lok Sabha and Rajya Sabha while appreciating the importance of Judiciary.
5. Differentiate between the functions underlying Municipalities, Panchayats and Co-operative Societies.

UNIT-I

Constitution of India: Constitutional history-Govt of India Act 1909, 1919 and 1935, Constitution making and salient features. Directive Principles of State Policy- Its importance and implementation.

UNIT-II

Scheme of the Fundamental Rights & Duties: The Fundamental Rights - To Equality, to certain Freedom under Article 19, to Life and Personal Liberty Under Article 21. Fundamental Duties - the legal status.

UNIT III

Union Government and its Administration - Structure of the Indian Union: Federalism, distribution of legislative and financial powers between the Union and the States.
Parliamentary form of government in India: Executive-President's role, power and position.

UNIT IV

Legislature and Judiciary: Central Legislature-Powers and Functions of Lok Sabha and RajyaSabha.
Judiciary: Supreme Court-Functions, Judicial Review and Judicial Activism

UNIT V

Local Self Government - District's Administration Head (Collector): Role and Importance. Municipalities & Municipal Corporations: Introduction, Chairperson/Mayor, Commissioner and Role of Elected Representatives. Panchayati Raj: Introduction, Zilla Panchayat, Chairperson, CEO, Elected Officials and their roles. Block/Mandal level: Organizational Hierarchy(Different departments). Village level: Role of Elected and Officials.

Text Books:

1. Indian Government & Politics, Ed Prof V Ravindra Sastry, Telugu Akademy, 2nd edition, 2018.
2. Indian Constitution at Work, NCERT, First edition 2006, Reprinted- January 2020.

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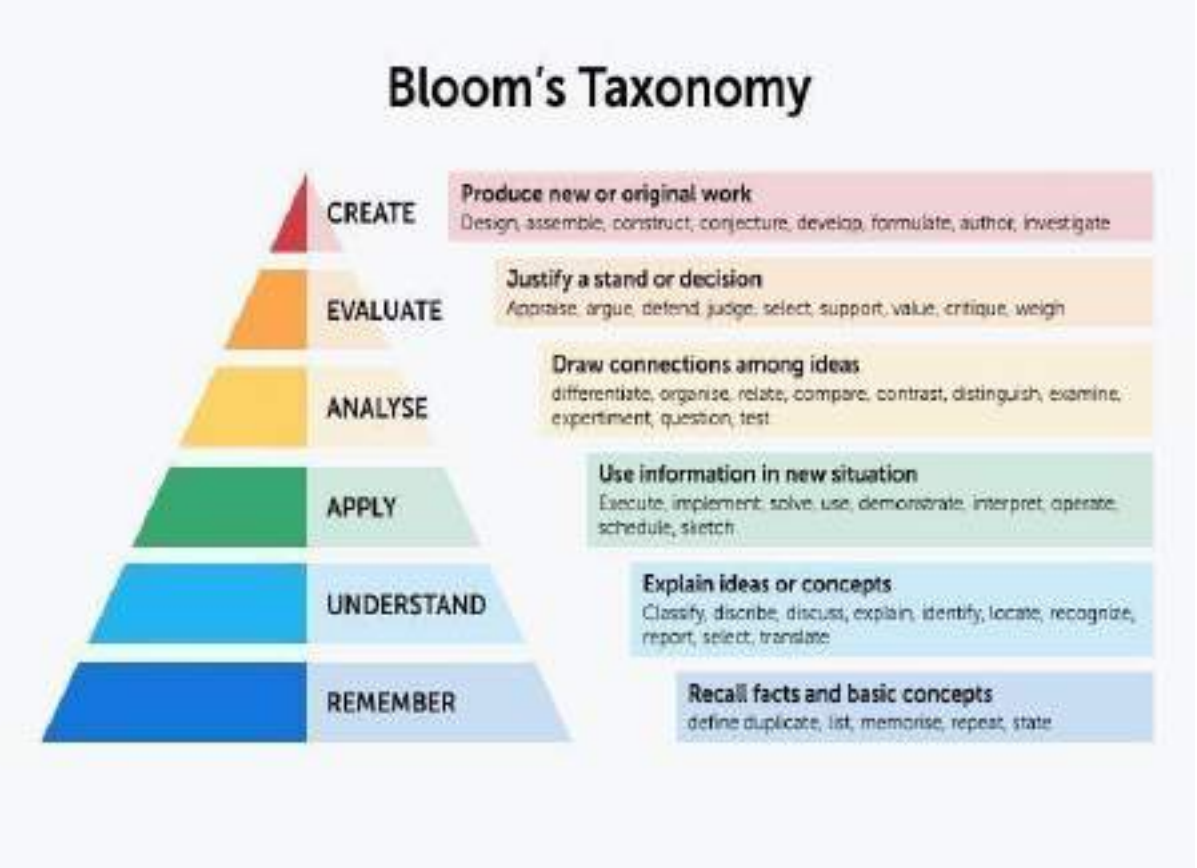
Suggested Reading:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, Framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction tothe Constitution of India, Lexis Nexis, 2015.

Online Resources:

1. http://www.nptel.ac.in/courses/103107084/Script.pdf



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20EE C28

POWER SYSTEMS LAB

(Semester-VI)

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Power systems-I, Power systems-II, Switchgear and Protection

Course Objectives: The objective of the course is to

1. Determine regulation & efficiency of short, medium and long transmission lines and to calculate A, B,C and D constants .
2. Understand the importance of protective relays in power system such as different protection of Transformer, IDMT Characteristics of over current relay and static relays.
3. Understand steps involved in finding sequence parameter of Transformers and Alternators.
4. Determinedielectric strength of Transformer oil, sting efficiency and Fault location of Underground cables cable

Course Outcomes: After completion of the course student will be able to

1. Calculate ABCD constants of transmission lines and evaluate regulation and efficiency.
2. Examine relay setting and compensation techniques for safe operating of power system.
3. Identity sequence parameters of transformer and alternator and discuss its importance.
4. Calculate the time constant, perform Fault Analysis of an Alternator and Identify Fault location of an Underground Cable.
5. Determine the dielectric strength of transformer oil and calculate the efficiency of string insulators of a transmission line.

List of Experiments

1. Determination of regulation & efficiency of 3-Phasetransmission lines.
2. IDMT characteristics of Over-current relay.
3. Determination of A, B, C, D constants of 1-Phasetransmissionline.
4. Differential protection of 1-phase transformer.
5. Sequence impedance of 3-PhaseAlternators by fault Analysis.(LG,LL & LLL)
6. Determination of positive, negative and zero-sequence impedance of 3 – Phase transformers.
7. Determination of Synchronous machine reactance and Time constant from 3-Phase S.C test.
8. Determination of dielectric strength of Transformer oil and Megger.
9. Characteristics of Static Over current Relays.
10. Measurement of capacitance of 3-corecables.
11. Determination of positive, negative and zero-sequence impedance of 3 phase Alternator.
12. Determination of Voltage distribution and String efficiency of string of Insulators.
13. Study of Series-shunt compensation of a long transmission line.
14. Fault location of Underground cables.
15. Visiting nearby substation and submitting there port

Note: At least TEN experiments should be completed in the semester.

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CO-PO & PSO Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	1	2	1	1	2	-	-	-	1	-	1	2	-	1
CO2	3	2	2	1	1	1	-	-	-	1	-	1	2	-	1
CO3	3	2	2	1	1	1	-	-	-	1	-	1	2	-	1
CO4	3	2	2	1	1	1	-	-	-	1	-	1	2	-	1
CO5	3	2	2	1	1	1	-	-	-	1	-	1	2	-	1

"Every defeat, every heartbreak, every loss, contains its own seed, its own lesson on how to improve your performance, the next time."

-Malcolm X

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20EE C29

Electrical Simulation Lab

(Semester-VI)

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Electrical Circuit Analysis, Control Systems, Power Systems, Power system Operation and Control, Artificial Intelligence Techniques.

Course Objectives:

1. To understand the time and frequency response of the system
2. To understand the load flows, transient stability studies, economic load dispatch and load frequency control in power system
3. To understand the soft computing techniques

Course Outcomes: After completion of this course, students will be able to:

1. Analyze the DC and AC circuits
2. Demonstrate the time and frequency response of the system
3. Perform Load flow studies and economic load dispatch
4. Conduct Load frequency control and transient stability studies
5. Realize the Electrical operations using ANNs and Heuristic Techniques.

List of Experiments:

1. Verification of Basic Theorems 2.Timeresponse of R, L, C circuits.
3. Determination of power angle diagram for Salient and Non-salient pole synchronous machine.
4. Time Domain Analysis of LTI Systems
5. Effect of PID Controllers
6. Stability Analysis of Unity Feedback Control Systems
7. Computation of line parameters
8. Modeling of Transmission Lines
9. Load Flow Studies.
10. Fault Analysis.
11. Transient stability studies.
12. Economic load dispatch.
13. Load Frequency control of single-area and two-area systems
14. Determination of Load Flows using ANNs
15. Economic Load Dispatch using Genetic Algorithm

Note: At least TEN experiments should be conducted in the Semester

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CO-PO & PSO Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	2	-	-	-	1	-	1	2	-	1
CO2	3	2	2	1	1	1	-	-	-	1	-	1	2	-	1
CO3	3	2	2	1	1	1	-	-	-	1	-	1	2	-	1
CO4	3	2	2	1	1	1	-	-	-	1	-	1	2	-	1
CO5	3	2	2	1	1	1	-	-	-	1	-	1	2	-	1

"I never had a policy; I have just tried to do my very best each and every day."

-Abraham Lincoln

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20EE C30

ELECTRICAL DRIVES LAB

(Semester-VI)

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Power Electronics, Machines Theory, and labs.

Course Objectives:

1. To experiment and analyze the motor performance connected with power semi conductor source.
2. To be familiar with different speed control techniques of Drives.
3. To validate the experiment all results with simulations.

Course Outcomes: After completion of this course, Students will be able to:

1. Analyze the control strategies to modify the output parameters of dc and ac drives.
2. Develop, testing and experimental procedures by applying basic knowledge in electrical and electronics.
3. Demonstrate the principle of energy efficient motors by load matching.
4. Interpret the performance of a given drive by suitable experimentation.
5. Investigate the performance of a given drive by using suitable simulation software.

LIST OF EXPERIMENTS

PART-A

1. Speed control of DC drive using Thyristor controlled rectifier.
2. Speed control of DC drive using DC-DC Chopper.
3. Four-Quadrant Operation of DC drive.
4. Closed loop speed control of DC motor using PID controller.
5. Speed control of single-phase induction motor speed using TRIAC.
6. Speed control of Three-Phase Induction Motor using V/f control.
7. Speed Control of Three-Phase Induction Motor using AC-AC converter.
8. Regenerative/Dynamic braking operation for AC drive.

PART-B

1. Simulation of Speed control of DC Motor using BJT-H bridge.
2. Simulation of Regenerative/ Dynamic breaking operation of DC motor.
3. Simulation of Step/ Ramp speed response of DC motor.
4. Simulation of VSI-fed3-PhaseInduction Motor drive.
5. Simulation of CSI-fed3-PhaseInduction Motor drive.
6. Simulation of Permanent Magnet synchronous motor drive.
7. Simulation of speed control of Permanent Magnet synchronous motor using V/f control method.

Note: Any Six experiments from Part-A and Four from Part-B should be performed

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CO-PO & PSO Correlation Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	-	-	-	-	3	1	1	2	3	3	1
CO2	2	3	1	2	-	-	-	-	3	1	1	2	3	3	1
CO3	2	2	1	2	-	-	-	-	3	1	1	1	3	3	1
CO4	2	2	1	2	-	-	-	-	3	1	1	1	3	3	1
CO5	2	3	1	3	1	-	-	-	3	1	1	2	3	3	1

"Effective leadership is putting first things first. Effective management is discipline, carrying it out."

-Stephen Covey

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20EEC31

IoT Lab

(Semester-VI)

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisites: Students should have prior knowledge on basic understanding of C programming language,understanding the IoT technologies and standards.

Course Objectives:

1. To understand fundamental connectivity schemes of Arduino / RaspberryPi boards
2. To understand the recent application domains of IoT in every day life
3. To interface external objects with Arduino / Raspberry Pi
4. To develop programming skills, application development and prototyping using Arduino/ Raspberry Pi.

Course outcomes: After completion of this course, students will be able to:

1. Understand use of Arduino / RaspberryPi board circuit
2. Implement interfacing of various sensors with Arduino /Raspberry Pi
3. Demonstrate the abilityto transmit data wirelessly between different devices
4. Show an ability to upload/download sensor data on cloud and server
5. Analyze basic protocols in wireless sensor network

List of Experiments

1. Interfacing of Raspberry Pi with existing system components
2. Characteristics of p-n junction diode, Zener diode and Light Emitting Diode (LED) using Arduino IDE
3. Design of half wave rectifier using Arduino /Raspberry Pi
4. Temperature measurement using Arduino /Raspberry Pi
5. Distance measurement using Arduino /RaspberryPi
6. Stopwatch control using Arduino / Raspberry Pi
7. Traffic Light Controller using Arduino /Raspberry Pi
8. Dark Sensing LED using Arduino/Raspberry Pi
9. Design of digital dc voltmeter and ammeter using Arduino /Raspberry Pi
10. Design of digital ac voltmeter and ammeter using Arduino / Raspberry Pi
11. Measurement of power and energy using Arduino / Raspberry Pi
12. Speed control of dc motor using Arduino / Raspberry Pi
13. Monitoring of temperature and humidity in PC screen using Raspberry Pi
14. Interfacing of motor using relay with Arduino /Raspberry Pi and write a program to turn ON motor when push button is pressed
15. Interfacing of Bluetooth with Arduino /Raspberry Pi and write a program to send sensor data to smart phone using Bluetooth
16. Uploading of temperature and humidity data from Arduino/Raspberry Pi to thing speak cloud
17. Retrieval of temperature and humidity data from thing speak cloud to Arduino/Raspberry Pi

Note: At least TEN experiments from above should be conducted in the semester

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CO-PO and CO-PSO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	2	1	-	-	-	-	-	3	2	1	-
CO2	3	3	3	3	3	2	-	-	3	3	1	3	3	2	-
CO3	3	3	3	3	3	2	-	-	3	3	1	3	3	2	-
CO4	3	3	3	3	3	2	-	-	3	3	1	3	3	2	-
CO5	3	3	3	3	3	2	-	-	3	3	1	3	3	2	-

"Talent is what God gives us,
Skill is what we give back to Him."

-Eliel Pierre

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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY(A)

AICTE MODEL CURRICULUM

B.E. (ELECTRICAL AND ELECTRONICS ENGINEERING)

SEMESTER-VII

Sl. No.	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			
			Hours per week			Duration in Hours	Maximum Marks		Credits
			L	T	P		CIE	SEE	
THEORY									
1	**18EEC25**	Power System Protection	3	-	-	3	30	70	3
2	**18EEC26**	Electrical Drives	3	-	-	3	30	70	3
3	**18EEC27**	Signals & Systems	3	-	-	3	30	70	3
4	**18EEEXX**	Core Elective-5	3	-	-	3	30	70	3
5	**18XXOYY**	Open Elective-2	3	-	-	3	30	70	3
PRACTICALS									
6	**18EEC28**	Power Systems-II Lab	-	-	3	3	25	35	1.5
7	**18EEC29**	Electrical Drives Lab	-	-	3	3	25	35	1.5
8	**18EEC30**	Project: Part-1	-	-	4	-	50		2
		Total	**15**	**-**	**10**	**21**	**250**	**420**	**20**

L: Lecture T: Tutorial P: Practical

CIE - Continuous Internal Evaluation SEE - Semester End Examination

Course Code	Core Elective-5
18EEE17	Power System Dynamics and Control
18EEE18	Switch Mode Power Converters
18EEE19	Electrical Machine Design
18EEE20	High Voltage Engineering

Course Code	Open Elective-2
18MEO03	Research Methodologies
18MEO04	Entrepreneurship
18EGO01	Technical Writing Skills
18CSO04	Basics of Data Science using R
18CSO07	Basics of Cyber Security

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AICTE MODEL CURRICULUM

B.E. (ELECTRICAL AND ELECTRONICS ENGINEERING)

SEMESTER-VIII

Sl. No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			
			Hours per week			Duration In Hours	Maximum Marks		Credits
			L	T	P		CIE	SEE	
THEORY									
1.	**18EEEXX**	Core Elective-6	3	-	-	3	30	70	3
2.		Open Elective-3	3	-	-	3	30	70	3
PRACTICALS									
3.	**18EEC31**	Technical Seminar	-	-	2	-	50	-	1
4.	**18EEC32**	Project: Part-2	-	-	20	Viva voce	100	100	10
		Total	**6**		**22**		**210**	**240**	**17**

L: Lecture T: Tutorial P: Practical
CIE - Continuous Internal Evaluation SEE - Semester End Examination

Course Code	Core Elective-6
18EEE21	Advanced Electric Drives
18EEE22	Digital Signal Processing
18EEE23	Smart Grid
18EEE24	Digital Control System

Course Code	Open Elective-3
18MEO07	Intellectual Property Rights (IPR)
18CEO02	Disaster Mitigation and Management (DMM)
18ITO02	Python Programming
18EGO02	Gender Sensitization
18PY O01	History of Science and Technology

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VII – SEMESTER

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18EEC25 **POWER SYSTEM PROTECTION**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. To analyze principles of operation of the different Protection Devices.
2. To understand the different protection schemes employed in the protection of power system
3. To acquire knowledge of Numerical Protection Algorithm

Course Outcomes: After completion of this course, students will be able to

1. Understand basic terminology of relays and types of over current protection of power system.
2. Distinguish the type of distance protection with principle & their application to three phase transmission lines.
3. Choose suitable differential scheme for the protection of various equipment in electrical power system.
4. Describe the principle of operation, and able to calculate the ratings of circuit breakers.
5. Familiarize with different protection methods against over-voltages.
6. Identify various elements of numerical relays, their functions and different techniques used in their design.

UNIT-I

Introduction to Protection Schemes: Need for protection, Backup protection, Zones of protection, Definitions of relay pickup, dropout and reset values, Classification of relays, Operating principles and construction of electromagnetic and induction relays.

Overcurrent Protection: Time-current characteristics, current settings, time settings, overcurrent protection schemes, direction relay, applications of Definite Time, IDMT and Directional relays distribution feeders, Earth fault and phase fault protection schemes, directional earth fault relay, static over current relay, fuse characteristics, types of fuses

UNIT-II

Distance Protection: Introduction, Impedance relay, reactance relay, MHO relay, effect of arc resistance and Power Swings on the performance of Distance Relaying, Selection of distance relays, Three-stepped Distance protection, Comparison of different distance protection schemes, Distance protection of three-phase lines.

UNIT-III

Differential protection: Introduction, simple differential protection, zone of differential protection, Percentage differential relay, Earth-leakage protection, Percentage Differential Protection of Transformers, Differential protection of transformer against Inrush phenomenon, Inter-turn faults in transformer. Differential protection of Bus-bars, Internal and External faults, Protection of Three-phase bus bars. Introduction to the Basic protection of Generator and Induction Motors

UNIT-IV

Circuit Breakers: Arc interruption, restriking voltage, recovery voltage, RRRV, current chopping, resistance switching, classification of circuit breakers, selection of circuit breakers

Over voltage protection: causes for over voltages, protection of transmission lies against direct lightning strokes, ground wires, arcing horns, lightning arrestors, surge absorbers, Peterson coils, insulation coordination

UNIT-V:

Basics of Numerical Protection: Block diagram of numerical relay, Sampling theorem, Least Error Square Technique, Digital Filtering, Numerical Relaying for overcurrent, Differential and distance protection (Elementary Treatment).

Text Books:

1. Badriram& Viswakarma, "Power System Protection and Switchgear", Tata McGraw Hill, 2011
2. Y.G. Paithankar & S.R. Bhide, "Fundamentals of power system protection", Prentice Hall, India, 2010.

Suggested Readings:

1. T.S.Madhava Raao, Power System Protection: Static Relays, Tata McGraw-Hill Education 1989
2. P.M.Anderson, Power System Protection, John Wiley, 2012
3. Electricity Training Association, Power System Protection. Vol.2.: Systems and Methods, Institute of engineering and Technology, 1995

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18EEC26 **ELECTRICAL DRIVES**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. To Understand the characteristics of various Electric Drives and its control using different power electronic converter circuits
2. To apply and analyse the concept of speed control DC motor drives with single phase, three phase converters and choppers.
3. To apply and analyse the concept of speed control induction motor by using AC voltage controller, VSI, CSI and cyclo-converter.
4. To apply and analyse the concept of speed control of synchronous motors using VSI, CSI and cyclo-converter.

Course Outcomes: After completion of this course, students will be able to:

1. Analyze 1-Φ & 3-Φ converters fed DC motors as well as chopper fed DC motors.
2. Understand the operational variance between single and multi-quadrant operation of various Electric Drives.
3. Comprehend the speed control of an AC-AC & DC-AC converter fed induction motor on stator and rotor side.
4. Illustrate the principles of speed control of synchronous motor with VSI, CSI and cyclo-converter.
5. Differentiate the features of closed loop operation of DC and AC electric drive and their controllers

UNIT-I

Electric Drive: Introduction, Block diagram and parts of electric drive

Dynamics of Electrical Drives: Types of Load- Types and Characteristics of load torque – Dynamics of motor-load combination – steady state & transient stability of an electrical drive.

Phase control converters fed DC drivers: Review of speed control techniques of DC motors, Single Phase and Three-phase semi and fully controlled converters connected to DC separately excited and DC series motors– continuous current mode of operation, output voltage and current waveforms, Speed and Torque expressions, Speed- Torque Characteristics. Problems on Converter fed DC motors.

UNIT –II

Four quadrant operation of DC drive: Introduction to four quadrant operation, motoring operation, electric braking – Plugging, Dynamic and regenerative braking operations. Four quadrant operation of D.C motors by dual converters – Closed loop operation of DC motor

UNIT –III

Chopper fed DC drives: Single, two and four quadrant chopper fed dc separately excited and series excited motors– continuous current operation, output voltage and current wave forms, speed torque expressions, speed torque characteristics, Problems on Chopper fed DC Motors, closed loop operation.

UNIT-IV

Induction Motor Drives-1: Variable voltage characteristics–Control of Induction Motor by AC Voltage Controllers – Waveforms –Speed torque characteristics, Variable Voltage Variable Frequency control of induction motor by voltage source inverter (VSI), current source inverter (CSI) and cyclo-converters, Comparison of VSI and CSI, closed loop operation of induction motor drives.

UNIT-V

Induction Motor Drives-2: Static rotor resistance control, closed loop speed control with static rotor resistance control, Slip power recovery schemes–Static Scherbius drive, Static Kramer Drive and their performance, speed torque characteristics.

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Gandipet, Hyderabad-75

Text Books:

1. G. K. Dubey, “Power Semiconductor Controlled Drives”, Prentice Hall, 1989.
2. R. Krishnan, “Electric Motor Drives: Modeling, Analysis and Control”, Prentice Hall, 2001.
3. M.H.Rashid, “Power Electronic Circuits, Devices and applications”, PHI.

Suggested Reading:

1. G. K. Dubey, “Fundamentals of Electrical Drives”, CRC Press, 2002.
2. W. Leonhard, “Control of Electric Drives”, Springer Science & Business Media, 2001.

HEAD
Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

With effect from the academic year 2021-22

18EEC27 **SIGNALS AND SYSTEMS**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. To introduce the concepts of continuous time and discrete time systems and analyse systems in complex frequency domain.
2. To demonstrate sampling theorem and its applications.
3. To elucidate the techniques of Laplace and Z- transforms and their applications on various systems

Course Outcomes: After completion of this course, students will be able to:

1. Understand the basics of signals and systems and classify them
2. Analyse systems in complex frequency domain.
3. Understand sampling theorem and its implications.
4. Explore the applications of Laplace transforms to continuous time systems
5. Apply the Z-transform techniques to discrete time systems

UNIT-I

Introduction to Signals and Systems: Signals and systems as seen in everyday life, in various branches of engineering and science, Signal properties: periodicity, absolute integrability, deterministic and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability and their examples.

UNIT-II

Behaviour of continuous and discrete-time LTI systems: Impulse response and step response, convolution, input-output behaviour with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems, System representation through differential equations and difference equations, State-space Representation of systems, State-Space Analysis, Multi-input, Multi-output representation, State Transition Matrix and its Role, Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

UNIT-III

Fourier Transforms: Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients, Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Property of duality in Fourier. The Discrete- Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem.

UNIT-IV

Laplace and z- Transforms: Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behaviour. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis

UNIT-V

Sampling and Reconstruction: The Sampling Theorem and its implications, Spectra of sampled signals, Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects, Relation between continuous and discrete time systems, Introduction to the applications of signal and system theory- Feedback control systems,

Text Books:

1. A.V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and systems", Prentice Hall India, 1997
2. J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", Pearson, 2006.

Suggested Reading:

1. H. P. Hsu, "Signals and systems", Schaum's series, McGraw Hill Education, 2010.
2. S. Haykin and B. V. Veen, "Signals and Systems", John Wiley and Sons, 2007.

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

With effect from the academic year 2021-22

18EEC28 **POWER SYSTEMS-II LAB**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	1.5

Course Objectives:

1. To simulate and understand the load flows, Fault Analysis of power system.
2. To understand the transient stability studies, Economic power scheduling and Load frequency control in power system.
3. To understand the importance of protective relay kits and also study the various components in substations

Course Outcomes: After completion of this course, students will be able to:

1. Apply the load flow studies for any given power system.
2. Analyze the fault in the real time power system.
3. Estimate the consequences of transient stability, economic power scheduling and load frequency control.
4. Examine function of different types of relays for different power system applications.
5. Illustrate the functionality of each component in the substation.

List of Experiments

1. Simulation of Load Flow Studies
2. Simulation of Fault Analysis.
3. Simulation of Transient stability studies.
4. Simulation of Economic power scheduling.
5. Simulation of Load Frequency control of one area system.
6. IDMT characteristics of Over-current relay.
7. Differential protection of 1-phase transformer.
8. Draw the Characteristics of Static relays.
9. Operation of relays in long transmission line.
10. Over Current & Earth Fault Relay Testing Kit (Static Type)
11. Study of Universal Relay Testing Kit
12. Generator Differential Protection Study Unit
13. Study of Distance Relay Testing Kit / Impedance Relay kit
14. Visiting nearby substation and submitting the report.

Note: At least **TEN** experiments should be conducted in the semester.

HEAD
Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

With effect from the academic year 2021-22

18EEC29 **ELECTRICAL DRIVES LAB**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	1.5

Course Objectives:

1. To experiment and analyse the motor performance connected with power semiconductor source.
2. To be familiar with different speed control techniques of Drives.
3. To validate the experimental results with simulations.

Course Outcomes: After completion of this course, Students will be able to:

1. Analyse the control strategies to modify the output parameters of dc and ac drives.
2. Develop, testing and experimental procedures by applying basic knowledge in electrical and electronics.
3. Demonstrate the principle of energy efficient motors by load matching.
4. Interpret the performance of a given drive by suitable experimentation.
5. Investigate the performance of a given drive by using suitable simulation software.

List of experiments:

PART-A

1. Speed control of DC drive using Thyristor controlled rectifier.
2. Speed control of DC drive using DC-DC Chopper.
3. Four-Quadrant Operation of DC drive.
4. Closed loop speed control of dc motor using PID controller.
5. Speed control of single-phase induction motor speed using TRIAC.
6. Speed control of Three-Phase Induction Motor using V/f control.
7. Speed Control of Three-Phase Induction Motor using AC-AC converter.
8. Regenerative/ Dynamic braking operation for AC drive.

PART-B

1. Simulation of Speed control of DC Motor using BJT-H bridge.
2. Simulation of Regenerative/ Dynamic breaking operation of DC motor.
3. Simulation of Step/ Ramp speed response of DC motor.
4. Simulation of VSI-fed 3-Phase Induction Motor drive.
5. Simulation of CSI-fed 3-Phase Induction Motor drive.
6. Simulation of Permanent Magnet synchronous motor drive.

Note: Any **Six** experiments from **Part-A** and **Four** from **Part-B** should be performed.

HEAD
Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

With effect from the academic year 2021-22

18EEC30 **PROJECT: PART-1**

Instruction	4 Hours per week
Semester End Examination	50 Marks
Credits	2

Prerequisite: Knowledge of preparing slides by using power point presentations, Capable of searching for suitable literature and Presentation skills.

Course Objectives:
This course aims to:
1. The student takes up investigative study in the broad field of Engineering / Technology, either fully theoretical/practical or involving both theoretical and practical.
2. The work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a supervisor.
3. This is expected to provide a good initiation for the student(s) towards R&D.

Course Outcomes:
Upon completion of this course, students will be able to:
1. List the various approaches to the selected problem.
2. Interpret the advantages and disadvantages of various approaches.
3. Apply the selected approach for simulating / modelling / designing the problem.
4. Analyse and write a report on the results of the simulation / modelling of the problem selected.
5. Justify and present the results of the simulation / model / design before the departmental committee.

The objective of Project Part -1 is to enable the student take up investigative study in the broad field of Engineering Technology, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a supervisor. This is expected to provide a good initiation for the student(s) towards R&D.
The work shall include:

Survey and study of published literature on the assigned topic;
Working out a preliminary Approach to the Problem relating to the assigned topic;
Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
Preparing a Written Report on the Study conducted for Presentation to the Department;
Final Seminar, as oral Presentation before a departmental Committee.

Guidelines for the award of Marks: (Max. Marks: 50)

Evaluation by	Max. Marks	Evaluation Criteria / Parameter
Supervisor	20	Project Status / Review
	5	Report
Department Committee	5	Relevance of the Topic
	5	PPT Preparation
	5	Presentation
	5	Question and Answers
	5	Report Preparation

If we have built castles in the air, our work need not be lost; that is where they should be. Now lay the foundation under them. But a fool is one who, having no goal, redoubles his efforts.

Vikasa Mantras- Vivekananda Institute of Human Excellence

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

With effect from the academic year 2021-22

18EEE17 **POWER SYSTEM DYNAMICS AND CONTROL**

(Core Elective-5)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. To understand the power system stability and its impact on the system.
2. To analyze linear dynamical systems and use of numerical integration methods
3. To model different power system components for the study of stability and methods to improve stability

Course Outcomes: At the end of the course, the student will able to

1. Acquire the concepts of various types of stability and its control
2. Apply different numerical techniques for stability studies
3. Understand the concepts of small and large disturbance stability
4. Acquire the concepts of different models of synchronous machines and its controllers
5. Recognize the importance of enhancing the power system stability

UNIT-I

Introduction to Power System Operations: Introduction to power system stability, Power System Operations and Control. Stability problems in Power System, Impact on Power System Operations and control

UNIT-II

Analysis of Linear Dynamical System and Numerical Methods: Analysis of dynamical System, Concept of Equilibrium, Small and Large Disturbance Stability, Modal Analysis of Linear System, Analysis using Numerical Integration Techniques, Issues in Modelling: Slow and Fast Transients, Stiff System.

UNIT-III

Modeling of Synchronous Machines: Physical Characteristics, Rotor position dependent model, d-q Transformation, Model with Standard Parameters. Steady State Analysis, Short Circuit Transient Analysis, Synchronization of Synchronous Machine to an Infinite Bus, Modeling of Excitation and Prime Mover Systems, Physical Characteristics and Models.

UNIT-IV

Stability Analysis: Angular stability analysis in Single Machine Infinite Bus System, Angular Stability in multi-machine systems–Intra-plant, Local and Inter-area modes, Frequency Stability, Centre of Inertia Motion, Load Sharing, Governor droop, Single Machine Load Bus System-Voltage Stability

UNIT-V

Enhancing System Stability: Planning Measures, Stabilizing Controllers (Power System Stabilizers), Operational Measures-Preventive Control, Emergency Control.

Text Books:

1. K.R. Padiyar, “Power System Dynamics, Stability and Control”, B. S. Publications, 2002.
2. P. Sauer and M. A. Pai, “Power System Dynamics and Stability”, Prentice Hall, 199

Suggested Reading:

1. P. Kundur, “Power System Stability and Control”, McGraw Hill, 1995
2. P. M. Anderson & A. A. Fouad “Power System Control and Stability”, Galgotia, New Delhi,1981

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

With effect from the academic year 2021-22

18EEE18 **SWITCH MODE POWER CONVERTERS**

(Core Elective-5)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objective:

1. To study the design aspects of DC-DC converters and SMPS.
2. To comprehend the basic concepts of resonant converters.
3. To familiarize with the design of inductor, transformer for power converter circuits and to know various voltage control techniques in inverters.

Course Outcomes: After completion of the course, the student will be able to

1. Design different types of DC-DC converters.
2. Comprehend different types of SMPS for electrical applications.
3. Understand the operation of different resonant converters.
4. Design a suitable filter along with the suitable selection of transformer and switches that are used in power electronic converter circuits.
5. Compare different voltage control techniques in inverters.

UNIT-I

Basic Converter Circuits: Design of critical inductance and capacitance of Buck, Boost and Buck Boost Regulators, Cuk Converter Choice of Switching Frequency-Design Aspects

UNIT-II

Isolated SMPS: Fly back Converters, Forward Converters, Half Bridge and Full Bridge Converters, Push Pull Converters and SMPS with multiple outputs, Choice of Switching Frequency-Design Aspects

UNIT-III

Resonant Converters: Classification, Basic resonant circuit concepts, Load resonant, Resonant switch converters, Resonant D.C Link Inverters with Zero Voltage Switching, High frequency Link Integral Half-Cycle converters.

UNIT-IV

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

UNIT-V

Voltage Control in Inverters: Voltage control Techniques in inverters, Bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage, three-phase sinusoidal modulation

Text Books:

1. Mohan N. Undeland . T & Robbins W, Power Electronics Converters, Application and Design. John Wiley, 3rd edition, 2007.
2. Mohammed H. Rashid, “Power Electronics, Devices, circuits and applications”, Pearson Education, 4th Edition, 2017
3. H. W. Whittington, B. W. Flynn and D. E. MacPherson, Switched Mode Power Supplies, Design and Construction, Universities Press, 2009.

Suggested Reading:

1. Umanand L., Bhat S.R., Design of magnetic components for switched Mode Power Converters. , Wiley Eastern Ltd.,1992
2. V. Ramanarayanan, Course Material on Switched Mode Power Conversion

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

With effect from the academic year 2021-22

18EEE19 **ELECTRICAL MACHINE DESIGN**

(Core Elective-5)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. To understand the design parameters of various electrical machines**.**
2. To analyze the electrical and mechanical characteristics of electrical machines**.**
3. To become familiar with CAD usage.

Course Outcomes: After completion of this course, students will be able to:

1. Recognize the various parameters required for machine design.
2. Interpret the electrical machines based on different design constraints.
3. Assess the size of a machine with the given data.
4. Describe the various computational methods applicable in machine design.
5. Design an electric machine with the given conditions.

UNIT-I

Basics of Machine design aspects: Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

UNIT-II

Design of Transformers: Output equations of single and three-phase transformers, Sizing of a transformer, main dimensions, window space factor, overall dimensions, design of cooling tank, methods for cooling of transformers.

UNIT-III

Design of Induction Motors: Output equation, Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, magnetic leakage calculations, leakage reactance of poly phase machines, magnetizing current, short circuit current.

UNIT-IV

Design of Synchronous Machines: Output equation, Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of turbo alternators, Cooling of alternators.

UNIT-V

Computer aided Design (CAD): Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design.

Text Books:

1. K. Sawhney, “A Course in Electrical Machine Design”, Dhanpat Rai and Sons, 1970.
2. K. M. V. Murthy, “Computer Aided Design of Electrical Machines”, B.S. Publications, 2008.

Suggested Reading:

1. S. K. Sen, “Principles of Electrical Machine Design with computer programmes”, Oxford and IBH Publishing, 2006.
2. V. N. Mittal and Arvind Mittal “Design of Electrical Machines” Standard Publishers Distributors, New Delhi, 2009.

HEAD
Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

With effect from the academic year 2021-22

18EEE20 **HIGH VOLTAGE ENGINEERING**

(Core Elective-5)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. To know the breakdown mechanism in gases, liquids and solid dielectrics.
2. To understand the methods of generation and measurement of high voltages and currents.
3. To know the testing of HV electrical equipment and High Voltage laboratories.

Course Outcomes: After completion of this course, students will demonstrate:

1. Define Townsend's first and second ionization coefficients
2. Illustrate various breakdown mechanisms in gas, liquid and solid insulating materials.
3. Analyze the generation of dc, ac and impulse voltage and currents.
4. Discuss the various measurement methods of dc, ac and impulse voltages and currents.
5. Explain the testing of high voltage equipment, HV laboratories and safety precautions in HV labs.

UNIT-I

Breakdown in Gases: Mechanism of breakdown, Types of collisions, Ionization processes, Townsend's First and second Ionization coefficients, Townsend's breakdown mechanism, Streamer theory of breakdown, Panchen's Law, Corona discharges.

UNIT-II

Breakdown in liquid and solid insulating materials: Pure liquids and commercial liquids, Breakdown in pure and commercial liquid, Solid dielectrics and Composite dielectrics, Intrinsic breakdown, Electro-mechanical breakdown, Thermal breakdown, Breakdown due to treeing and tracking, Breakdown due to internal discharges.

UNIT-III

Generation of High Voltages and Currents: Generation of high dc voltages, Generation of high ac voltages, Generation of Impulse voltages and currents, Tripping and control of impulse generators.

UNIT-IV

Measurement of High Voltage and Currents: Measurement of Peak voltage, Impulse voltages and high Direct current measurements, Cathode Ray Oscillographs for Impulse voltage and current measurements, Measurement of dielectric constant and loss factor, Partial discharge measurements.

UNIT-V

High Voltage testing of Electrical Apparatus: Testing of Insulators, bushings, isolators, circuit breakers, Cables, Power capacitors and Power transformers. High Voltage laboratory, Indoor and Outdoor laboratories, Safety precautions in HV labs

Text Books:

1. M.S. Naidu and V. Kamaraju, "High Voltage Engineering", McGraw Hill Education, 2013.
2. C.L. Wadhwa, "High Voltage Engineering", New Age International Publishers, 2007.

Suggested Reading:

1. E.Kuffel, W.S.Zaengl & J.Kuffel, "High Voltage Engineering Fundamentals", Newness Publication, 2000
2. M. Khalifa, "High Voltage Engineering: Theory and Practice", Dekker, 1990

HEAD
Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

With effect from the academic year 2021-22

18ME O03 **RESEARCH METHODOLOGIES**

(Open Elective-2)

Instruction	3 Hours per week
Duration of SEE	3Hours
SEE	70Marks
CIE	30Marks
Credits	3

Objectives:

1. To make the students to formulate the research problem.
2. To identify various sources for literature review and data collection.
3. To prepare the research design.
4. To equip the students with good methods to analyze the collected data.
5. To explain how to interpret the results and report writing.

Outcomes: At the end of the course, the students are able to

1. Define research problem. (BL-1)
2. Review and assess the quality of literature from various sources. (BL-2)
3. Understand and develop various sresearch designs. (BL-2)
4. Analyze problem by statistical techniques: ANOVA,F-test,Chi-square. (BL-4)
5. Improve the style and format of writing a report for technical paper/Journal report. (BL-4)

UNIT – I

Research methodology: Objectives and motivation of research, types of research- descriptive vs. analytical, applied vs. fundamental, quantitative vs. qualitative, conceptual vs. empirical, research approaches, significance of research, research methods vs. methodology, research process, criteria of good research, problems encountered by researchers in India, technique involved in defining a problem.

UNIT–II

Literature survey: Importance of literature survey, sources of information-primary, secondary, tertiary, assessment of quality of journals and articles, information through internet.

UNIT – III

Research design: Meaning of research design, need of research design, feature of a good design important concepts related to research design, different research designs, basic principles of experimental design, steps in sample design.

UNIT – IV

Data collection: Collection of primary data, Secondary data, measures of central tendency-mean, mode, median, measures of dispersion- range, mean deviation, standard deviation, measures of asymmetry (skewness), important parametric tests -z, t, F, Chi-Square, ANOVA significance.

UNIT-V

Research report formulation and presentation: Synopsis, dissertation, technical paper and journal paper, writing research grant proposal, making presentation with the use of visual aids, writing a proposal for research grant.

Text Books:

1. C.R Kothari, "Research Methodology Methods & Technique", New Age International Publishers,2004.
2. R. Ganesan, "Research Methodology for Engineers", MJP Publishers,2011.
3. Vijay Upagade and AravindShende, "Research Methodology", S. Chand &Company Ltd., New Delhi,2009.

Suggested Reading:

1. G. NageswaraRao, "Research Methodology and Quantitative methods", BS Publications, Hyderabad,2012.
2. Naval Bajjai, "Business Research Methods", Pearson Education,2011.

HEAD
Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

With effect from the academic year 2021-22

18ME O04 **ENTREPRENEURSHIP**

(Open Elective-2)

Instruction	3 Hours per week
Duration of SEE	3Hours
SEE	70Marks
CIE	30Marks
Credits	3

Objectives:

1. Concept and procedure of idea generation.
2. The nature of industry and related opportunities and challenges.
3. Elements of business plan and it s procedure.
4. Project management and its techniques.
5. Behavioural issues and Time management.

Outcomes: At the end of the course, the students are able to

1. Understand the concept and essence of entrepreneurship. (BL-2)
2. Identify business opportunities and nature of enterprise. (BL-3)
3. Analyze the feasibility of new business plan. (BL-4)
4. Apply project management techniques like PERT and CPM for effective planning and execution of projects. (BL-3)
5. Use behavioral, leadership and time management aspects in entrepreneurial journey (BL-3)

UNIT-I

Entrepreneurship: Definition, functions of entrepreneurship, qualities of entrepreneurs, identification and characteristics of entrepreneurs, entrepreneur vs. intrapreneur, first generation entrepreneurs, women entrepreneurs, conception and evaluation of ideas and their sources.

UNIT-II

Indian industrial environment: Competence, opportunities and challenges, entrepreneurship and economic growth, small scale industry in India, objectives, linkage among small, medium and heavy industries, types of enterprises, corporate social responsibility.

UNIT-III

Business plan: Introduction, elements of business plan and its salient features, business model canvas, technical analysis, profitability and financial analysis, marketing analysis, feasibility studies, executive summary, selection of technology and collaborative interactions.

UNIT-IV

Project management: During construction phase, project organization, project planning and control using CPM, PERT techniques, human aspects of project management, assessment of tax burden.

UNIT-V

Behavioral aspects of entrepreneurs: Personality, determinants, attributes and models, leadership concepts and models, values and attitudes, motivation aspects, time management: approaches of time management, their strengths and weaknesses. time management matrix and the urgency addiction .

Text Books:

1. Vasant Desai, "Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House, 1997.
2. Prasanna Chandra, "Project-Planning, Analysis, Selection, Implementation and Review", Tata Mcgraw-Hill Publishing Company Ltd.1995.
3. S.S. Khanka, "Entrepreneurial Development", S. Chand & Co. Pvt. Ltd., New Delhi,2015.

Suggested Reading:

1. Robert D. Hisrich, Michael P. Peters, "Entrepreneurship", 5/e, Tata Me Graw Hill Publishing Company Ltd., 2005.
2. Stephen R. Covey and A. Roger Merrill, "First Things First", Simon and Schuster Publication,1994.

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

With effect from the academic year 2021-22

18EGO01 **TECHNICAL WRITING SKILLS**

(Open Elective-2)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	70 marks
CIE	30 marks
Credits	3

Course Objectives: The course will introduce the students to:

1. Process of communication and channels of communication in general writing and technical writing in particular.
2. Learn Technical Writing including sentence structure and be able to understand and use technology specific words.
3. Write business letters and technical articles.
4. Write technical reports and technical proposals.
5. Learn to write agenda, record minutes of a meeting, draft memos. Understand how to make technical presentations.

Course Outcomes: After successful completion of the course students will be able to:

1. Communicate effectively, without barriers and understand aspects of technical communication.
2. Differentiate between general writing and technical writing and write error free sentences using technology specific words
3. Apply techniques of writing in business correspondence and in writing articles.
4. Draft technical reports and technical proposals.
5. Prepare agenda and minutes of a meeting and demonstrate effective technical presentation skills.

Unit I

Communication – Nature and process.
Channels of Communication – Downward, upward and horizontal communication. Barriers to communication.
Technical Communication – Definition, oral and written communication. Importance and need for Technical communication. Nature of Technical Communication. Aspects and forms of Technical communication. Technical communication Skills – Listening, Speaking, Reading & Writing.

Unit II

Technical Writing – Techniques of writing. Selection of words and phrases in technical writing. Differences between technical writing and general writing. Abstract and specific words. Sentence structure and requisites of sentence construction. Paragraph length and structure.

Unit III

Business correspondence – Sales letters, letters of Quotation, Claim and Adjustment letters.
Technical Articles : Nature and significance, types. Journal articles and Conference papers, elements of technical articles.

Unit IV

Technical Reports : Types, significance, structure, style and writing of reports. Routine reports, Project reports.
Technical Proposals : Definition, types, characteristics, structure and significance.

Unit V

Mechanics of Meetings : Preparation of agenda, participation, chairing and writing minutes of a meeting. Memorandum. Seminars, workshops and conferences.
Technical Presentations : Defining purpose, audience and locale, organizing content, preparing an outline, use of Audio Visual Aids, nuances of delivery, importance of body language and voice dynamics.

Text Book :

1. Meenakshi Raman & Sangeeta Sharma, "Technical Communications-Principles and Practice", Oxford University Press, Second Edition, 2012.
2. 1.M Ashraf Rizvi, "Effective Technical Communication", Tata McGraw Hill Education Pvt Ltd, 2012.

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Suggested Reading :

1. .Kavita Tyagi & Padma Misra, “Basic Technical Communication”, PHI Learning Pvt Ltd, 2012.
2. R.C Sharma & Krishna Mohan, “Business Correspondence and Report Writing”, Tata McGraw Hill, 2003

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc18_mg13/preview
2. https://www.technical-writing-training-and-certification.com/
3. https://academy.whatfix.com/technical-writing-skills

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With effect from the academic year 2021-22

18CSO04 **BASICS OF DATA SCIENCE USING R**

(Open Elective-2)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Pre-requisites: Probability and Statistics, basics of programming languages.

Course Objectives: The objectives of this course are

1. Understand R programming language.
2. Explore the programming skills needed to use R tool for statistical analysis of Biological data.
3. Analyze biological data.

Course Outcomes: On Successful completion of the course, students will be able to

1. Summarize the basics of R and in-built data visualization packages.
2. Describe the data analysis using Bayesian and stochastic modelling.
3. Relate gibbs, Z- sampling distributions and compare the binomial, chi-square, wilcoxon and Fisher's exact tests in hypothesis testing.
4. Explore the ANOVA in Regression analysis and classify the multivariate data.
5. Experiment with the biological data using R tool and apply clustering algorithms to biological data.
6. Identify R commands for data manipulation and database technologies for datasets of bioinformatics.

UNIT - I

Basics of R: Introduction, R features, setting up and exploring R environment, loading packages, types of data objects in R, working with R data objects, Controlling work space, importing files. Programming with R: Variables and assignment, operators, control structures, Functions-built-in, writing own functions, package creation.

UNIT - II

Data Analysis and Graphics: Data summary functions in R, Graphics technology in R, saving graphics, additional graphics packages. Bayesian Data Analysis: Need of Bayesian approach, Application of Bayes rule, Priors, Likelyhood functions, evaluating the posterior, Applications of Bayesial Statistics in Bioinformatics. Stochastic Modeling: Stochastic process and Markov Processes, Classification of Stochastic processes, modeling a DNA sequence with Markov Chain, Characteristics of Markov Chain.

UNIT - III

MCMC using Brugs: ABO blood type example. Gibbs sampling. Statistical Inference: Sampling distributions, Parameter estimation, interval estimation, bootstrapping, R packages for bootstrapping. Hypothesis Testing: Package ctest, Binomial test, comparing variances, Wilcoxon tests, Chi-Square test, Fisher's Exact tests, Likelihood Ratio tests.

UNIT - IV

ANOVA and Regression: ANOVA table, perforating ANOVA using R, graphical analysis of ANOVA comparison, Regression: Correlations, linear regression model, fitting and testing of regression model, generalization of the model. Working with Multivariate Data: Multivariate data, sample statistics, display of multivariate data, outliers and principal components. Classification of discriminate analysis- classification with two population and more than two populations, cross validation classification trees.

UNIT - V

Clustering methods: measures of dissimilarities, K-means clustering, K-Medoid clustering, Hierarchical clustering-Agglomerate and divisive. R Packages: Bio-conductor and Seqin R.

Data Technologies: R for Data manipulation, example, Database technologies, Bioinformatics resources on the WWW.

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Gandipet, Hyderabad-75

Textbooks:

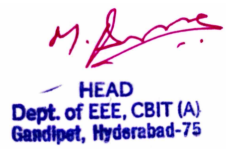
1. Kim Seefeld, Ernest Linder, "Statistics using R with Biological examples", 2007 (https://cran.r-project.org/doc/contrib/Seefeld_StatsRBio.pdf).
2. Robert Gentleman, "R Programming for Bioinformatics", 1st Edition, CRC Press, 2008.

Suggested Reading:

1. ArvilCohhlan "A Little Book of R for Bioinformatics", Release 1.0, CC ver 3.0

Online Resources:

1. https://epdf.tips/r-programming-for-bioinformatics.html
2. https://epdf.tips/r-programming-for-bioinformatics.htmlhttps://www.cyclismo.org/tutorial/R/objectOriented.html
3. https://www.w3schools.in/r/object-oriented/



With effect from the academic year 2021-22

18CSO07 **BASICS OF CYBER SECURITY**

(Open Elective-2)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Pre-requisites: Operating System, Computer Network, Cryptography.

Course Objectives: This course aims to:

1. Identify and present indicators that a cybercrime has occurred and understand methods and tools used in cybercrimes.
2. Collect, Process, Analyze and Present Computer Forensics Evidence.
3. Understand the legal perspectives and Organizational implications of Cyber Security

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

1. List the different types of cybercrimes and analyze legal frameworks to handle cybercrimes.
2. Identify the Tools and Methods used in cybercrimes.
3. Analyze and resolve cyber security issues and laws governing Cyberspace.
4. Describe the need of Digital Forensics and the importance of digital evidence in prosecution.
5. Interpret the commercial activities in the event of significant information security incidents in the Organization.
6. Discuss the vulnerabilities in networking protocols and their mitigation techniques.

UNIT - I

Introduction to Cyber Crime: Cyber Crime: Definition and Origins of the Word, Cybercrime and Information Security, Classification of Cyber Crimes, Cyber Crime: The Legal Perspective, Cyber Crime: An Indian Perspective, A Global Perspective of Cyber Crime.

UNIT - II

Cyber Offenses: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector. Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

UNIT - III

Cyber Security: The Legal Perspectives: Cyber Crime and the Legal Landscape around the World, Need of Cyber laws: the Indian Context, The Indian IT Act, Challenges to Indian Law and Cyber Crime Scenario in India, Digital Signatures and the Indian IT Act, Cyber Crime and Punishment, Cyber Law, Technology and Students: The Indian Scenario.

UNIT - IV

Understanding Cyber Forensics: Introduction, Digital Forensics Science, Need for Computer Forensics, Cyber Forensics and Digital Evidence, Forensics Analysis of Email, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Cyber Forensics Investigation, Challenges in Computer Forensics.

UNIT - V

Cyber Security: Organizational Implications: Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

Text Books:

1. Sunit Belpre and Nina Godbole, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley India Pvt. Ltd, 2011.
2. Kevin Mandia, Chris Prosise, Incident Response and computer forensics, Tata McGraw Hill, 2006.

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Suggested Reading:

1. Alfred Basta, Nadine Basta, Mary Brown, Ravinder Kumar, Cyber Security and Cyber Laws, Paperback – 2018.
2. Mark F Grady, Fransesco Parisi, The Law and Economics of Cyber Security, Cambridge university press, 2006.

Online Resources:

1. https://www.edx.org/learn/cybersecurity
2. https://www.coursera.org/courses?query=cyber%20security
3. https://swayam.gov.in/course/4002-cyber-law

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VIII- SEMESTER

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With effect from the academic year 2021-22

18EEC31 **TECHNICAL SEMINAR**

Instruction	2 Hours per week
Duration of Semester End Examination	--
Semester End Examination	--
CIE	50 Marks
Credits	1

Course Objectives:

1. To introduce students to critical reading, understanding, summarizing, explaining and preparing report on state-of- the-art topics in a broad area of his/her specialization.
2. Seminar topics may be chosen by the students with advice from the faculty members and the student shall read further relevant articles in the domain.
3. Documenting the seminar report in a prescribed format.

Course Outcomes:

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

1. Collect, Organize, Analyze and Consolidate information about emerging technologies from the literature.
2. Exhibit effective communication skills, stage courage, and confidence.
3. Demonstrate intrapersonal skills.
4. Explain new innovations/inventions in the relevant field.
5. Prepare and experience in writing the Seminar Report in a prescribed format.

The goal of a seminar is to introduce students to critical reading, understanding, summarizing, explaining and preparing report on state-of-the-art topics in a broad area of his/ her specialization. Seminar topics may be chosen by the students with advice from the faculty members and the student shall read further relevant articles in the domain.

The seminar must be clearly structured and the power point presentation shall include following aspects:

1. Introduction to the field
2. Literature survey
3. Consolidation of available information
4. Summary and Conclusions
5. References

Each student is required to:

1. Submit a one-page synopsis of the seminar talk for display on the notice board.
2. Deliver the seminar for a maximum duration of 30 minutes, where the presentation should be for 20 minutes in PowerPoint, followed by Question and Answers session for 10 minutes.
3. Submit the detailed report of the seminar in spiral bound in a précised format as suggested by the department.

- Seminars are to be scheduled from 3rdweek to the last week of the semester and any change in schedule shall be discouraged.
- For the award of sessional marks, the students are judged by three (3) faculty members and are based on oral and written presentations as well as their involvement in the discussions during the oral presentation.

Note: Topic of the seminar shall be preferably from any peer reviewed recent Journal publications.

Guidelines for awarding marks (CIE): Max. Marks: 50		
S.No	**Description**	**Max. Marks**
1	Contents and relevance	10
2	Presentation skills	10
3	Preparation of PPT slides	05
4	Questions and answers	05
5	Report in a prescribed format	20

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

With effect from the academic year 2021-22

18EEC32 **PROJECT: PART-2**

Instruction	20 P Hours per Week
Duration of SEE	Viva Voce
SEE	100 Marks
CIE	100 Marks
Credits	10

Prerequisite: Student must have earned the credit of 'Project: Part - 1'.

Course Objectives:

1. The object of Project: Part2 is to enable the student extend further the investigative study, either fully theoretical/practical or involving both theoretical and practical work.
2. The work shall be carried out under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry.
3. Preparing an Action Plan for conducting the investigation, including team work;

Course Outcomes:

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

1. Recall the details of the approach for the selected problem.
2. Interpret the approach to the problem relating to the assigned topic.
3. Determine the action plan to conduct investigation.
4. Analyze and present the model / simulation /design as needed.
5. Evaluate, present and report the results of the analysis and justify the same.

The objective of 'Project: Part-2' is to enable the student extend further the investigative study taken up, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In depth study of the topic assigned;
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/ Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar presentation before Departmental Committee.

Guidelines for awarding marks in CIE: (**Max. Marks: 100**)

Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Departmental Review Committee	10	Review 1
	15	Review 2
	25	Submission
Supervisor	10	Regularity and Punctuality
	10	Work Progress
	10	Quality of the work which may lead to publications
	10	Report Preparation
	10	Analytical / Programming / Experimental Skills

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

With effect from the academic year 2021-22

18EEE21 **ADVANCED ELECTRIC DRIVES**

(Core Elective – 6)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. To Understand the principles of commutation in converters and study the performance, stability and control aspects of DC motors and Induction motors.
2. To Understand the microprocessor-based control of electric drives
3. To Study the working principles and control aspects of special motors: Brushless DC motor, Switched Reluctance Motor drives.

Course Outcomes: After completion of this course, students will be able to:

1. Identify and consider the requirement of power converters for a given application.
2. Illustrate the digital methods of DC motor speed control techniques.
3. Show how the changes effect in different speed control schemes of Induction motor.
4. Analyse the performance of Synchronous motor with and without sinusoidal supply.
5. Recognize and formulate problems encountered by special motor drives for a particular application.

UNIT I

Review of Power Converters: Over view of Power converters in Electric Drives, Commutation in Thyristorpower converters, Principle of natural commutation and forced commutation, Discontinuous conduction in converters, DC choppers, Force commutated inverters, Frequency conversion. Inverter voltage control, Harmonic neutralisation, Voltage controller.

UNIT II

DC Drives: General considerations, Evaluation of a dc drive performance Forced commutation schemes to improve the performance of the drives, Steady-State Analysis of the Three-Phase Converter Controlled rectifiers, Steady-state analysis of chopper-controlled dc motors, Closed loop control of solid state DC drives, DC motor speed control using microprocessor (Block Diagram and Flowchart Approach only)

UNIT III

Induction Motor Drive: Speed control of IM, Analysis of IM on non-sinusoidal voltage waveforms, Scalar and vector control of induction motor, Direct torque and flux control of induction motor, Analysisof CSI fed IM ,Performance of CSI fed IM, Static slip energy recovery schemes employing Converter cascades in the rotor circuit Dynamic behavior and stability of Variable frequency IM, Induction motor speed control using microprocessor (Block Diagram and Flowchart Approach only).

UNIT IV

Synchronous Motor Drive: Analysis of SM fed from non-sinusoidal supplies, Performance of SM on non-sinusoidal voltages, Performance of CSI fed SM, Marginal angle control of SM, stability of SM on non-sinusoidal supplies, Self-controlled synchronous motor drive, Vector control of synchronous motor, Synchronous motor speed control using microprocessor (Block Diagram and Flowchart Approach only).

UNIT V

Special Motor Drives: Introduction to various special motor drives. **Switched reluctance motor**- drive construction, Working principle, Normalized torque-speed characteristics, Speed Control Schemes, **Brushless DC Motor**–construction, Working principle, Torque-speed characteristics, Speed Control Schemes,Permanent magnet motor drives, **Solar Powered Drive-** motors suitable for pump drives, solar powered pump drives, **Battery Powered Drives**-battery powered vehicles, basics, current status and scope for growth

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Text Books:

1. Vedam Subramanyam, 'Thyristor Control of Electric Drives', Tata McGraw Hill Publishing Co., New Delhi,1987.
2. G.K.Dubey, Fundamentals of Electrical Drives; Narosa Publishing House, 1995.
3. P.S.Bimbra, Generalised theory of Electrical Machines, Khanna Publication, 2006.

Suggested Reading:

1. R. Krishnan, 'Electric Motor Drive: Modeling, Analysis and Control' Prentice Hall of India, 2001.
2. B.K.Bose, 'Power Electronics and AC Drives', Prentice Hall, 2002

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

With effect from the academic year 2021-22

18EEE22 **DIGITAL SIGNAL PROCESSING**

(Core Elective – 6)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. To explain mathematical representation of signals in continuous, discrete time and frequency domain.
2. To demonstrate analysis of discrete time systems using Z-transforms, Discrete-Fourier Transform (DFT) and the FFT algorithms
3. To illustrate design of IIR and FIR digital filters for various applications.

Course Outcomes: After completion of this course, students will be able to:

1. Represent signals mathematically in continuous and discrete-time domain
2. Analyse discrete-time systems using z-transformation
3. Analyse the Discrete-Fourier Transform (DFT) and FFT algorithms
4. Design analog IIR filter and covert into digital IIR filters by using various digitized techniques
5. Design analog FIR filter by using various windowing techniques

UNIT-I

Discrete-time signals and systems: Sequences, representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals, aliasing, Sampling theorem and Nyquist rate.

UNIT-II

Z-transformations: Region of Convergence, Analysis of Linear Shift Invariant systems using z-transform, Properties of Z-transform for causal signals, Interpretation of stability in z-domain, Inverse z-transforms.

UNIT-III

Discrete Fourier Transform: Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform (FFT) Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.

UNIT-IV

IIR Filters: Design of Butterworth, Chebyshey filters, IIRfilter design by impulse invariant bilinear transformation, impulse invariance method, step invariance method.

UNIT-V

FIR Filters: Characteristics of FIR Digital Filters. Frequency response, comparison of FIR, IIR filters, Window techniques, Design of these filters using Rectangular, Hamming, Bartlet, Kaiser windows, Architecture and features of TMS 320F/2047 and ADSP signal processing chips, Applications of DSP.

Text Books:

1. S. K. Mitra, "Digital Signal Processing: A computer based approach", McGraw Hill, 2011.
2. A.V. Oppenheim and R. W. Schafer, "Discrete Time Signal Processing", Prentice Hall, 1989.
3. J. G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", Prentice Hall, 1997.
4. P. VenkataRamani, M. Bhaskar, "Digital Signal Processo1; Architecture, Programming & Application", TataMcGrawHill-2004

Suggested Reading:

1. Anandkumar A, Digital Signal Processing, Second edition PHI learning, 2015
2. L. R. Rabiner and B. Gold, "Theory and Application of Digital Signal Processing", Prentice Hall,1992.
3. J. R. Johnson, "Introduction to Digital Signal Processing", Prentice Hall, 1992.
4. D. J. DeFatta, J. G. Lucas andW. S. Hodgkiss, "Digital Signal Processing", John Wiley & Sons,1988

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Dept. of EEE, CBIT (A)
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With effect from the academic year 2021-22

18EEE23 **SMART GRID**

(Core Elective – 6)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. To study the importance of smart grid and components of smart grid
2. To understand the communication technologies, infrastructure required for smart metering
3. To know various functions of distribution automation and operation of micro grid

Course outcomes: At the end of this course, students will be able to:

1. Discuss the components and operation of Smart Grid at transmission and distribution level
2. Select the communication technology required for smart grid applications
3. Illustrate components and operation of smart metering and implementation of demand side integration
4. Analyze the different types of micro grid, storage systems and communication infrastructure
5. Explain the equipment used in distribution automation and implement the distribution management system functions

UNIT-I

Introduction to smart grid: Today's Grid versus the Smart Grid, drivers of smart grid, functionalities and key components of smart grid, smart grid components for transmission system, smart grid functionalities at distribution level, smart grid vision and road map to India, policies, standards, regulations, national smart grid mission framework,

UNIT-II

Communication Technologies: Dedicated and shared communication channels, switching techniques, communication channels: wired communication, twisted pair, optical fiber, radio communication, Ethernet, wireless LAN, Bluetooth, WiMAX, standards for information exchange

UNIT-III

Smart Metering Infrastructure: Evolution of electricity metering, benefits of smart metering, components of smart metering, hardware requirements, communication infrastructure and protocols for smart metering: Home area network, neighborhood area network, data concentrator, meter data management system, Demand side integration(DSI): services, implementation of DSI, hardware support

UNIT-IV

Micro Grids: Introduction, mini/micro grids, architecture of micro grid, types of micro grid, Dc micro grid, ac micro grid, AC. DC micro grid, Protocols and standards, communication to monitor real time network status, energy storage in micro grids, benefits of distributed generation and energy storage in micro grid systems

UNIT-V:

Distribution Automation: Substation automation equipment: current transformers, voltage transformers, relay IED, faults in distribution system: components for fault isolation and restoration, voltage regulation, Distribution Management systems: Data sources and associated external systems, modelling and analysis tools, Applications: Network reconfiguration, volt/var control, outage management system, operation of DER, fault diagnosis and location

Text Books:

1. Janaka Ekanayake, Liyanage, Wu, Akihiko Yokoyama, Jenkins, Smart Grid, Wiley Publications, 2012
2. Stuart Borlas'e, "Smart Grid: Infrastructure, Technology and solutions" CRC Press

Suggested Reading:

1. James Momoh, "Smart Grid Fundamentals of Design and Analysis" IEEE Press, Wiley Publications, 2012
2. Smart grid Hand Book for Regulators and policy makers, Nov 2017 published by India Smart Grid Forum
3. Bharat Modi, Anuprakash, Yogesh Kumar, "Fundamentals of Smart grid Technology", Katson publishers, 2015

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With effect from the academic year 2021-22

18EEE24 **DIGITAL CONTROL SYSTEMS**

(Core Elective-6)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. To represent a continuous time system in its discrete form and develop a mathematical modeling.
2. To analyze a discrete time system using Z-transform tool and also to design discrete controllers and compensators.
3. To study the Classical Approach Theory of Discrete-time systems and to analyze non-linear system using Lyapunov stability concept.

Course Outcomes: After the completion of this course, students will able to:

1. Understand the concepts of discrete representation of the continuous time system
2. Analyze the stability of open loop and closed loop discrete-time systems.
3. Develop the state space models for discrete time systems and to examine the effect of pole-zero cancellation on a system
4. Design digital controllers to improve the system reliability
5. Apply the concepts of quadratic function to analyze the stability of linear and nonlinear systems

UNIT-I

Discrete Representation of Continuous Systems: Basics of Digital Control Systems. Discrete representation of continuous systems. Mathematical Modeling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency. ZOH equivalent.

UNIT-II

Discrete Time System Analysis and its Stability: Z-Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Solution of Discrete time systems. Time response of discrete time system. Stability analysis of Discrete Time System by Jury test and using bilinear transformation.

UNIT-III

State Space Approach for discrete time systems: State space models of discrete systems, State space analysis. Controllability and observability analysis. Effect of pole - zero cancellation on the controllability & observability. Pole placement by state feedback.

UNIT-IV

Design of Digital Control System: Design of Discrete PID Controller, Design of discrete state feedback controller. Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator.

UNIT-V

Lyapunov's Stability Analysis: The concept of linear and nonlinear systems, Quadratic function, Sylvester's criterion for definiteness of quadratic function, Lyapunov's stability criterion, Direct method of Lyapunov for the linear system, Methods of constructing Lyapunov function for non linear systems- Krasovskii's method.

Text Books:

1. K. Ogata, "Digital Control Systems", Prentice Hall India Learning Private Limited, Second edition, 2005.
2. M. Gopal, "Digital Control Engineering", New age international Publications, 2003
3. M.Gopal, ''Digital control and State Variable Methods'', 3rd Edition TMH, Sep -. 2008

Suggested Readings:

1. B.C. Kuo, "Digital Control System",2nd Edition, Oxford University Press,2003
2. G.F. Franklin, J.D. Powell & M. L. Workman "Digital Control of Dynamic Systems", 3rd Edition 2006
3. R.T. Stefani et al., "Design of feedback control systems, Oxford University", Press,2002

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With effect from the academic year 2021-22

18ME O07 **INTELLECTUAL PROPERTY RIGHTS**

(Open Elective-3)

Instruction	3 Hours per week
Duration of SEE	3Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. Fundamental aspects of IP.
2. Salient features of IPR acts.
3. The methods of registrations of Intellectual property.
4. Awareness for innovation and its importance of protection.
5. The changes in IPR culture and techno-business aspects of IPR.

Outcomes: At the end of the course, the students are able to

1. Understand the evolution of IP, working of organization's at global level to protect and promote IP. (BL-2)
2. Familiarize with the patent filing process at national and international level. (BL-2)
3. Draw the logical conclusion of research, innovation and patent filing. (BL-3)
4. Compare different kinds of IP and their patenting system. (BL-4)
5. Understand the techno-legal-business angle of IP, infringement and enforcement mechanisms for protection. (BL-2)

UNIT-I

Introduction: Definition of intellectual property, the need for intellectual property rights (IPR), kinds of intellectual property rights, IPR in India – genesis and development, IPR abroad, importance of WTO, TRIPS agreement, patent cooperation treaty, Berne and universal copyright conventions.

UNIT-II

Patents: Definition of patent, commercial significance , term of patent, patentable subject- matter, rights and obligations of patentee, searching of existing patents, drafting of patent, specification of patent, filing of a patent, the different layers of the patent system (national, regional and international options), compulsory licensing and licenses of rights, revocation of patents, differences between utility model and patent.

UNIT-III

Industrial designs: Definition of designs, registration of design, rights and duties of proprietor of design, piracy of registered design.

Trademarks: Meaning of trademarks, purpose of protecting trademarks, registration of trademarks, passing off, assignment and licensing of trademarks, infringement of trademarks.

Geographical indications: Definition, differences between GI and trademarks.

UNIT-IV

Copy right: Nature and scope of copy right, term of copyright, subject matter of copyright, rights conferred by copyright ,publication, broad casting, telecasting, computer program, database protection, assignment and transmission of copyright, infringement of copy right trade secrets and know-how agreement.

UNIT-V

Enforcement of intellectual property rights: Infringement of intellectual property rights, enforcement measures, emerging issues in intellectual property protection, case studies of patents and IP Protection.

Unfair competition: What is unfair competition, relationship between unfair competition and intellectual property laws.

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Text Books:

1. Ajit Parulekar and Sarita D'Souza, "Indian Patents Law-Legal & Business Implications",Macmillan India Ltd., 2006.
2. B.L.Wadehra, "Law relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications", Universal law Publishing Pvt Ltd., India,2000.
3. P.Narayanan, "Law of Copyright and Industrial Designs"; Eastern law House, New Delhi,2010.

Suggested readings:

1. CronishW.R , " Intellectual Property Patents, Copyright, Trade Marks and Allied rights", Sweet & Maxwell,1993.
2. P.Narayanan, "Intellectual Property Law" Eastern Law Edn.,1997.

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With effect from the academic year 2021-22

18CE O02 **DISASTER MITIGATION AND MANAGEMENT**

(Open Elective-3)

Instruction	3 L Hours per Week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives: This course aims to,

1. Equip the students with the basic knowledge of hazards, disasters, risks and vulnerabilities.
2. Impart knowledge in students about the nature, causes, consequences and mitigation measures of the variousHydro-meteorological disasters.
3. Introduce the concepts of causes, consequences and mitigation measures of the various Geographical disasters.
4. Enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters.
5. Equip the students with the knowledge of the impacts of disaster, chronological phases in a disaster management cycle and to create awareness about the disaster management framework and legislations in the context of Central and State Level Authorities.

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

1. Identify and understand the fundamental terminologies in disaster management.
2. Distinguish between the Hydro-meteorological disasters and apply the concepts of structural and non-structuralmitigation measures.
3. Categorize different Geographical Disasters and apply the knowledge in utilizing the early warning systems.
4. Analyze various mechanisms and consequences of human induced disasters.
5. Develop an awareness of disaster management phases and formulating effective disaster management plans, ability to understand various participatory roles of stakeholders- Central and State Government bodies at different levels.

UNIT- I:

Introduction: Basic definitions- Hazard, Disaster, Vulnerability, Risk, Resilience, Mitigation, Management; classification of types of disaster- Natural and manmade; Introduction to Disaster management cycle; International Decade for natural disaster reduction (IDNDR); International strategy for disaster reduction (ISDR), Nationaldisaster management authority (NDMA).

UNIT- II:

Natural Disasters:

Hydro meteorological disasters:

Causes, Early warning systems- monitoring and management, structural and non-structural measures for floods, drought and Tropical cyclones; Applications. Case studies related to various hydro-meteorological disasters.

UNIT- III:

Geographical based disasters: Causes, zoning, Early warning systems- monitoring and management, structural and non-structural mitigation measures for earthquakes, tsunami, landslides, avalanches and forest fires. Case studies related to various geographical based disasters.

UNIT- IV:

Human Induced Disasters: Chemical disaster- Causes, impacts and mitigation measures for chemical accidents, Risks and control measures in a chemical industry, chemical disaster management; Case studies related to various chemical industrial hazards eg: Bhopal gas leakage; Management of chemical terrorism disasters and biological disasters; Case studies related to power break downs, fire accidents, traffic accidents, oil spills and stampedes, building failure disasters.

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Gandipet, Hyderabad-75

UNIT- V:

Concept of Disaster Impacts and Management:

Disaster impacts- environmental, physical, social, ecological, economical, political, etc.; health, psycho-social issues; demographic aspects, gender, age, special needs; hazard locations; global and national disaster trends;climate change and urban disasters.

Disaster management cycle and its phases, risk analysis, vulnerability and capacity assessment; Post-disaster environmental response water, sanitation, food safety, waste management, disease control; Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Text Books:

1. PradeepSahni, "Disaster Risk Reduction in South Asia", Prentice Hall, 2003.
2. B. K. Singh, "Handbook of Disaster Management: Techniques & Guidelines", Rajat Publication, 2008.

Suggested Reading:

1. Ministry of Home Affairs, Government of India, "National Disaster Management Plan, Part I and II",
2. K. K. Ghosh, "Disaster Management", APH Publishing Corporation, 2006.
3. http://www.indiaenvironmentportal.org.in/files/file\disaster_management_india1.pdf
4. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs)
5. Hazards, Disasters and your community: A booklet for students and the community, Ministry of Home Affairs.
6. Disaster Medical Systems Guidelines, Emergency Medical Services Authority, State of California, EMSA no.214,June 2003.
7. Inter Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and PsychosocialSupport in Emergency Settings, Geneva: IASC.
8. http://ndma.gov.in/ (Home page of National Disaster Management Authority)

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With effect from the academic year 2021-22

18ITO02 **PYTHON PROGRAMMING**

(Open Elective-3)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. To facilitate learning to use lists, tuples and dictionaries in Python programs.
2. To familiarize with functions and file handling.
3. To learn data structures of Python programming,
4. To impart knowledge on OOPs concepts and handle exceptions in Python.
5. To introduce GUI Programming and familiarize with data visualization.

Course Outcomes:

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

1. Understand the fundamental concepts and control structures of python programming.
2. Write user defined iterative & recursive functions, identify appropriate predefined functions and perform file handling Operations.
3. Use suitable data structures such as sequences, dictionaries and sets in python programming.
4. Apply concepts of OOP, exception handling and build regular expressions using Python.
5. Design and Develop GUI based applications and visualize the data.

UNIT-I

Introduction to Python Programming: Using Python, The IDLE Programming Environment, Input and Output Processing, Displaying Output with the Print Function, Comments, Variables, Reading Input from the Keyboard, Performing Calculations, More About Data Output: New line, Item Separator, Escape Characters, Formatting parameters.

Decision Structures and Boolean Logic: if, if-else, if-elif-else Statements, Nested Decision Structures, Comparing Strings, Logical Operators, Boolean Variables.

Repetition Structures: Introduction, while loop, for loop, Sentinels, Input Validation Loops, Nested Loops.

UNIT-II

Functions: Introduction, Defining and Calling a Function, Designing a Program to Use Functions, Local Variables, Passing Arguments to Functions, Global Variables and Global Constants, Value-Returning Functions Generating Random Numbers, Writing Our Own Value-Returning Functions, The math Module, Random Module, Time Module and Storing Functions in Modules.

Python File Input-Output: Opening and closing file, various types of file modes, reading and writing to files, manipulating directories.

UNIT-III

Lists and Tuples: Sequences, Introduction to Lists, List slicing, Finding Items in Lists with the in Operator, List Methods and Useful Built-in Functions, Copying Lists, Processing Lists, Two-Dimensional Lists, Tuples.

Strings: Basic String Operations, String Slicing, Testing, Searching, and Manipulating Strings.

Dictionaries and Sets: Dictionaries, Sets, Serializing Objects.

Recursion: Introduction, Problem Solving with Recursion, Examples of Recursive Algorithms.

UNIT-IV

Classes and Object-Oriented Programming: Procedural and Object-Oriented Programming, Classes, Working with Instances, Techniques for Designing Classes.

Exception Handling: What is exception, various keywords to handle exception such try, catch, except, else, finally, raise.

Regular Expressions: The match() Function, The search() Function, The sub() Function, The findall() and finditer() Functions, Flag Options.

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Gandipet, Hyderabad-75

UNIT-V

GUI Programming: Graphical User Interfaces, Using the tkinter Module, Display text with Label Widgets, Organizing Widgets with Frames, Button Widgets and Info Dialog Boxes, Getting Input with Entry Widget, Using Labels as Output Fields, Radio Buttons, Check Buttons.

Introduction to plotting in Python – Basic Plots- Line and Scatter Plot, box plot, bar plots, Histograms and plotting data contained in files.

Text Book:

1. Tony Gaddis, "Starting Out With Python", 3rd Edition, Pearson, 2015.

Suggested Reading:

1. ReemaThareja "Python Programming", Oxford Press, 2017
2. Kenneth A. Lambert, "Fundamentals of Python", Delmar Cengage Learning, 2013.
3. Fabio Nelli, "Python Data Analytics (With Pandas, NumPy, and Matplotlib)", Apress, 2nd Edition, 2018.
4. James Payne, "Beginning Python using Python 2.6 and Python 3", wrox programmer to programmer, 2010.
5. Paul Gries, "Practical Programming: An Introduction to Computer Science using Python", 3rd Edition, 2016.

Web Resource:

1. https://www.python.org/

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With effect from the academic year 2021-22

18EGO02 **GENDER SENSITIZATION**

(Open Elective-3)

Instruction	3 Periods per week
Duration of SEE Examination	3 Hours
SEE Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: This course will introduce the students to:

1. Sensibility regarding issues of gender in contemporary India.
2. A critical perspective on the socialization of men and women.
3. Popular debates on the politics and economics of work while helping them reflect critically on gender violence.

Course Outcomes: After successful completion of the course the students will be able to:

1. Understand the difference between "Sex" and "Gender" and be able to explain socially constructed theories of identity.
2. Recognize shifting definitions of "Man" and "Women" in relation to evolving notions of "Masculinity" and "Femininity".
3. Appreciate women's contributions to society historically, culturally and politically.
4. Analyze the contemporary system of privilege and oppressions, with special attention to the ways gender intersects with race, class, sexuality, ethnicity, ability, religion, and nationality.
5. Demonstrate an understanding of personal life, the workplace, the community and active civic engagement through classroom learning.

UNIT – I

Understanding Gender:

Gender: Why Should We Study It? (*Towards a World of Equals*: Unit -1)

Socialization: Making Women, Making Men (*Towards a World of Equals*: Unit -2)

Introduction. Preparing for Womanhood. Growing up Male. First lessons in Caste. Different Masculinities.

UNIT – II

Gender And Biology:

Missing Women: Sex Selection and Its Consequences (*Towards a World of Equals*: Unit -4) Declining Sex Ratio. Demographic Consequences.

Gender Spectrum: Beyond the Binary (*Towards a World of Equals*: Unit -10) Two or Many? Struggles with Discrimination.

UNIT – III

Gender and Labour:

Housework: the Invisible Labour (*Towards a World of Equals*: Unit -3) "My Mother doesn't Work." "Share the Load."

Women's Work: Its Politics and Economics (*Towards a World of Equals*: Unit -7)

Fact and Fiction. Unrecognized and Unaccounted work. Additional Reading: Wages and Conditions of Work.

UNIT-IV

Issues Of Violence

Sexual Harassment: Say No! (*Towards a World of Equals*: Unit -6)

Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading: "*Chupulu"*.

Domestic Violence: Speaking Out (*Towards a World of Equals*: Unit -8)

Is Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives. Additional Reading: New Forums for Justice.

Thinking about Sexual Violence (*Towards a World of Equals*: Unit -11)

Blaming the Victim-"I Fought for my Life…." - Additional Reading: The Caste Face of Violence.

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Gandipet, Hyderabad-75

UNIT – V
Gender: Co - Existence
Just Relationships: Being Together as Equals (*Towards a World of Equals*: Unit -12)
Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers. Additional Reading: Rosa Parks-The Brave Heart.

Textbook:
1. A. Suneetha, Uma Bhrugubanda, DuggiralaVasanta, Rama Melkote,VasudhaNagaraj, AsmaRasheed, GoguShyamala, DeepaSreenivas and Susie Tharu **"Towards a World of Equals: A Bilingual Textbook on Gender"** published by Telugu Akademi, Hyderabad, Telangana State, **2015**.

Suggested Reading:
1. Menon, Nivedita. Seeing like a Feminist. New Delhi: Zubaan-Penguin Books, 2012
2. Abdulali Sohaila. "I Fought For My Life…and Won."Available online at: http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/

Web Resources:
1. https://aifs.gov.au/publications/gender-equality-and-violence-against-women/introduction
2. https://theconversation.com/achieving-gender-equality-in-india

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Note: Since it is an Interdisciplinary Course, Resource Persons can be drawn from the fields of English Literature or Sociology or Political Science or any other qualified faculty who has expertise in this field from engineering departments.

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

With effect from the academic year 2021-22

18PY O01 **HISTORY OF SCIENCE AND TECHNOLOGY**

(Open Elective-3)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: This course aims to:

1. Gain the knowledge about origin of science in the Stone Age and its progress during Antiquity period.
2. Familiar with scientific views in the Medieval period and during the Industrial revolution.
3. Aware of modern scientific developments from 19th century onwards.

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

1. Demonstrate the process of beginning of science and civilization, knowledge acquisition and philosophical approach of science and its advancements in the Stone Ages and Antiquity period.
2. Illustrate the advancements in science and technology in the medieval period across Asia and Arab countries and decline and revival of science in Europe.
3. Explain the scientific approach and its advances of the Europeans and how the role of engineer during the industrial revolution and the major advancements.
4. Make use of the advancements in the field of science and technology by adopting new philosophies of 19th and first half of 20th century in finding ethical solutions to the societal problems.
5. Interpret the changes in specializations of science and the technology and build the relation between information and society from second half of 20th century onwards.

UNIT-I

Science - The Beginning (through 599 BC): The Stone Ages, Knowledge among hunter gatherers, Agricultural Revolution and other revolutions, Civilization, Major advances.

Science in Antiquity (600 BC - 529 AD): Philosophy, a precursor to science, Hellenistic world and the Roman Empire, Other cultures of the period, major advances.

UNIT-II

Medieval Science (530 AD - 1452 AD): The decline of science in Europe, Science in China, Science and mathematics in India, Arab science, revival of science in Europe, technology revolution of the Middle ages, Major advances.

The Renaissance and the Scientific Revolution (1453 AD – 1659 AD): Renaissance, Scientific Revolution, Technology, Major advances.

UNIT-III

Scientific Method: Measurement and Communication (1660 AD – 1734): European domination, The scientific method, Major advances.

The Industrial Revolution (1735 AD – 1819 AD): Industrial Revolution, Rise of the engineer, Major Advances.

UNIT-IV

Science and Technology in the 19th Century (1820 AD – 1894 AD): Philosophical basis of 19th-century science, Science and the public, Science and technology, Major advances.

Rise of Modern Science and Technology (1895 AD – 1945 AD): The growth of 20thcentury science, New philosophies, Quantum reality, Energy sources, Electricity: a revolution in technology, Major advances.

UNIT-V

Big Science and the Post-Industrial Society (1946 AD – 1972 AD): Big science, Specialization and changing categories, Technology changes society, Major advances.

The Information Age (1973 AD – 2015 AD): Information and society, Globalization, The post-industrial society, Problems of the Information age, Major Advances.

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Text Books:

1. Bryan Bunch and Alexander Hellemans, “The History of Science and Technology”, Houghton Mifflin Company (New York), 2004.
2. JD Bernal, “Science in History”, 4 Volumes, Eklavya Publishers, 2012.

Suggested Reading:

1.“The 100 Most Influential Scientists of All Time”, Edited by Kara Rogers, Britannica Educational Publishing, 2010.
2. Alberto Hernandez, “A Visual History of Science and Technology”, The Rosen Publishing Group, 2016.

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Scheme of Instruction and Syllabi

of

ME I to IV SEMESTERS

of

TWO YEAR PG COURSE

in

POWER SYSTEMS & POWER ELECTRONICS
(AICTE Model Curriculum with effect from AY 2020-21)

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
(Autonomous Institution under UGC, Affiliated to Osmania University)
Department of Electrical and Electronics Engineering

Accredited by NBA and NAAC-UGC,

Chaitanya Bharathi (Post), Gandipet, Hyderabad–500075

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Department of Electrical and Electronics Engineering

Chaitanya Bharathi Institute of Technology (A)

Gandipet, Hyderabad-500075

Programme: PG-EEE (Power Systems & Power Electronics)

VISION and MISSION of the Institute

Vision

To be a centre of excellence in technical education and research

Mission

To address the emerging needs through quality technical education and advanced research

Quality Policy

Chaitanya Bharathi Institute of Technology imparts value based technical education and training to meet the requirements of student, industry, trade/profession, research and development organizations for self-sustained growth of society.

VISION and MISSION of EEE Department

Vision

To achieve Academic and Professional Excellence in Teaching and Research in the frontier areas of Electrical and Electronics Engineering **Vis-a -Vis** serve as a Valuable Resource for Industry and Society.

Mission

Empowering the Faculty and Student Rendezvous to Nurture Interest for Conceptual Keystone, Applied Multidisciplinary Research, Inspiring Leadership and Efficacious Entrepreneurship culture, Impeccable Innovation in frontier areas to be synergetic with Environmental, Societal and Technological Developments of the National and International community for Universal Intimacy.

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M1: Emphasis on providing Strong Theoretical Foundation & Engineering Leadership Eminence, infusion of Creativity and Management skill while maintaining Ethics and Moral for Sustainable Development. (Individual development)

M2: Enable the Faculty and Student Interactions to trigger interest for Applied Multidisciplinary Research and Entrepreneurship Culture resulting in Significant Advancement of the field of Specialization with Involvement of Industries and Collaborative Educational Networks. (Sense of Ownership, Networking and Eco system Development).

M3: Extend the Conducive Neighborhoods for Innovation in frontier areas to keep pace with Environmental, Societal and Technological Developments of the National and International Community to Serve Humanity. (Service to Society, Atmanirbhar Bharat)

Program Educational Objectives of M.E (Power Systems & Power Electronics) Program

PEO 1: Will excel in Power System and Power Electronics area.

PEO 2: Will become successful in executing software related applications.

PEO 3: Will carry out research in new technologies relevant to PS & PE.

PEO 4: Will develop with professional ethics, effective communication skills and knowledge of societal impacts of computing technologies.

Program Outcomes of M.E (Power System & Power Electronics) Program

PO 1: An ability to independently carry out research /investigation and development work to solve practical problems.

PO 2: An ability to write and present a substantial technical report/document.

PO 3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PO 4: The students will be able to analyze, design and develop new control strategies in the areas of Power Systems and Power Electronics suitable for Industry requirements.

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Gandipet, Hyderabad-75

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SCHEME OF INSTRUCTION AND EXAMINATION

OF

MODEL CURRICULUM (R-20)

I-Semester of ME (PS & PE)

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
THEORY									
1	20EEC101	Real Time Applications for Power Systems	3	-	-	3	40	60	3
2	20EEC102	Power Electronic Converters	3	-	-	3	40	60	3
3	20EEE10X	Program Specific Elective- I	3	-	-	3	40	60	3
4	20EEE10X	Program Specific Elective- II	3	-	-	3	40	60	3
5	20MEC103	Research Methodology and IPR	2	-	-	2	40	60	2
6	AC-1	Audit Course-I	2	-	-	2	0	50	Non-Credit
PRACTICALS									
7	20EEC103	Power Systems Lab	-	-	4	-	50	-	2
8	20EEC104	Power Electronics Simulation Lab	-	-	4	-	50	-	2
TOTAL			16	-	8	-	300	350	18

L: Lecture T: Tutorial P:Practical SEE - Semester End Examination
CIE - Continuous Internal Evaluation

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Gandipet, Hyderabad-75

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

SCHEME OF INSTRUCTION AND EXAMINATION

OF

MODEL CURRICULUM (R-20)

II- Semester of ME (PS & PE)

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
THEORY									
1	20EEC105	Power System Dynamics	3	-	-	3	40	60	3
2	20EEC106	Advanced Power Electronic Circuits	3	-	-	3	40	60	3
3	20EEE10X	Program Specific Elective-III	3	-	-	3	40	60	3
4	20EEE10X	Program Specific Elective-IV	3	-	-	3	40	60	3
5	AC-II	Audit Course-II	2	-	-	2	0	50	Non-Credit
PRACTICALS									
6	20EEC107	Power Electronics Lab	-	-	4	-	50	-	2
7	20EEC108	Power Systems Simulation Lab	-	-	4	-	50	-	2
8	20EEC109	Mini Project with Seminar	-	-	4	-	50	-	2
		TOTAL	**14**	**0**	**12**	**-**	**310**	**290**	**18**

L: Lecture T: Tutorial P: Practical SEE - Semester End Examination
CIE- Continuous Internal Evaluation

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SCHEME OF INSTRUCTION AND EXAMINATION

OF

MODEL CURRICULUM (R-20)

III- Semester of ME (PS & PE)

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
THEORY									
1	20EEE10X	Program Specific Elective- V	3	-	-	3	40	60	3
2	OE	Open Elective	3	-	-	3	40	60	3
PRACTICALS									
3	20EEC110	Industrial Project /Dissertation Phase 1		-	20	Viva	100	-	**10**
TOTAL			**6**	**0**	**20**	**-**	**180**	**120**	**16**

L: Lecture T: Tutorial P: Practical SEE - Semester End Examination
CIE - Continuous Internal Evaluation

SCHEME OF INSTRUCTION AND EXAMINATION

OF

MODEL CURRICULUM (R-20)

IV- Semester of ME (PS & PE)

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination		Credits
			Hours per week			Maximum Marks		
			L	T	P	CIE	SEE	
PRACTICALS								
1	20EEC111	Industrial Project /Dissertation Phase II	-	-	32	100	100	16
	TOTAL		**0**	**0**	**32**	**100**	**100**	**16**

L: Lecture T: Tutorial P: Practical SEE - Semester End Examination
CIE Continuous Internal Evaluation

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List of Program Specific Electives/ Open Electives/ Audit Courses

Course Code	Program Specific Electives Group-1
20EEE101	Electrical Power Distribution System
20EEE102	Mathematical Methods for Power Engineering
20EEE103	Restructured Power Systems
20EEE107	Renewable Energy System
20EEE109	Digital Protection of Power System
20EEE110	Power Quality
20EEE114	Smart Grids
20EEE115	High Voltage Engineering

Course Code	Program Specific Electives Group-2
20EEE104	Power Semi Conductor devices & Modelling
20EEE105	Electric Drive Systems
20EEE106	HVDC
20EEE108	Artificial Intelligence Techniques for Power Systems
20EEE111	FACTS and Custom power devices
20EEE112	Switch mode & Resonant Converters
20EEE113	Energy Auditing & Management
20EEE116	Electric and Hybrid Vehicles

Course Code	Open Electives
20CSO 101	Business Analytics
20MEO101	Industrial Safety
20MEO 102	Introduction to Optimization Techniques
20MEO 103	Composite Materials
20CEO 101	Cost Management of Engineering Projects
20EEO 101	Waste to Energy

Course Code	Audit Courses – I & II
20EGA 101	English for Research Paper Writing
20EGA 102	Indian Constitution and Fundamental Rights
20EGA 103	Stress Management by Yoga
20EGA 104	Personality Development through Life Enlightenment Skills
20ECA 101	Value Education
20CEA 101	Disaster Mitigation and Management
20ITA 101	Pedagogy Studies
20EEA 101	Sanskrit for Technical Knowledge

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20EEC101 **REAL TIME APPLICATIONS FOR POWER SYSTEMS**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To understand the real-time computer operations of power system
2. To understand the importance of contingency analysis at planning stage for secured operation of power system.
3. To understand the concept of load forecasting in real time power system operation

Course Outcomes: After completion of this course, the student will be able to:

1. Understand the study of optimal power flows
2. Acquire knowledge of state estimation required for the real-time operation of power system
3. Describe the importance of contingency analysis at planning stage for secured operation of power system and simulating the contingency studies with different methods.
4. Discuss the power system security and challenges in secured operation of power system in real-time environment.
5. Explain various methods and models available in power system load forecasting

UNIT-I

Optimal Power Flow: Introduction to optimal power flow, Gradient method, Newton's method, Linear sensitivity analysis, linear programming method with real power variables, linear programming with AC power flow variables and detailed cost functions, security constraint optimal power flow, interior point method, bus incremental costs

UNIT-II

State Estimation: Introduction to power system state estimation, Weighted-Least square state estimation, state estimation of AC networks, state estimation by orthogonal decomposition, Detection and identification of bad measurements, network observability, pseudo-measurements, application of state estimation.

UNIT-III

Contingency Analysis of Power system: Approximations in Contingency Analysis, Simulation of Addition and Removal of Multiple Lines in a Power System, Simulation of Tie-lines in Interconnected Power Systems, Network Reduction for Contingency Analysis, Contingency Analysis, Approximate Power Flow Method for Simulating Contingencies

UNIT-IV

Power system Security: Introduction, factors affecting power system security, generator outages, transmission line outage, linear sensitivity factors, contingency selection, concentric relaxation, bounding, adaptive localization

UNIT-V

Load Forecasting: Introduction, Analytic methods, demand models, price forecasting, forecasting errors, system identification, econometric models, time series, time series model development, demand prediction.

Text Books:

1. Wood, A. J., Wollenberg, B. F., & Sheblé, G. B. 'Power Generation, operation and control', John Wiley &Sons, 2013.
2. T.K.Nagsarkar, M.S.Sukhija, 'Power system analysis', Oxford publications, 2007.

Suggested Reading:

1. J J Grainger and W D Stevenson, Power system Analysis, Mc Graw Hill 2003
2. Debs, Atif S. *Modern power systems control and operation*. Springer Science & Business Mec

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With effect from the academic year 2020-2021

20EEC102 **POWER ELECTRONIC CONVERTERS**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To understand the concepts and basic operation of transient and steady state analysis of all power electronic converters with passive and active loads.
2. To understand the operation of single phase and three phase full–wave converters and analyse harmonics in the input current.
3. To analyze the operation of single phase cyclo-converters, Inverters and dc–dc converters

Course Outcomes: After completion of this course, students will be able to:

1. Give a systematic approach for transient and steady state analysis of all power electronic converters with passive and active loads.
2. Know and carry out transient and steady state analysis of different power converters of different types of loads and switching sequences.
3. Analyze power electronic devices
4. Analyze and design DC-DC and DC-AC converters.
5. Analyze and design AC regulator and Cyclo converter

UNIT-I

Power Semiconductor Switched Circuits: Analysis of power semiconductor switched circuits with R, L, RL, RC loads and D.C. motor loads, Battery charging circuit.

UNIT-II

Phase Controlled Rectifiers: Single-Phase and Three-Phase AC to DC converters, Single phase half controlled and fully controlled converters, operating domains of three phase full converters and semi-converters. Reactive power considerations.

UNIT-III

Non-Isolated DC-to-DC Converters (Choppers): Analysis and design of DC to DC converters, Control of DC-DC converters, Buck converters, Boost converters, Buck Boost converters, Cuck converters.

UNIT-IV

Inverters: Single phase and three phase inverters, Single phase half bridge and full bridge inverters, voltage source and current source inverters, comparison between voltage source and current source inverters, Voltage control and harmonic minimization in inverters.

UNIT-V

AC Voltage Controllers and Cyclo-Converters: AC to AC power conversion using voltage regulators, Uni-directional and Bi-directional AC voltage controllers, applications of AC voltage controllers, AC Choppers and cyclo-converters, step down and step-up cyclo converters, Consideration of harmonics, introduction to Matrix converters.

Text Books:

1. Ned Mohan, Undeland and Robbin,Power Electronics: converters, Application and design, John's Wiley and sons. Inc, Newyork.
2. M.H.Rashid,Power Electronics, Prentice Hall of India 1994.

Suggested Reading:

1. Soumitra Kumar Mandal, Power Electronics, McGraw Hill education
2. Dr. P.S. Bimbhra, Power Electronics, Khanna publications
3. M D Singh, K B Khanchandani, Power Electronics, McGraw Hill education

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20MEC 103 **RESEARCH METHODOLOGY AND IPR**

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

Course Objectives: To make the students to

1. Motivate to choose research as career, identify various sources for literature review and reportwriting
2. Formulate the research problem, prepare the research design and equip with good methods toanalyze the collected data
3. Know about IPR copyrights

Course Outcomes: At the end of the course, student will be able to:

1. Define research problem, review and asses the quality of literature from various sources
2. Improve the style and format of writing a report for technical paper/ Journal report, understand and develop various research designs
3. Collect the data by various methods: observation, interview, questionnaires
4. Analyze problem by statistical techniques: ANOVA, F-test, Chi-square
5. Understand apply for patent and copyrights

UNIT - I

Research Methodology: Research Methodology: Objectives and Motivation of Research, Types of Research, research approaches, Significance of Research, Research Methods verses Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. Defining the Research Problem: Selection of Research Problem, Necessity of Defining the Problem

UNIT - II

Literature Survey Report writing: Literature Survey: Importance and purpose of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet. Report writing: Meaning of interpretation, layout of research report, Types of reports, Mechanics of writing a report. Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal

UNIT - III

Research Design: Research Design, Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Steps in sample design, types of sample designs.

UNIT - IV

Data Collection and Analysis: Data Collection: Methods of data collection, importance of Parametric, non parametric test, testing of variance of two normal population, use of Chi-square, ANOVA, Ftest, z-test

UNIT - V

Patents and Copyright: Patent: Macro economic impact of the patent system, Patent document, How to protect your inventions. Granting of patent, Rights of a patent, how extensive is patent protection. Copyright: What is copyright. What is covered by copyright. How long does copyright last? Why protect copyright? Related Rights: what are related rights? Enforcement of Intellectual Property Rights: Infringement of intellectual property rights, Case studies of patents and IP Protection

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Text Books:

1. C.R Kothari, "Research Methodology, Methods & Technique"; New Age International Publishers, 2004
2. R. Ganesan, "Research Methodology for Engineers", MJP Publishers, 2011
3. Y.P. Agarwal, "Statistical Methods: Concepts, Application and Computation", Sterling Publs., Pvt., Ltd., New Delhi, 2004

Suggested Reading:

1. Ajit Parulekar and Sarita D' Souza, "Indian Patents Law – Legal & Business Implications"; Macmillan India Ltd., 2006
2. B. L.Wadehra; "Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications"; Universal law Publishing Pvt. Ltd., India 2000.
3. P. Narayanan; "Law of Copyright and Industrial Designs"; Eastern law House, Delhi 2010

Discussion is an exchange of intelligence, argument is an exchange of ignorance; Discussion is to find out what is right, argument is to find out who is right.

Vikasa Mantras- Vivekananda Institute of Human Excellence

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20EEC103 **POWER SYSTEMS LAB**

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Course Objectives:

1. To understand the I–V and P-V characteristics of a PV module
2. To measure the sequence reactance of synchronous machine and 3-phase transformer
3. a) To understand the characteristics of various relays
   b) To estimate efficiency, regulation and ABCD constants of 3-phase transmission line

Course Outcomes:

After completion of the course, **s**tudent will be able to:

1. Learn the measurement of sequence reactance of synchronous machine and 3-phase transformer
2. Knowledge about the relay characteristics
3. Acquire Knowledge to estimate efficiency, regulation and ABCD constants of 3-phase transmission line
4. Learn about various types of faults
5. Validate the I–V and P-V characteristics of a PV module

LIST OF EXPERIMENTS:

1. Measurement of positive, negative and zero sequence reactance of synchronous machine
2. Measurement of positive and zero sequence reactance of three-phase transformer
3. Determination of Regulation & Efficiency of a three phase transmission line
4. Determination of ABCD constants of a three phase transmission line
5. Inverse time characteristics of over current relay
6. Characteristics of static over current relay
7. Differential protection of single-phase transformer
8. Study of microprocessor based inverse current relay characteristics
9. Study of over voltage and under voltage relays
10. Study of line-to-ground, line-to-line and three-phase faults
11. Single PV module I-V and P-V characteristics with radiation and temperature changing effect.
12. I-V and P-V characteristics with series and parallel combination of modules.
13. Effect of shading and Effect of tilt angle on I-V and P-V characteristics of solar module.
14. Finding MPP by varying the resistive load by varying the duty cycle of DC-DC converter.
15. Observe the output voltage waveform of inverter in auto mode.
16. Three-phase UPQC for power quality mitigation

Note: At least **TEN** experiments should be conducted in the semester

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With effect from the academic year 2020-2021

20EEC104 **POWER ELECTRONICS SIMULATION LAB**

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Course Objectives:

1. To be acquainted with simulation of different power converters
2. To Simulate and compare the output of single-phase and three-phase converters with R, RL and RLE loads
3. To Simulate single and three-phase Inverters and their voltage control techniques

Course Outcomes: After completion of the course, students will be able to:

1. Acquire the knowledge of using simulation tools for power electronic converters modelling.
2. Analyze the performance of phase -controlled converters by simulation
3. Demonstrate the effects of different topologies and voltage control techniquesin inverters.
4. Simulate different dc-dc converter circuits
5. Investigate with ac-ac conversion and reactive power compensation calculations.

List of Experiments

1. Single-phase semi-converter using RL & RLE loads with and without freewheeling diode.
2. Three-phase full converter using RL load with and without LC Filter
3. Three-phase fully controlled converter fed dc drive
4. Performance analysis of phase-controlled rectifiers with source inductance(single phase and three phase)
5. Analysis of Buck and Buck-Boost converters
6. Speed control of dc drive using dc chopper
7. Analysis of single-phase and Three phase IGBT inverters
8. Single, multiple and sinusoidal PWM techniques
9. Voltage control of an inverter using unipolar & bipolar PWM techniques
10. Inverter voltage control using Space Vector Modulation
11. Single-phase current source inverter with RL load
12. Analysis of three phase AC voltage controller with R & RL loads
13. Single-phase Cyclo-converter with R & RL loads
14. Single-phase Dual converter with R & RL loads
15. Reactive power compensation using FACTS controllers
16. Simulation of matrix converter.

Note: At least **TEN** Experiments should be conducted in the semester

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20EEC105 **POWER SYSTEM DYNAMICS**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To understand and analyze the various stability concepts of the power system
2. To study the concept of modeling the synchronous machines
3. To understand the phenomenon of SSR oscillations in power system

Course Outcomes: After completion of the course, the student will be able to

1. Distinguish various stabilities issues in the power system
2. Understand the modeling of synchronous machine
3. Describe the role of Excitation, PSS and Prime Movers in improving the power system performance during disturbances
4. Analyze the small-signal stability of the power system
5. Infer the concepts of LFOs and SSR in detail

UNIT-I

Synchronous Machine Modeling: Introduction, Park's Transformation, Flux Linkage Equations, Voltage Equations, Formulation of State-Space Equations, Current Formulation, Per Unit Conversion, Normalized Voltage and Torque Equations, Torque and Power, Equivalent Circuit of a Synchronous Machine, Flux Linkage State-Space Model

UNIT-II

Stability: Definitions classification of stability, Analysis of Steady state stability, Factors affecting Steady state stability, Transient stability, Equal-area criterion, Factor influencing Transient stability, Numerical Methods for analyzing transient stability,

Definition of voltage stability, voltage security, voltage collapse, Factors contributing and affecting voltage stability and minimization of voltage collapse, analysis of voltage stability/collapse, P-V and Q-V curves

UNIT-III

System performance improvement:

Excitation systems: Requirements, elements of excitation systems, types of excitation systems, modeling of excitation systems

Power system stabilizers: Basic concepts in applying PSS, Structure and tuning of PSS

Load models: Concept of load modeling, static and dynamic load models

Prime Movers: Hydraulic turbine and governing systems, steam turbine and governing system

UNIT-IV

Small-signal stability: Fundamentals of stability of dynamic systems, Modal matrices, free motion of dynamic systems, mode shapes, small-signal analysis of SMIB, synchronizing and damping torque analysis, state equations for small-signal model.

Unit V

Sub-Synchronous Oscillations: Turbine-generator torsional characteristics, Torsional interactions with power system controls, Sub-Synchronous Resonance (SSR), counter-measures for SSR

Text Books:

1. P. M. Anderson & A. A. Fouad "Power System Control and Stability", Wiley 7 Sons, 2003
2. P. Kundur, "Power System Stability and Control", McGraw Hill Inc, 1994
3. K R Padiyar,'power system dynamics: stability and control', BS Publications, 2008

Suggested Reading:-

1. J Machowski, J Bialek& J. R W. Bumby, "Power System Dynamics and Stability", John Wiley & Sons, 1997
2. L. Leonard Grigsby (Ed.); "Power System Stability and Control", Second edition, CRC Press,2007

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With effect from the academic year 2020-2021

20EEC106 **ADVANCED POWER ELECTRONIC CIRCUITS**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: Students will be able to:
1. Understand the operation of advanced power electronic circuit topologies.
2. Understand the load, switch and resonant converters.
3. Understand the modeling and design concepts of various DC-DC converters used in renewable

Course Outcomes: After completion of course Student will be able to:
1. Demonstrate the knowledge of DC isolated and non-isolated regulators
2. Demonstrate the knowledge of load and switch resonant converters
3. Demonstrate the knowledge resonant inverters
4. Model and design DC-DC converters for renewable energy conversion.
5. Apply the knowledge of dc-dc converters used in dc drives and renewable energy applications

UNIT-I
DC Regulators-I: Boost type APFC and control. Three phase utility inter phases and control-Buck, Boost, Buck-Boost SMPS, Topologies

UNIT-II
DC Regulators-II: Modes of operation –Push-Pull and Forward Converter Topologies - Voltage Mode Control. Half bridge, Full bridge and Fly-back Converters.

UNIT-III
Resonant Converters-I: Load Resonant Converter. Zero Voltage Switching Clamped Voltage Topologies.

UNIT-IV
Resonant Converters-II: Resonant DC Link Inverters with Zero Voltage Switching, High Frequency Link Integral Half Cycle Converter

UNIT-V
Application of DC-DC converters: Modeling and design of DC-DC Converters for various renewable energy conversion, Few power electronic circuits used in DC drives.

Text Books:
1. Rashid "Power Electronics" Prentice Hall India 2007.
2. G.K.Dubey et.al "Thyristorised Power Controllers" Wiley Eastern Ltd., 2005, 06.
3. Dewan & Straughen "Power Semiconductor Circuits" John Wiley & Sons., 1975.

Suggested Reading:
1. G.K. Dubey& C.R. Kasaravada "Power Electronics & Drives" Tata McGraw Hill., 1993
2. Cyril W Lander "Power Electronics" McGraw Hill., 2005.
3. B. K Bose "Modern Power Electronics and AC Drives" Pearson Education (Asia)., 2007
4. Abraham I Pressman "Switching Power Supply Design" McGraw Hill Publishing Company., 2001.

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With effect from the academic year 2020-2021

20EEC107 **POWER ELECTRONICS LABORATORY**

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Course Objectives:

1. To understand the performance of converters for different loads.
2. To know various methods of speed control of electric drives.
3. To identify different topologies of converters and switching methods.

Course Outcomes: After the completion of this course, students will be able to:

1. Demonstrate the effects of different loads on the performance of various phase-controlled converters and choppers.
2. Understand the various topologies and control techniques used in inverters.
3. Acquire the conversion principles of AC-AC converters
4. Analyze different power electronic based speed control techniques of electric drives
5. Utilize matrix converter for different power conversions and analyze resonant converters.

List of Experiments

1. Three-phase half controlled and full controlled bridge rectifiers withR and RL loads.
2. Analysis of chopper circuit.
3. Analysis of single-phase series-resonant inverter.
4. Three-phase Mc-Murray Bed-Ford inverter with R and RL loads.
5. Three-phase IGBT inverter with R & RL loads.
6. Closed-loop control of permanent magnet dc drive.
7. Three-phase step down cyclo-converter with R and RL loads.
8. Static rotor resistance control of slip-ring induction motor.
9. Operation of two quadrant dc drive.
10. Analysis of ZVS buck converter
11. Design and implementation of ZCS buck converter
12. Obtaining different converters using Matrix converter module
13. Speed control of SRIM using static Kramer's system.
14. Speed control of Three phase induction motor using AC-AC converter.
15. Design of a flyback converter for solar energy powered DC loads
16. Analysis of three phase cascaded multi-level inverter.

Note: At least **TEN** experiments should be conducted

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

With effect from the academic year 2020-2021

20EEC108	**POWER SYSTEMS SIMULATION LAB**	
Instruction		4 Hours per week
CIE		50 Marks
Credits		2

Course Objectives:

1. To Simulate and compare the various aspects economic load dispatch and load flows.
2. To Simulate and observe stability studies and short-circuit studies
3. To Conduct experiments on modeling of Transmission line

Course Outcomes: After completion of this course**,** students will be able to:

1. Validate the adaptability of economic load dispatch and load flow for a given situation by simulation results.
2. Acquire the knowledge about formation of Impedance and Admittance Matrices
3. Acquire the knowledge to analyze the Symmetrical and un-symmetrical fault currents
4. Acquire the knowledge to simulate various types of transmission models
5. Acquire the knowledge about Symmetrical and Unsymmetrical components for a given system.

List of Experiments:

1. Single Area and Two Area Load Frequency Control
2. Economic Load Dispatch in Power Systems
3. Formation of Z-Bus Matrix using Building Algorithm
4. Load Flow Studies Using Gauss-Seidel and Newton-Raphson Method
5. Transient Stability Studies
6. Short Circuit Analysis for unsymmetrical faults
7. Formation of Bus Admittance Matrix
8. Three Phase Short Circuit Analysis of Synchronous Machine
9. Unsymmetrical Fault Analysis for RLC loads
10. Step Response of Synchronous Machine
11. Determination of Symmetrical Components
12. Simulation of Ferranti Effect
13. Modeling of Transmission Lines
14. Solution of Swing Equation
15. Load flow studies of Distribution Systems
16. Simulation of UPQC for power quality mitigation

Note: At least **TEN** experiments should be conducted in the semester.

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

with effect from the academic year 2020-2021

20EEC109 **MINI PROJECT WITH SEMINAR**

Instruction	4 Hours per week
SEE	50 Marks
Credits	2

I. Course Objectives:

1. Motivate the students to face the challenges in which demonstration of their competence in research techniques.
2. Provide an opportunity to contribute to engineering arena in their own form.

II. Course Outcomes: On successful completion of the course students will be able to:

1. Organise the literature review to identify and formulate the engineering problem
2. Design engineering solutions to simple problems utilizing modern tools and methods
3. Demonstrate a sound technical knowledge of their selected mini project topic
4. Communicate with engineers and the community to have the conscious of surroundings
5. Adapt the skills and attitudes of a Professional Engineer.

III. General Instructions:

1. Mini Project is of 14 week duration out of which one week prior reading, twelve weeks of active research and final week for presentation of their work for assessment.
2. Each student will be allotted to a faculty supervisor for mentoring.

IV. Methodology:

1. The student can select either mathematical modeling based / experimental investigations or numerical modeling.
2. All the investigations are clearly stated and documented with reasons / explanations.
3. The project should contain
   i. A clear statement of research objectives
   ii. Background work
   iii. Literature review
   iv. Techniques used
   v. Prospective deliverables
   vi. Benefit from this research
   vii. Detailed discussion on results
   viii. Conclusions and references

V. Assessment:

1. 50% of the marks for oral presentation which will take place at the end of the semester.
2. Evaluation will be done by a committee consisting of supervisor, one senior faculty and Head of the department or his nominee.
3. Evaluation will be carried out based on 'RUBRIC' (which will be supplied by the dept.)
4. 50% of the marks for scientific report on the project.
5. Report should be written as per standard journal format. The repertoire of the report content can be taken from the department.

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

with effect from the academic year 2020-2021

20EEC110 **INDUSTRIAL PROJECT / DISSERTATION PHASE- I**

Instruction	20 Hours per week
SEE	100 Marks
Credits	10

Course Objectives: At the end of the course:

1. Students will be exposed to self-learning various topics.
2. Students will learn to survey the literature such as books, national/international refereed journals and contact resource persons for the selected topic of research.
3. Students will learn to write technical reports.
4. Students will develop oral and written communication skills to present.
5. Student will defend their work in front of technically qualified audience.

Course Outcomes: On successful completion of the course students will be able to:

1. State research questions related to main problem and identify the Research methods
2. Identify literature for review.
3. Integrate theory and practice.
4. Apply knowledge and understanding in relation to the agreed area of study.
5. Communicate in written form by integrating, analysing and applying key texts and practices

Guidelines:

1. The Project work will preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.
2. Seminar should be based on the area in which the candidate has undertaken the dissertation work.
3. The CIE shall include reviews and the preparation of report consisting of a detailed problem statement and a literature review.
4. The preliminary results (if available) of the problem may also be discussed in the report.
5. The work has to be presented in front of the committee consists of Head, Chairperson-BoS, Supervisor and Project coordinator.
6. The candidate has to be in regular contact with his supervisor and the topic of dissertation must be mutually decided by the guide and student.

Guidelines for the award of Marks: Max. Marks: 100		
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Supervisor	30	Project Status / Review(s)
	20	Report
Department Committee	10	Relevance of the Topic
	10	PPT Preparation(s)
	10	Presentation(s)
	10	Question and Answers
	10	Report Preparation

Note: Department committee has to assess the progress of the student for every two weeks.

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Gandipet, Hyderabad-75

20EEC111 INDUSTRIAL PROJECT / DISSERTATION PHASE- II

Instruction	32 Hours per week
SEE	100 Marks
CIE	100 Marks
Credits	16

Course Objectives: At the end of the course:

1. Students will be able to use different experimental techniques and will be able to use different software/ computational/analytical tools.
2. Students will be able to design and develop an experimental set up/ equipment/test rig.
3. Students will be able to conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them.
4. Students will be able to either work in a research environment or in an industrial environment.
5. Students will be conversant with technical report writing and will be able to present and convince their topic of study to the engineering community.

Course Outcomes: On successful completion of the course students will be able to:

1. Contribute to Research and Development work.
2. Apply a holistic view to critically, independently and creatively to identify, formulate and deal with complex issues.
3. Evaluate critically different engineering/Technological solutions.
4. Integrate knowledge critically and systematically
5. Develop the ethical aspects of Research work.

Guidelines:

1. It is a continuation of Project work started in semester III.
2. The student has to submit the report in prescribed format and also present a seminar.
3. Develop strong communication skills to defend their work in front of technically qualified audience
4. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion.
5. The report must bring out the conclusions of the work and future scope for the study. The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner (HoD and BoS Chair Person) guide/co-guide.
6. The candidate has to be in regular contact with his/her guide/co-guide.

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Gandipet, Hyderabad-75

Guidelines for awarding marks in CIE:		Max. Marks: 100
Evaluation by	**Max .Marks**	**Evaluation Criteria / Parameter**
Review Committee	05	Review 1
	10	Review 2
	10	Review 3
	15	Final presentation with the draft copy of the report standard format
	10	Submission of the report in a standard format
Supervisor	10	Regularity and Punctuality
	10	Work Progress
	10	Quality of the work which may lead to publications
	10	Analytical / Programming / Experimental Skills
	10	Report preparation in a standard format

Evaluation by	**Max .Marks**	**Evaluation Criteria / Parameter**
External and Internal	20	Power Point Presentation
	40	Quality of thesis and evaluation
Examiner(s) together	20	Quality of the project 1. Innovations 2. Applications 3. Live Research Projects 4. Scope for future study 5. Application to society
	20	Viva-Voce

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Program Specific Electives

20EEE101 ELECTRIC POWER DISTRIBUTION SYSTEM

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To study sub-transmission, Distribution substations
2. To understand the philosophy of Distribution Automation and SCADA
3. To explore with the optimization aspects of distribution system

Course Outcomes: After completion of the course, students will be able to:

1. Acquire knowledge of sub-transmission, Distribution substations
2. Understand Distribution voltage regulation
3. Discuss the Distribution automation and its application in practice
4. Explain the concept of optimization in distribution automation
5. Demonstrate the need and functioning of SCADA system

UNIT-I

Sub-Transmission Lines & Substations: Types of sub transmission, Distribution substation, Bus schemes, Substation location, Rating of substation, Calculation of voltage drops with primary feeders, Derivation of the K constant, Application curves, Interpretation of the Percentage Voltage drop formula.

UNIT-II

Primary Feeders: Types of primary feeders, Primary feeder loading, Tie lines, Design of radial primary feeders, Voltage drop calculations by ABCD constants, Uniformly distributed load, Non uniformly distributed load, Distribution Feeder Analysis

Secondary Feeders: Secondary voltage levels, Present design practice, Secondary Banking, Economic design of secondaries, Total annual cost equation.

UNIT-III

Distribution voltage regulation: Three-phase balanced and non-three-phase primary lines, analysis distribution and equipment costs, introduction to Distribution system voltage regulation, voltage standards, voltage control, feeder-voltage regulators, line-drop compensation, capacitor automation, voltage fluctuations

UNIT-IV

Distribution Automation: Introduction, Project planning, Definitions, Communication, Sensors, Supervisory Control and Data Acquisition Systems (SCADA), Consumer Information Service(CIS), Geographical Information System (GIS), Automatic Meter Reading (AMR), Automation system.

Optimization: Costing of schemes, optimal placement of Capacitors, Optimum size of line conductor in Distribution Systems, Restoration and Reconfiguration of network, Economic loading of distribution transformers, Optimal switching device placement.

UNIT-V

SCADA: Introduction, Block Diagram, components of SCADA, Functions of SCADA, SCADA applied to distribution automation, Advantages of Distribution Automation through SCADA, Communication protocols in SCADA systems

Text Books:

1. Turan Gonen, Electric Power Distribution System Engineering, CRC Press, 2nd Edition, 2008
2. A.S. Pabla, Electric Power Distribution, Tata McGraw Hill Publishing Co. Ltd., 5th Edition, 2004

Suggested Reading:

1. M.K. Khedkar, G.M. Dhole, A Text Book of Electric power Distribution Automation, University Science Press, New Delhi,2010
2. Anthony J Pansini, Electrical Distribution Engineering, CRC Press, 1992
3. James Momoh, Electric Power Distribution, automation, protection & control, CRC Press, 20(

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20EEE102 MATHEMATICAL METHODS FOR POWER ENGINEERING

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To understand the relevance of mathematical methods to solve engineering problems.
2. To understand the theoretical workings of the simplex method for linear programming and perform iterations of it by hand.
3. To understand how to model and solve problems using linear and nonlinear programming with and without constraints

Course Outcomes: After completion of the course, students will be able to:

1. Recognize and identify the nature of the mathematical problems that are commonly encountered in power engineering
2. Knowledge about vector spaces, linear transformation, Eigen values and eigenvectors of linear operators
3. To learn about linear programming problems and understanding the Simplex method for solving linear programming problems in various fields of science and technology
4. Acquire knowledge about nonlinear programming and various techniques used for solving constrained and unconstrained nonlinear programming problems
5. Understanding the concept of random variables, functions of random variable and their probability distribution

UNIT-I

Vector spaces, linear transformations, Matrix representation of linear transformation

UNIT-II

Eigen values and Eigen vectors of linear operator

UNIT-III

Linear Programming Problems, Simplex Method, Duality, Non Linear Programming problems

UNIT-IV

Unconstrained Problems, Search methods, Constrained Problems

UNIT-V

Lagrange method, Kuhn-Tucker conditions, random Variables, distributions, Independent Random Variables

Text Books:

1. Kenneth Hoffman and Ray Kunze,Linear Algebra, 2nd Edition, PHI, 1992
2. Erwin Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, 2004
3. Irwin Miller and Marylees Miller, John E. Freund's, Mathematical Statistics, 6th Edn, PHI, 2002
4. J. Medhi, Stochastic Processes, New Age International, New Delhi., 1994

Suggested Reading:

1. A Papoulis,Probability, Random Variables and Stochastic Processes, 3rd Edition, McGraw Hill, 2002
2. John B Thomas,An Introduction to Applied Probability and Random Processes, John Wiley, 2000
3. Hillier F S and Liebermann G J, Introduction to Operations Research, 7th Edition, McGraw Hill, 2001
4. Simmons D M,Non Linear Programming for Operations Research, PHI, 1975

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With effect from the academic year 2020-2021

20EEE103 **RESTRUCTURED POWER SYSTEMS**

Instruction	3 Hour per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To understand open access and operation of power system in deregulated and competitive environment.
2. To understand the role of ISO in pool markets, Bilateral markets and transmission pricing issues
3. To understand different aspects of managing ancillary services and open access same time information system.

Course Outcomes: After completion of the course, students will be able to:

1. Understand the operation of power system in de-regulated and competitive environment
2. Discuss operation and planning policies, in deregulated environment.
3. Describe the transmission pricing methodologies.
4. Distinguish different ancillary services provided by the ISO
5. Explain open access same-time information system.

UNIT-I

Introduction to Power System Deregulation: Operation of vertically integrated power systems, Fundamental of Restructured systems, Benefits of deregulation, Power pools, Energy Brokerage system, Electricity market models, Market models based on contractual arrangements, Market architecture, Spot market, Day-ahead market and retail market, Models for trading arrangements. Congestion management.

UNIT-II

Power System Operation in Competitive Environment: Operational planning activities of ISO, ISO in pool markets, ISO in bilateral markets, Operational planning activities of a GENCO, Unit commitment in deregulated environment, Competitive bidding. Risk assessment.

UNIT-III

Transmission Pricing Issues: Power wheeling, transmission open access, cost components in transmission, pricing of power transactions, Transmission cost allocation methods, Postage stamp method, Contract path method, MW-Mile method, MVA-Mile method, Unused transmission capacity method, Comparison of cost allocation methods.

UNIT-IV

Ancillary Services Management: Types of ancillary services, classification of ancillary services, load generation balancing related services, frequency regulation, load following, voltage control and reactive power support service, black start capability service, Synchronous generators as ancillary service providers. Standard market design.

UNIT-V

Open Access Same-time Information System: Structure of oasis, Posting of information, Transfer capability on oasis, Definitions- ATC, TTC, TRM, CBM, Methodologies to calculate ATC. Developments in India, IT applications in Restructured markets.

Text Books:

1. Lai, L.L. (Editor.), 'Power System Restructuring and Deregulation', John Wiley and Sons Ltd., 2001.
2. Bhattacharya, K., Bollen, M.H.J., and Daalder, J.E., 'Operation of Restructured Power Systems', Kluwer Academic Publishers. 2001.

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Suggested Readings:

1. LorrinPhilipson, H. Lee Willis, "Understanding electric utilities and de- regulation", Marcel Dekker Pub.,1998.
2. Steven Stoft, "Power system economics: designing markets for electricity", John Wiley and Sons, 2002.
3. M.Ilic, F.Galiana and L.Fink, 'Power System Restructuring Engineering and Economics', Kluwer Academic Publishers 1998.
4. Md Shahidephpour & M. Alomoush, 'Restructured Electrical Power Systems', Marcel Dekker Inc, 2001.

Time is what we need most, but what we use worst; Most of the misfortunes in our life are due to misused time.

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20EEE107 **RENEWABLE ENERGY SYSTEM**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To learn various renewable energy sources
2. To understand the working principles and implementation aspects of solar and wind energy sources.
3. To understand power electronics interface and power quality problems with grid

Course Outcomes: After completion of the course, students will be able to:

1. Acquire the knowledge on design of solar PV systems
2. Implement the concepts of wind power generation
3. Demonstrate the suitability of non-conventional energy for grid connection
4. Understand the working of distributed generation system in autonomous/grid connected modes
5. Analyze economic aspects of power generation and its power quality issues

UNIT-I

Generation of Electrical Energy: Introduction, Conventional and renewable sources of energy, Distributes and central station generation, DG technologies, Advantages and disadvantages of distributed generation, introduction to hydro, tidal, wave, Geothermal and biomass energy.

UNIT-II

Solar Energy Conversion: Solar radiation and its measurements, Types of solar collectors, Combined heat and power, Solar thermal power plant, Components of solar PV system, Efficiency and limits, Design of solar PV Hybrid system, Standalone and Grid connected systems

UNIT-III

Wind Energy: Power in the wind, Types of wind turbines, Components of wind mill, operation of wind turbines, Wind energy extraction, Types and design of wind turbine rotor, modes of wind power generation, Selection of optimum WEG, Grid interfacing of wind farm, Methods of grid connection, Properties of grid system.

UNIT-IV

Integration of grids & Power Quality: Interface with grid, direct and power electronics coupling, Impact of type of interface, Power Quality issues, Impact of distributed generation, Power Quality disturbances

UNIT-V

Economics of power generation: Transmission system operation, Protection of distributed Generators, Economics of distributed generation, Case studies, solar electricity in Sagar Island, Potential of wind energy in India.

Text Books:

1. RanjanRakesh , D.P.Kothari, Singal K C, “Renewable Energy Sources And Emerging Technologies” 2nd Edition Printice Hall Of India 2011
2. Math.H.Bollen, Fainan Hassan, “Integration Of Distributed Generation In The Power System” Wiley IEEE Press, July 2011

Suggested Reading:

1. Loi Lei Lai, Tze Fun Chan, “ Distributed Generation: Induction And Permanent Magnet Generators” October 2007, Wiley IEEE Press
2. Roger A Messenger, Amir Abtahi, :” Photovoltaic Systems Engineering” 3rd Edition 2010
3. James A Manwell, John G McGowan Antony L Rogers , “Wind Energy Explained: Theory, Design And Application” John Wiley And Sons 2010

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With effect from the academic year 2020-2021

20EEE109 DIGITAL PROTECTION OF POWER SYSTEM

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To study the architecture and the required mathematical background for the design and development of digital relays
2. To Explore the basic elements in digital relays and understand various algorithms used in digital protection
3. To understand the application of various algorithms for the digital protection of practical power system.

Course Outcomes: After completion of the course, students will be able to:

1. Recognize the need and architecture of digital relays
2. Comprehend the application of mathematics in power system protection
3. Describe the importance of every element of digital relay
4. Distinguish various mathematical algorithms used for the estimation of power system parameters
5. Explain various algorithms used for the digital protection of power system.

UNIT-I

Digital Relays: Evolution of digital relays, Advantages, Architecture of digital relays, Performance and operational characteristics of digital protection

Mathematical Background: Finite difference techniques, Forward, backward and central difference interpolation, Numerical differentiation, Curve fitting and smoothing, Fourier analysis, Walsh function analysis.

UNIT-II

Basic Elements of Digital Protection: Signal conditioning: transducers, surge protection, analog filtering, analog multiplexers, Conversion subsystem: the sampling theorem, signal aliasing Error, sample and hold circuits, multiplexers, analog to digital conversion, Digital relay subsystem filtering concepts of the digital relay as a unit consisting of hardware and software

UNIT-III

Sinusoidal-Wave-Based Algorithms: sample, first, second derivative techniques, two-sample and three-sample techniques, Fourier-analysis-based algorithms, walsh-function-based techniques

UNIT-IV:

Algorithms based on Least Squares and Differential Equation:

Least Squares-based Algorithm: Integral LSQ fitting, Power series LSQ fitting, Multi-variable series LSQ

Differential Equation-based Algorithm: Representation of Transmission line, differential equation protection, simultaneous equation techniques,

UNIT-V:

Digital Protection:

Digital Protection of Transformers: Principles of protection, FIR-filter based algorithms, Least-square curve fitting based algorithms, Fourier-based Algorithms

Digital Protection Transmission Lines: current-based differential Protection, composite voltage and current-based protection schemes

Text Books:

1. A.T. Johns and S. K. Salman, “Digital Protection of Power Systems”, IEEE Press,1999
2. S.R.Bhide “Digital Power System Protection” PHI Learning Pvt.Ltd.2014

Suggested Reading:

1. Rebizant, Waldemar, Janusz Szafran, and Andrzej Wiszniewski, "Digital signal processing in power system protection and control" Springer, 2011.
2. A.G. Phadke and J. S. Thorp, “Computer Relaying for Power Systems”, Wiley/Research studiesPress, 2009

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With effect from the academic year 2020-2021

20EEE110 **POWER QUALITY**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To understand the theoretical concepts and standards of Power Quality (PQ), and methods to calculate and analyze voltage sag in distribution systems.
2. To have knowledge of Analysis of Voltage Sag
3. To understand PQ issues and sources of harmonics in Industrial systems and its mitigation

Course Outcomes: After completion of this course, students will be able to:

1. Acquire the knowledge of theoretical concepts and standards of Power Quality issues and its measurement
2. Acquire knowledge in identifying sources of harmonics
3. Acquire the knowledge to analyze voltage sag in distribution systems
4. Acquire the knowledge Harmonic Filtering Techniques
5. Acquire the knowledge in Solutions to power factor correction, Wiring and Grounding Problems

UNIT- I

Introduction to power quality: Overview of power quality phenomena, voltage quality, classification of power quality issues, Power quality measures and standards-THD-TIF-DIN-C-message weights. Flicker factor, transient phenomena-occurrence of power quality problems, Power acceptability curves- PQ Measuring Instruments. Standards and recommended practices

UNIT-II

Harmonics: Harmonic distortion and solutions, Voltage distortion Vs Current distortion, Sources of harmonics, Effect of harmonic distortion, Impact of capacitors, transformers and motors, harmonic sources from commercial and industrial loads, locating harmonic sources of power system.

UNIT-III

Voltage sag Analysis: Voltage sag Analysis, causes and sources of voltage sags, voltage flow chart, voltage sag magnitude and duration plots, fast assessment methods for voltage sags in distribution systems, effect of momentary voltage dips on the operation of Induction motor and Synchronous Motors.

UNIT-IV

Harmonic Filtering: Passive Harmonic Filtering, Three Phase Three-wire Shunt Active Filtering and their control using p-q theory and d-q modeling, Hybrid Filtering using Shunt Active Filters, Dynamic Voltage Restorer and its control, Power Quality Conditioner,

UNIT-V

PQ Consideration in Industrial Power Systems: Adjustable speed Drives and its applications, Reasons for grounding, typical wiring and grounding problems-solutions.

Power Factor Correction: Control Methods for Single Phase APFC, Three Phase APFC and Control Techniques

Text Books:

1. G.T. Heydt, “Electric power quality”, McGraw-Hill Professional, 2007
2. Math H. Bollen, “Understanding Power Quality Problems”, IEEE Press, 2000
3. C.Sankaran, ‘Power Quality’, CRC Press, 2001

Suggested Reading:

1. J. Arrillaga, “Power System Quality Assessment”, John wiley, 2000
2. J. Arrillaga, B.C. Smith, N.R. Watson & A. R.Wood ,”Power system Harmonic Analysis”, Wiley, 1997
3. Roger C.Dugan, Mark F.McGranaghan, Surya Santoso, H.Wayne Beaty, ‘Electrical Power Systems Quality’, 3rd Edition,Tata McGraw-Hill, 2012.
4. R.Sastry Vedam, M.Sarma, "Power Quality- Var Compensation in Power Systems ", CRC Press, 2009

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With effect from the academic year 2020-2021

20EEE114 **SMART GRIDS**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To understand concept of smart grid and its advantages and the operation of smart devices such as PMU, IED etc.
2. To know smart metering techniques and wide area measurement techniques.
3. To understand the operation of micro grid and its components and the problems associated with integration of distributed generation & its solution through smart grid.

Course Outcomes: After completion of the course, students will be able to:

1. Appreciate the difference between smart grid & conventional grid.
2. Acquire knowledge of smart devices such as PMU, IED etc
3. Apply smart metering concepts to industrial and commercial installations.
4. Formulate solutions in the areas of smart substations, distributed generation and wide area measurements.
5. Acquire knowledge of micro grid and modern communication technologies

UNIT-I

Introduction to Smart Grid: Evolution of Electric Grid, Concept of Smart Grid, Need of Smart Grid, Concept of Robust &Self-Healing Grid, Present development & International policies in Smart Grid

UNIT-II

Smart Devices-I: Real Time Prizing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home and Building Automation, Smart Substations, Substation Automation, Feeder Automation.

UNIT-III

Smart Devices-II: Geographic Information System (GIS),Intelligent Electronic Devices (IED) & their application for monitoring & protection, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).

UNIT-IV

Micro-grid: Need and applications of micro-grid, Formation of micro-grid, Issues of interconnection, Protection and control of micro-grid, Plastic and Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel-cells, micro-turbines, Captive power plants, Integration of renewable energy sources.

UNIT-V

Communication Systems: Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN), Bluetooth, ZigBee, GPS, Basics of CLOUD computing and Cyber Security for Smart Grid, Broadband over Power line (BPL). IP based protocols.

Text Books:

1. Ali Keyhani, Design of smart power grid renewable energy systems, Wiley IEEE, 2011.
2.Clark W. Gellings,The Smart Grid: Enabling Energy Efficiency and Demand Response, CRC Press.

Suggested Reading:

1. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, “Smart Grid: Technology and Applications”, Wiley 2012.
2. Stuart Borlas’e, “Smart Grid:Infrastructure, Technology and solutions” CRC Press.
3. A.G.Phadke , “Synchronized Phasor Measurement and their Applications”, Springer.

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With effect from the academic year 2020-2021

20EEE115 **HIGH VOLTAGE ENGINEERING**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To understand different high voltage measurements and the necessary instruments
2. To know how to measure high voltage AC/DC and impulse voltages and currents
3. To understand the planning, safety principles and layout of HV labs

Course Outcomes: After completion of this course, student will be able to:

1. Acquire knowledge about high voltage generation techniques
2. Acquaint with the different methods of generating high voltage AC/DC and impulse voltages and currents
3. Acquire the knowledge of measurement techniques for high voltage AC/DC and impulse voltages and currents
4. Acquire knowledge about planning and layout of HV labs
5. Attain methods of shielding, grounding and other safety precautions of HV labs

UNIT-I

Generation of High DC& AC voltages: Half and full wave rectifier circuits, Voltage doubler circuits, Voltage multiplier circuits: Cascaded rectifier circuit, Cockroft Walton voltage multiplier circuit, Electrostatic machines: Van de Graaff Generators, Electrostatic generators, Cascade transformers, Resonant transformers.

UNIT-II

Generation of Impulse voltages and currents: Impulse generator circuits, Multistage Impulse generator circuit, Generation of switching surges, Generation of impulse currents: Circuit for producing impulse current wave, Generation of high impulse currents, Generation of rectangular current pulses, Tripping and control of impulse generators.

UNIT-III

Measurement of High Voltage and Currents: Sphere gap, Factors affecting the spark over voltage, Uniform field spark gap, Rod gap, Electrostatic voltmeter, Generating voltmeter, Measurement of electric fields, Potential dividers (Resistive and Capacitive), Series impedance ammeters, Rogowski coils, Hall Effect generators, Digital techniques in HV measurements.

UNIT-IV

Planning and Layout of High Voltage Labs: Test facilities in HV labs, Classification of HV labs, Voltage and power ratings of test equipment, Layout of HV labs, Clearance, Shielding and Grounding of HV labs, Recent trends in HV engineering.

UNIT-V

High Voltage Safety Principles: Indian standards for HV clearances, Calibration of HV measuring instruments, Safety earthing, Safety in HV laboratory, Safety regulations for high voltage tests.

Text Book:

1. M.S.Naidu and V.Kamaraju, "High Voltage Engineering", Tata McGraw Hill 2001.
2. C.L. Wadhwa, "High Voltage Engineering", Wiley Eastern Ltd., New Delhi, 1994

Suggested Reading:

1. M. Khalifa, "High Voltage Engineering: Theory and Practise", Dekker, 1990.
2. E.Kuffel, W.S.Zaengl and J.Kuffel, "High Voltage Engineering Fundamentals", Newness Publication, 2000.

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With effect from the academic year 2020-2021

20EEE104 **POWER SEMICONDUCTOR DEVICES AND MODELING**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To understand the static and dynamic characteristics of current and voltage controlled power semiconductor devices
2. To enable the selection of devices for different power electronics applications
3. To understand the control, protection and firing circuits for different power devices.

Course Outcomes: After completion of this course, students will be able to:

1. Understand, the attributes of an ideal switch and its selection for a Specific Power electronic application.
2. Analyze the static and switching characteristics of different current controlled semiconductor devices
3. Analyze the static and switching characteristics of different voltage controlled semiconductor devices and also to differentiate various voltage controlled devices.
4. Design different firing and protection circuits for power semiconductor devices.
5. Select different heat sinks for power semiconductor devices.

UNIT-I

Power Switching Devices Overview: Attributes of an ideal switch, application requirements, circuit symbols; Power handling capability – (SOA); Device selection strategy – On-state and switching losses, EMI due to switching, Power diodes, Types, forward and reverse characteristics, switching characteristics, rating.

UNIT-II

Current Controlled Devices: BJT's, Construction, static characteristics, switching characteristics; Negative temperature coefficient and secondary breakdown; Power Darlington, Thyristors: Physical and electrical principle underlying operating mode, Two transistor analogy, concept of latching; Gate and switching characteristics; converter grade and inverter grade and other types; series and parallel operation; comparison of BJT and Thyristor, steady state and dynamic models of BJT & Thyristor.

UNIT-III

Voltage Controlled Devices: Power MOSFETs and IGBTs, Principle of voltage controlled devices, construction, types, static and switching characteristics, steady state and dynamic models of MOSFET and IGBTs - Basics of GTO, MCT, RCT and IGCT, Comparison of all power devices.

UNIT-IV

Firing and Protecting Circuits: Necessity of isolation, Pulse transformer, Opto coupler, Gate drives circuit-SCR, MOSFET, IGBTs and base driving for power BJT.

Protection: Voltage protection by Selenium Diodes and Metal-Oxide Varistors, Current Protection, Fusing, Fault Current with AC and DC sources, Design of snubbers.

UNIT-V

Thermal Protection: Heat transfer, conduction, convection and radiation; Cooling, liquid cooling, vapour phase cooling; Guidance for hear sink selection, Thermal resistance and impedance, Electrical analogy of thermal components, heat sink types.

Text Books:

1. B.W Williams, Power Electronics Circuit Devices and Applications, John wiley & sons, 1987.
2. Rashid M.H., Power Electronics Circuits, Devices and Applications, PHI, Third Edition, New Delhi, 2004
3. Mohan, Undeland and Robins, Power Electronics Concepts, applications and Design, John Wiley and Sons, Singapore, 2000.

Suggested Reading:

1. MD Singh and K.B Khanchandani, Power Electronics, Tata McGraw Hill, 2001.
2. Joseph Vithayathil, Power Electronics: Principles and Applications, Delhi, Tata McGrawHill, 2010.

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20EEE105 **ELECTRIC DRIVE SYSTEM**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To understand Basic electrical drives and their analysis.
2. To learn Design of controller for drives.
3. To understand vector control of electrical drives.

Course Outcomes: After completion of this course, students will be able to:

1. Model the Electric Drive System
2. Design modulation strategies of power electronics converters, for drives application
3. Design appropriate current/voltage regulators for electric drives
4. Select and implement the drives for Industrial Process
5. Implement various variable speed drives in Electrical Energy Conversion System

UNIT-I

Dynamics of Electric Drives: Fundamentals of torque equation. Speed torque convention and multi-quadrant operation, components of load torques. Classification of load torques steady state stability. Load equation, Speed control and drive classification. Close loop control of drives.

UNIT -II

DC Motor Drives: Modeling of DC machines.Steady state characteristics with armature and speed control. Phase controlled DC motor drives, chopper-controlled DC motor drives.

UNIT-III

Three Phase Induction Motor Drive: Dynamic modeling of induction machines. Small signal equations, control characteristics of induction machines, Phase-controlled induction machines, Stator voltage control, Static Slip recovery schemes, frequency control and vector control of induction motor drives.

UNIT-IV

Traction Motor: Review of characteristics of different types of DC & AC motors used for traction and their suitability. Starting and Braking methods of traction motors.

UNIT -V

Industrial Drives: Digital Control of Electric Drives. Stepper motor. Servo motor and their Applications.

Text Books:

1. G.K, Dubey, Power semi-conductor controlled Drives, Prentice Hall international, New Jersey, 1989.
2. R.Krishnan, Electric motor drives modelling, analysis and control, PHI-India-2009.
3. G.K.Dubey,"Fundamentals of electric Drives, Narosa Publishing House",2nd edition, 2011

Suggested Reading:

1. W. Leonhard, Control of Electrical drives, Springer, 3rd edition, 2001.
2. P.C. Krause, Analysis of Electric Machine, Wiley-IEEE press 3rd edition
3. K. Bose,Modern Power Electronics and AC Drives, Prentice Hall publication, 1st edition, 2001.

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20EEE106 **HVDC TRANSMISSION**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
1. To understand state of the art of HVDC technology and converter operation for two and multi- terminal DC systems.
2. To acquire knowledge about methods of HVDC converter control.
3. To understand the concept of AC-DC system interactions and protection scheme in HVDC system.

Course Outcomes: After completion of the course, students will be able to:
1. Explain state of the art HVDC technology.
2. Demonstrate the knowledge of HVDC converter operation and methods of control.
3. Demonstrate the knowledge of HVDC converter characteristics and control methods.
4. Demonstrate the knowledge of the protection methods and AC-DC system interactions.
5. Demonstrate the knowledge of multi-terminal DC systems.

UNIT-I
HVDC Power Transmission Technology: Development of HVDC Technology, DC versus AC Transmission, Selection of converter configuration.

UNIT-II
HVDC Converters: Rectifier and Inverter operation with and without overlap, comparison between rectifier and inverter mode of operation, Digital Simulation of converters, Control of HVDC converters and Systems.

UNIT-III
Converter Control: Individual phase control, Equidistant firing controls, higher level controls. Characteristics and non-characteristics harmonics filter design. Fault development and protection.

UNIT-IV
HVDC Systems: Interaction between AC-DC power systems, over voltages on AC/DC side, multi-terminal HVDC systems, control of MTDC systems.

UNIT-V
Modeling of HVDC Systems: Per unit system, Representation for power flow solution, representation for stability studies.

Text Books:
1. S.Kamakshaiah, V.Kamaraju,' HVDC Transmission', Tata McGraw-Hill Education Pvt. Ltd., 2011.
2. K. R. Padiyar, "HVDC Power Transmission Systems", Wiley Eastern Ltd., 1990.

Suggested Reading:
1. E. W. Kimbark, "Direct Current Transmission", Vol. I, Wiley Inderscience, 1971.
2. Erich Uhlmann, "Power Transmission by Direct Current", B.S. Publications, 2004.
3. Arrillaga, "High Voltage Direct Transmission", Peter Peregrinus Ltd. London, 1983.

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With effect from the academic year 2020-2021

20EEE108 Artificial Intelligence Techniques for Power Systems

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
1. To understand concepts of Artificial Neural Networks, Fuzzy logic and Meta-heuristic Techniques
2. To acquire the knowledge of optimization techniques and their hybridization with ANN and Fuzzy
3. To learn the intelligent approaches for the Power systems planning and operation

Course Outcomes: After completion of the subject, students will be able to:
1. Understand the various Artificial Intelligent and Meta-heuristic Techniques
2. Classify the techniques according to their method of approach
3. Select the suitable technique for the given power system problem
4. Implement suitable Intelligent technique for the given power system problem
5. Execute any power system planning and operation using Artificial Intelligent Techniques

UNIT-I
Artificial Neural Network (ANN): Biological foundations to intelligent Systems, Difference between Artificial Neuron and Biological Neuron, Activation functions, Basic Models of ANN, Hebb Rule, Training/Learning of NN, Supervised Learning Algorithms: Perceptron, Adaline, Back propagation algorithm, RBF NN, Associative Memory Networks: BAM NN, Hopfield NN, Unsupervised Learning Networks: LVQ algorithm, ART Network.

UNIT-II
Fuzzy Logic: Introduction to Fuzzy logic, Fuzzy sets, Fuzzy relations, Membership Functions, Defuzzification methods, Fuzzy reasoning, Fuzzy Inference System (FIS), Fuzzy Decision Making

UNIT-III
Meta-heuristic Techniques: Introduction, Genetic Algorithm, Particle Swarm Optimization, Differential Evolution, Simulated Annealing, Ant Colony Optimization, Honey Bee Algorithm, Harmony Search algorithm, Teaching-Learning-based algorithm, JAYA Algorithm.

UNIT-IV:
Hybrid System: characteristics, classification, ANFIS, Genetic-Neuro-Hybrid system: Properties, GA-based BPN, Advantages, Genetic-Fuzzy Hybrid Systems: Genetic-Fuzzy Rule based systems

UNIT-V
Applications:
Applications Artificial Intelligence Techniques in power systems for solving Load flow studies, Fault identification and classification, Load frequency Control, Excitation control, Economic Load Dispatch, Optimal Power Flow.

Text Books:
1. S.N.Sivanandam, S.N.Deepa, 'Principles of soft computing techniques', Wiley publications, 2007.
2. Xin-She Yang, "Nature-inspired optimization algorithms", Elsevier Inc., 2008.
3. S.Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic & Genetic Algorithms"- PHI, New Delhi, 2010.

Suggested Reading:
1. Haykin, Simon. *Neural networks: a comprehensive foundation*. Prentice-Hall, Inc., 2007.
2. Ross, Timothy J. *Fuzzy logic with engineering applications*. Vol 2. New York: wiley, 2004.
3. Goldberg, David E. *Genetic algorithms*. Pearson Education India, 2006.
4. Clerc, Maurice. *Particle swarm optimization*. Vol 93. John Wiley & Sons, 2010.

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With effect from the academic year 2020-2021

20EEE111	**FACTS AND CUSTOM POWER DEVICES**
Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To introduce the concepts of reactive power compensation which can be used for interconnected power transmission and distribution systems
2. To study the principles of operation and control of shunt, series and combined FACTS controllers
3. To study the various types of power quality problems in distribution systems and to know about the filters

Course Outcomes: After completion of the course, students will be able to:

1. Distinguish the performance of Transmission line with and without FACTS Devices
2. Compare the SVC and STATCOM
3. Understand the operation and control of various Static Series Compensators
4. Understand the operation and control of Unified Power Flow Controller
5. Distinguish various power quality issues and how are they mitigated by various FACTS Devices

UNIT-I

Reactive Power Flow Control in Power Systems: Power flow control, Constraints of maximum transmission line loading, Benefits of FACTS Transmission line compensation, Uncompensated line, Shunt compensation, Series compensation, Phase angle control, Reactive power compensation, Shunt and Series compensation principles, Reactive compensation at transmission and distribution level.

UNIT-II

Static Shunt Compensation: Static versus passive VAR compensator, Static shunt compensators, SVC and STATCOM, Operation and control of TSC, TCR and STATCOM Compensator control, Comparison between SVC and STATCOM.

UNIT III

Static Series Compensation: TSSC, SSSC -Static voltage and phase angle regulators, TCVR and TCPAR Operation and Control, Applications, Static series compensation, GCSC, TSSC, TCSC and Static synchronous series compensators and their Control.

UNIT IV

Combined Power Flow Controller: Circuit Arrangement, Operation and control of UPFC, Basic Principle of P and Q control, Independent real and reactive power flow control- Applications, Introduction to interline power flow controller (IPFC)

UNIT V

Power Quality Problems in Distribution Systems: harmonics, Loads that create harmonics, harmonic propagation, series and parallel resonances, mitigation of harmonics, passive filters, active filter, shunt, series, hybrid filters and their control.

Voltage swells, sags, flicker, unbalance and mitigation of these problems by unified power quality conditioner (UPQC), IEEE standards on power quality.

Text Books:

1. K R Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International Publishers, 2007**.**

2. N.G. Hingorani, L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.

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Suggested Reading:

1. X P Zhang, C Rehtanz, B Pal, “Flexible AC Transmission Systems- Modelling and Control”, Springer Verlag, Berlin 2006.
2. K.S.Sureshkumar, S.Ashok , “FACTS Controllers & Applications”, E-book edition, Nalanda Digital Library, NIT Calicut, 2003.
3. G. T. Heydt, “Power Quality”, McGraw-Hill Professional, 2007.
4. T. J. E. Miller, “Static Reactive Power Compensation”, John Wiley and Sons, New York, 1982

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20EEE112 SWITCH MODE & RESONANT CONVERTERS

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To apply the basic concepts of power electronics for designing converters.
2. To understand various types of SMPS design and its control methods
3. To know the stability analysis for the converters using Bode plots.

Course Outcomes: After completion of this course, students will be able to:

1. Identify different power electronic circuits for designing converters.
2. Design various types of SMPS for electrical applications.
3. Design control methods for SMPS
4. Analyze the stability using Bode plots for the converters.
5. Select different components used in SMPS hardware.

UNIT-I

Basic Converter Circuits: Buck Regulator, Boost Regulator, Buck Boost Regulator, Cuk Converters, Resonant Converters, Choice of Switching Frequency-Design Aspects

UNIT-1I

Isolated SMPS: Fly back Converters, Forward Converters, Half Bridge and Full Bridge Converters, Push Pull Converters and SMPS with multiple outputs, Choice of Switching Frequency-Design Aspects

UNIT-III

Control Aspects: PWM Controllers, isolation in feedback loop, Power Supplies with Multiple outputs, Stability analysis using Bode Diagrams.

UNIT-IV

Design Considerations: Selection of Output Filter Capacitor, Selection of Energy Storage Inductor, Design of High Frequency Inductor and High Frequency Transformer, Selection of Switches, Snubber Circuit Design, Design of Driver Circuits- Power MOSFETS.

UNIT-V

Electromagnet Interference (EMI): EMI Filter Components, Conducted EMI suppression, Radiated EMI suppression, Measurement. Protection: Over current over voltage protection, inrush current protection

Text Books:

1. Mohan N. Undeland. T & Robbins W, Power Electronics Converters, Application and Design, John Wiley, 3rd edition, 2002.
2.. M.H. Rashid, Power Electronics. Prentice-Hall of India.
3. Switched Mode Power Supplies, Design and Construction, H. W. Whittington, B. W. Flynnand D. E. MacPherson, Universities Press, 2009 Edition.

Suggested Reading:

1. Umanand L., Bhat S.R., Design of magnetic components for switched Mode Power Converters. , Wiley Eastern Ltd.,1992
2. Course Material on Switched Mode Power Conversion, V.Ramanarayanan.

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20EEE113 ENERGY AUDITING AND MANAGEMENT

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To understand the need for energy auditing
2. To understand of various loads involved based on power consumption for auditing
3. To know about different audit instruments used in practice

Course Outcomes: After completion of this course, students will be able to:

1. Acquire the background required for engineers to meet the role of energy managers
2. Gain the skills and techniques required to implement energy management
3. Demonstrate energy conservation aspects
4. Apply the energy conservation techniques to industrial loads
5. Perform basic energy audit in an organization

UNIT-I

Energy Auditing: Types and objectives, audit instruments. ECO assessment and Economic methods specific energy analysis, Minimum energy paths, consumption models, Case study

UNIT-II

Energy Efficient Motors: Electric motors, Energy efficient controls and starting efficiency, Motor Efficiency and Load Analysis Energy efficient / high efficient Motors, Case study.

Load Matching and selection of motors, Variable speed drives, Pumps and Fans, Efficient Control strategies, optimal selection and sizing.

UNIT-III

Energy Conservation Aspects: Transformer Loading/Efficiency analysis, Feeder/cable loss evaluation, Reactive Power management, Capacitor Sizing, Degree of Compensation, Capacitor losses, Location, Placement and Maintenance, Peak Demand controls, Methodologies.

UNIT-IV

Industrial Loads: Types of Industrial loads, Optimal Load scheduling-case study, Lighting, Energy efficient light sources, Energy conservation in Lighting Schemes, Electronic ballast, Power quality issues, Luminaries, Case study, Cogeneration, Types and Schemes, Optimal operation of cogeneration plants.

UNIT-V

E.C. Measures: Electric water heating, Geysers, Solar Water Heaters. Power Consumption in Compressors, Energy conservation measures, software, EMS

Text Books:

1. Umesh Rathore: Energy Management,S.K.Kataria &sons second edition
2. Anthony J. Pansini, Kenneth D. Smalling, Guide to Electric Load Management. PennwellPub;(1998)
3. Howard E. Jordan, Energy-Efficient Electric Motors and Their Applications., Plenum Pub Corp; 2ndedition, 1994

Suggested Reading:

1. Tanuj Kumar Bishat: SCADA and Energy Management system ;S.K.Kataria &sons, second edition
2. Giovanni Petrecca, Industrial Energy Management: Principles and Applications, The Kluwer international series -207, 1999

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

20 EEE116

ELECTRIC AND HYBRID VEHICLES

Instruction	3L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite:

1. Basic knowledge of Electrical & Mechanical Engineering, Engines, Machines, Batteries and Circuit analysis.

Course objectives:

1. To understand the concept Electric and Hybrid vehicles, and their advantages and disadvantages
2. To Understand the Performance Characteristics of various types of hybrid electric vehicles, Knowledge of various energy storage system of EV and EHV and energy management
3. To Develop and Optimise the design of propulsion motors for EV applications and knowledge of charging technologies.

Course Outcomes: After the completion of this course, students will be able to:

1. Be familiar to the models of describing Electric and hybrid vehicles and their performance.
2. Calculation of tractive effort required for EHV and EV with different vehicle parameters and optimisation of power train.
3. Design optimisation of Electric power train and implementation of charging technology.
4. Analyze the different possible ways of energy storage and battery selection.
5. Illustrate the principle of Hybrid Electric Vehicle, Battery Electric Vehicle and Plug-in EHV and able to prepare. a business plans.

UNIT-I

Introduction: Conventional Vehicles: Basics of vehicle performance, Four Stroke and 2 Stroke IC Engine and their construction and operating principle, measures to improve IC Engine performance, vehicle power source characterization, , transmission characteristics using clutch and gear box, gear ratio, Transmission Efficiency, Air pollution, global warming and climate change, EV Advantages, Introduction to Battery Electric Vehicle (BEV), Components and systems of Electric Vehicle, Performance of EVs , Govt. Policies and guidelines for implementation of electric mobility, Trends and challenges of implementation of electric mobility and start up opportunities.

UNIT-II

Hybrid Electric Vehicles: Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, Vehicle Mechanics, impact of modern drive-trains on energy supplies and Vehicle to grid (V2G) fundamentals. Electric Vehicle Modelling– Consideration of Rolling Resistance – Consideration of Vehicle Mass – Tractive Effort – Vehicle Acceleration –Selection and Sizing of the propulsion motor , Modelling Electric Vehicle Range, Plug-in electric vehicles, Hybrid electric drive for ship propulsion and military application,

UNIT-III

Electric and Hybrid Power Trains: Basic concept of hybrid traction, introduction to various hybrid drive train topologies, concept of Series Hybrid , Parallel Hybrid and Series-Parallel Hybrid Vehicle model, different modes of operation and Energy management strategies used in EHV . Power flow control in hybrid drive-train topologies, fuel efficiency analysis, Basic concept of electric traction, Components and systems of HEV, Regenerative braking fundamentals, drive system efficiency. Vehicle le to Grid(V2G) fundamentals,

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

UNIT-IV

Energy Storage and Charging Technology: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage**,** basics of construction and chemical reactions in Lead-acid battery , Nickel-Cadmium, Nickel-Metal Hydride, Lithium based batteries, basics of Metal Air batteries, battery sizing, Fuel Cell based energy storage system, Super Capacitor based energy storage , Hybridization of energy storage batteries with Capacitor based energy storage devices, Different types of EV charging stations for battery charging, Wireless charging technology,

UNIT-V

Design, Analysis, Testing & Qualification of Propulsion Motor: PM Materials (Nd FeB, SmCo, Ferrite and Alnico) . Properties of NdFEB, SmCo and Ferrite material w.r.t EV/EHV Requirements), Basic concepts of Design, Construction and analysis of water cooled/Air-cooled PM Motor for EV and HEV, Outer rotor PM Motor drive, Permanent Magnet assisted Hybrid Reluctance Motor of EV, Basics of Axial Flux PM Motor Basic Design and construction Aspects of Induction Motors for EV and HEV, Qualification Testing methods and standards, basics of EMI & EMC applicable to EHV, Use of electromagnetic Software for design optimisation of PM and Induction motor for EV/EHV.

Text Books:

1. C. Mi, M. A. Masrur, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.
3. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals", CRC Press, 2010.

Suggested Reading:

1. James Larminie, "Electric Vehicle Technology Explained", John Wiley & Sons, 2003
2. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016
3. Hybrid Vehicles and the future of personal transportation, Allen Fuhs, CRC Press, 2011.
4. Vehicle Power Management: Modeling, Control and Optimization, Xi Zhang, Chris Mi, Springer, 2011.
5. National Electric Mobility Mission Plan 2020 Released by DHI, Govt. of India
6. Zero Emission Vehicles (ZEV) Towards a Policy Framework, NITI Aayog
7. IEC and different IS and Eclectic Mobility Standards.

CO-PO&PSO Correlation Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	-	-	-	3	1	1	1	2	2	-	-	1
CO2	2	1	1	1	1	2	-	-	-	-	2	-	3	-	2
CO3	2	2	1	1	2	-	2	1	2	2	3	2	3	3	2
CO4	2	1	1	1	3	2	3	1	-	-	1	1	2	3	2
CO5	3	-	1	1	-	2	3	1	2	2	-	2	2	3	2

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

With effect from the academic year 2020-21

Open Electives

20CSO 101 **BUSINESS ANALYTICS**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: The main objectives of this course are to:

1. Understanding the basic concepts of business analytics and applications
2. Study various business analytics methods including predictive, prescriptive and prescriptive analytics
3. Prepare the students to model business data using various data mining, decision making methods

Course Outcomes: After completion of the course, students will be able:

1. To understand the basic concepts of business analytics
2. Identify the application of business analytics and use tools to analyze business data
3. Become familiar with various metrics, measures used in business analytics
4. Illustrate various descriptive, predictive and prescriptive methods and techniques
5. Model the business data using various business analytical methods and techniques

Unit-I

Introduction to Business Analytics: Introduction to Business Analytics, need and science of data driven (DD) decision making, Descriptive, predictive, prescriptive analytics and techniques, Big data analytics, Web and Social media analytics, Machine Learning algorithms, framework for decision making, challenges in DD decision making and future.

Unit-II

Descriptive Analytics: Introduction, data types and scales, types of measurement scales, population and samples, measures of central tendency, percentile, decile and quadrille, measures of variation, measures of shape-skewness, data visualization

Unit-III

Forecasting Techniques: Introduction, time-series data and components, forecasting accuracy, moving average method, single exponential smoothing, Holt's method, Holt-Winter model, Croston's forecasting method, regression model for forecasting, Auto regression models, auto-regressive moving process, ARIMA, Theil's coefficient

Unit-IV

Decision Trees: CHAID, Classification and Regression tree, splitting criteria, Ensemble and method and random forest. **Clustering**: Distance and similarity measures used in clustering, Clustering algorithms, K-Means and Hierarchical algorithms, **Prescriptive Analytics**- Linear Programming (LP) and LP model building,

Unit-V

Six Sigma: Introduction, introduction, origin, 3-Sigma Vs Six-Sigma process, cost of poor quality, sigma score, industry applications, six sigma measures, DPMO, yield, sigma score, DMAIC methodology, Six Sigma toolbox

Text Books:

1. U Dinesh Kumar, "Data Analytics", Wiley Publications, 1st Edition, 2017
2. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, "Business analytics Principles, Concepts, and Applications with SAS", Associate Publishers, 2015

Suggested Reading:

1. S. Christian Albright, Wayne L. Winston, "Business Analytics - Data Analysis and Decision Making", 5th Edition, Cengage, 2015

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc18-mg11/preview
2. https://nptel.ac.in/courses/110105089/

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

20MEO 101 **INDUSTRIAL SAFETY**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: The students will be able to understand

1. Causes for industrial accidents and preventive steps to be taken.
2. Fundamental concepts of Maintenance Engineering. About wear and corrosion along with preventive steps to be taken. The basic concepts and importance of fault tracing.
3. The steps involved in carrying out periodic and preventive maintenance of various equipments used in industry

Course Outcomes: At the end of the course the students will be able to:

1. Identify the causes for industrial accidents and suggest preventive measures.
2. Identify the basic tools and requirements of different maintenance procedures.
3. Apply different techniques to reduce and prevent Wear and corrosion in Industry.
4. Identify different types of faults present in various equipments like machine tools, IC Engines, boilers etc.
5. Apply periodic and preventive maintenance techniques as required for industrial equipments like motors, pumps and air compressors and machine tools etc

UNIT - I

Industrial Safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes, Fire prevention and firefighting, equipment and methods.

UNIT – II

Fundamentals of Maintenance Engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT – III

Wear and Corrosion and their Prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications of Screw down grease cup, Pressure grease gun, Splash lubrication, Gravity lubrication, Wick feed lubrication, Side feed lubrication, Ring lubrication, Definition of corrosion, principle and factors affecting the corrosion, Types of corrosion, corrosion prevention methods.

UNIT–IV

Fault Tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, any one machine tool, Pump, Air compressor, Internal combustion engine, Boiler, Electrical motors, Types of faults in machine tools and their general causes.

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

UNIT – V

Periodic and Preventive Maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of Machine tools, Pumps, Air compressors, Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Text Books:

1. H. P. Garg, "Maintenance Engineering", S. Chand and Company
2. Audels, "Pump-hydraulic Compressors", Mcgraw Hill Publication

Suggested Readings:

1. Higgins & Morrow, "Maintenance Engineering Handbook", Da Information Services.
2. Winterkorn, Hans, "Foundation Engineering Handbook", Chapman & Hall London

If we have built castles in the air, our work need not be lost; that is where they should be. Now lay the foundation under them. But a fool is one who, having no goal, redoubles his efforts.

Vikasa Mantras- Vivekananda Institute of Human Excellence

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

20MEO 102 INTRODUCTION TO OPTIMISATION TECHNIQUES

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. Students will come to know the formulation of LPP models
2. Students will understand the Algorithms of Graphical and Simplex Methods. Students will understand the Transportation and Assignment techniques. Students will come to know the procedure of Project Management along with CPM and PERT techniques
3. Students will understand the concepts of sequencing

Course Outcomes: At the end of the course, the students were able to:

1. Formulate a managerial decision problem into a mathematical model;
2. Apply transportation problems in manufacturing industries;
3. Build and solve assignment models
4. Apply project management techniques like CPM and PERT to plan and execute project successfully
5. Apply sequencing concepts in industry applications

UNIT-I

Introduction: Definition and Scope of Operations Research.

Linear Programming: Introduction, Formulation of linear programming problems, graphical method of solving LP problem, simplex method

UNIT-II

Transportation Models: Finding an initial feasible solution - North West Corner Method, Least Cost Method, Vogel's Approximation Method, Finding the optimal solution, Unbalanced Transportation problem, Degeneracy in Transportation,

UNIT-III

Assignment Techniques: Introduction, Hungarian technique of Assignment techniques, unbalanced problems, problems with restrictions, Maximization in Assignment problems

UNIT-IV

Project Management: Definition, Procedure and Objectives of Project Management, Differences between PERT and CPM, Rules for drawing Network diagram, Scheduling the activities, Fulkerson's rule, Earliest and Latest times, Determination of critical path, duration of the project

UNIT-V

Sequencing Models: Introduction, General assumptions, processing 'n' jobs through two machines, processing 'n' jobs through three machines.

Text Books:

1. Hamdy, A. Taha, "Operations Research-An Introduction", Prentice Hall of India Pvt. Ltd., 6/e, 1997.
2. S.D. Sharma, "Operations Research", Kedarnath, Ramnath & Co., Meerut, 2009.
3. V.K. Kapoor, "Operations Research", S. Chand Publishers, New Delhi, 2004.

Suggested Reading:

1. Harvey M. Wagner, "Principles of Operations Research", Second Edition, Prentice Hall of India Ltd., 1980.
2. R. Paneer Selvam, "Operations Research", Second Edition, PHI Learning Pvt. Ltd., New Delhi, 2008
3. Nita H. Shah, Ravi M. Gor, Hardik Soni, "Operations Research", PHI Learning Private Limited, 2013

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

20MEO 103 **COMPOSITE MATERIALS**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: To make the students to learn the

1. Composite materials and their constituents. Classification of the reinforcements and evaluate the behavior of composites.
2. Fabrication methods of metal matrix composites. Manufacturing of Polymer matrix composites.
3. Failure mechanisms in composite materials.

Course Outcomes: At the end of the course, student will be able to

1. Classify and characterize the composite materials.
2. Describe types of reinforcements and their properties.
3. Understand different fabrication methods of metal matrix composites.
4. Understand different fabrication methods of polymer matrix composites.
5. Decide the failure of composite materials.

UNIT - I

Introduction: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II

Reinforcements: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepegs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V

Strength: Lamina Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength;

Text Books:

1. R.W.Cahn – VCH , "Material Science and Technology", (Vol 13) Composites , West Germany.
2. WD Callister, Jr., Adapted by R. Balasubramaniam , "Materials Science and Engineering, an introduction"., John Wiley & Sons, NY, Indian edition, 2007.

Suggested Readings:

1. Ed-Lubin, "Hand Book of Composite Materials"
2. K.K.Chawla, "Composite Materials".
3. Deborah D.L. Chung, "Composite Materials Science and Applications"
4. Daniel Gay, Suong V. Hoa, and Stephen W. Tsai, "Composite Materials Design and Applications"

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

20CEO 101 COST MANAGEMENT OF ENGINEERING PROJECTS

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To enable the students to understand the concepts of Project management. To provide knowledge on concepts of Project Planning and scheduling.
2. To create an awareness on Project Monitoring and Cost Analysis. To provide adequate knowledge to the students on Recourse Management Costing-Variance Analysis
3. To train the students with the concepts of Budgetary Control for cost management and to provide basic platform on Quantitative techniques for cost management.

Course Outcomes: At the end of course students will able to

1. Acquire in-depth knowledge about the concepts of project management and understand the principles of project management.
2. Determine the critical path of a typical project using CPM and PERT techniques.
3. Prepare a work break down plan and perform linear scheduling using various methods.
4. Solve problems of resource scheduling and leveling using network diagrams.
5. Learn the concepts of budgetary control and apply quantitative techniques for optimizing project cost.

UNIT- I:

Project Management: Introduction to project managements, stakeholders, roles, responsibilities and functional relationships. Principles of project management, objectives and project management system. Project team, organization, roles, responsibilities. Concepts of project planning, monitoring, staffing, scheduling and controlling.

UNIT- II:

Project Planning and Scheduling: Introduction for project planning, defining activities and their interdependency, time and resource estimation. Work break down structure. Linear scheduling methods-bar charts, Line of Balance (LOB), their limitations. Principles, definitions of network-based scheduling methods: CPM, PERT. Network representation, network analysis-forward and backward passes.

UNIT- III:

Project Monitoring and Cost Analysis: introduction-Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making, Time cost tradeoff-Crashing project schedules, its impact on time on time, cost. Project direct and indirect costs.

UNIT- IV:

Resources Management and Costing-Variance Analysis: Planning, Enterprise Resource Planning, Resource scheduling and levelling. Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis

Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement

UNIT- V:

Budgetary Control:: Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Quantitative techniques for cost management: Linear Programming, PERT/CPM, Transportation Assignment problems, Simulation, Learning Curve Theory.

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

Text Books:

1. Charles T Horngren "*Cost Accounting A Managerial Emphasis*", Pearson Education; 14 edition (2012),
2. Charles T. Horngren and George Foster, "*Advanced Management Accounting*" Prentice-Hall; 6th Revised edition (1 February 1987)
3. Robert S Kaplan Anthony A. Atkinson, "*Management & Cost Accounting*" , Pearson; 2 edition (18 October 1996)

Suggested Readings:

1. K. K Chitkara, "*Construction Project Management: Planning, scheduling and controlling*", Tata McGraw-Hill Education. (2004).
2. Kumar Neeraj Jha "*Construction Project Management Theory and Practice*", Pearson Education India; 2 edition (2015)

Running away does not help us with our problems; unless we are overweight! Running away from our problems is a race we will never win. You can't run away from trouble. There is no place that far.

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

With effect from the academic year 2020-21

20EEO 101 **WASTE TO ENERGY**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To know the various forms of waste
2. To understand the processes of Biomass Pyrolysis.
3. To learn the technique of Biomass Combustion.

Course Outcomes: After completion of this course, students will be able to:

1. Understand the concept of conservation of waste
2. Identify the different forms of wastage
3. Chose the best way for conservation to produce energy from waste
4. Explore the ways and means of combustion of biomass
5. Develop a healthy environment for the mankind

UNIT-I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT-II

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT-III

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers– Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT-IV

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT-V

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Text Books:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

Suggested Readings:

1. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

With effect from the academic year 2020-21

Audit Courses

20 EG A 101 **ENGLISH FOR RESEARCH PAPER WRITING**

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks

Course Objectives:

1. To understand the nuances of language and vocabulary in writing a Research Paper.
2. To develop the content, structure and format of writing a research paper.
3. To enable the students to produce original research papers without plagiarism.

Course Outcomes: After successful completion of the course, the students will be able to:

1. Interpret the nuances of research paper writing.
2. Differentiate the research paper format and citation of sources.
3. To review the research papers and articles in a scientific manner.
4. Avoid plagiarism and be able to develop their writing skills in presenting the research work.
5. Create a research paper and acquire the knowledge of how and where to publish their original research papers.

Unit 1

Academic Writing: Meaning & Definition of a research paper– Purpose of a research paper – Scope –Benefits- Limitations – outcomes.

Unit II

Research Paper Format: Title – Abstract – Introduction – Discussion – Findings – Conclusion – Style of Indentation – Font size/Font types – Indexing – Citation of sources.

Unit III

Research Methodology: Methods (Qualitative – Quantitative) Review of Literature. Criticizing, Paraphrasing & Plagiarism.

Unit IV

Process of Writing a research paper: Choosing a topic - Thesis Statement – Outline – Organizing notes - Language of Research – Word order, Paragraphs – Writing first draft –Revising/Editing - The final draft and proof reading.

Unit V

Research Paper Publication: Reputed Journals – National/International – ISSN No, No. of volumes, Scopus Index/UGC Journals – Free publications - Paid Journal publications – /Advantages/Benefits

Textbook:

1. C. R Kothari, Gaurav, Garg, **Research Methodology Methods and Techniques,** New Age International Publishers. 4th Edition.

Suggested Reading:

1. Day R (2006) **How to Write and Publish a Scientific Paper,** Cambridge University Press
2. **MLA Hand book for writers of Research Papers**, East West Press Pvt. Ltd, New Delhi, 7th Edition.
3. Lauri Rozakis, Schaum's, **Quick Guide to Writing Great Research Papers**, Tata McGraw Hills Pvt. Ltd, New Delhi.

Online Resources:

NPTEL: https://onlinecourses.nptel.ac.in/noc18_mg13/preview

HEAD
Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

With effect from the academic year 2020-21

20EGA 102 INDIAN CONSTITUTION AND FUNDAMENTAL RIGHTS

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks

Course Objectives: The course will introduce the students to:

1. The history of Indian Constitution and its role in the Indian democracy.
2. Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement. to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. Have knowledge of the various Organs of Governance and Local Administration.

Course Outcomes: After successful completion of the course he students will be able to:

1. Understand the making of the Indian Constitution and its features.
2. Understand the Rights of equality, the Right of freedom and the Right to constitutional remedies.
3. Have an insight into various Organs of Governance - composition and functions.
4. Understand powers and functions of Municipalities, Panchayats and Co-operative Societies.
5. Understand Electoral Process, special provisions.

ÜNIT I

History of making of the Indian constitutions - History, Drafting Committee (Composition & Working).
Philosophy of the Indian Constitution: Preamble, Salient Features.

UNIT-II

Contours of Constitutional Rights and Duties - Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT-III

Organs of Governance- Parliament: Composition, Qualifications, Powers and Functions
Union executives : President, Governor, Council of Ministers, Judiciary, appointment and transfer of judges, qualifications, powers and functions

UNIT-IV

Local Administration - District's Administration head: Role and importance. Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayati Raj: Introduction, PRI: Zilla Panchayat, Elected Officials and their roles, CEO Zilla Panchayat: positions and role.
Block level: Organizational Hierarchy(Different departments) Village level: role of elected and appointed officials. Importance of grass root democracy.

UNIT-V

Election commission: Election Commission: Role and functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and functioning. Institute and Bodies for the welfare of SC / ST / OBC and women

Text Books:

1. **The Constitution of India**, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, **Framing of Indian Constitution**, 1st Edition, 2015.
3. M. P. Jain, **Indian Constitution Law**, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, **Introduction to the Constitution of India**, Lexis Nexis, 2015.

Online Resources:

1. http://www.nptel.ac.in/courses/103107084/Script.pdf

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

With effect from the academic year 2020-21

20EGA 103 **STRESS MANAGEMENT BY YOGA**

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks

Course Objectives: The Course will introduce the students to:

1. Creating awareness about different types of stress and the role of yoga in the management of stress.
2. Promotion of positive health and overall wellbeing (Physical, mental, emotional, social and spiritual).
3. Prevention of stress related health problems by yoga practice.

Course Outcomes: After successful completion of the course, the students will be able to :

1. To understand yoga and its benefits.
2. Enhance Physical strength and flexibility.
3. Learn to relax and focus.
4. Relieve physical and mental tension through asanas
5. Improve work performance and efficiency.

Unit I

Meaning and definition of Yoga - Historical perspective of Yoga - Principles of Astanga Yoga by Patanjali.

Unit II

Meaning and definition of Stress - Types of stress - Eustress and Distress. Anticipatory Anxiety and Intense Anxiety and depression. Meaning of Management- Stress Management.

Unit III

Concept of Stress according to Yoga - Stress assessment methods - Role of Asana, Pranayama and Meditation in the management of stress.

Unit IV

Asanas- (5 Asanas in each posture) - Warm up - Standing Asanas - Sitting Asanas - Prone Asanas - Supine asanas - Surya Namaskar

Unit V

Pranayama- Anulom and Vilom Pranayama - Nadishudhi Pranayama – Kapalabhati-Pranayama - Bhramari Pranayama - Nadanusandhana Pranayama.

Meditation Techniques: Om Meditation - Cyclic meditation : Instant Relaxation technique (QRT), Quick Relaxation Technique (QRT), Deep Relaxation Technique (DRT)

Text Books:

1. "**Yogic Asanas for Group Training - Part-I**": Janardhan Swami Yogabhyasi Mandal, Nagpur.
2. "**Rajayoga or Conquering the Internal Nature**"by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata.
3. Nagendra H.R nad Nagaratna R, **Yoga Perspective in Stress Management**, Bangalore, Swami Vivekananda Yoga Prakashan

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc16_ge04/preview
2. https://freevideolectures.com/course/3539/indian-philosophy/11

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

20EGA 104 **PERSONALITY DEVELOPMENT THROUGH LIFE'S ENLIGHTENMENT SKILLS**

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks

Course Objectives: The course will introduce the students to :

1. To learn to achieve the highest goal happily.
2. To become a person with stable mind, pleasing personality and determination.
3. To awaken wisdom among themselves.

Course Outcomes: After successful completion of the course the students will be able to:

1. Develop their personality and achieve their highest goal of life.
2. Lead the nation and mankind to peace and prosperity.
3. To practice emotional self regulation.
4. Develop a positive approach to work and duties.
5. Develop a versatile personality.

UNIT-I

Neetisatakam – Holistic development of personality - Verses 19, 20, 21, 22 (Wisdom) - Verses 29, 31, 32 (Pride and Heroism) - Verses 26,28,63,65 (Virtue)

UNIT-II

Neetisatakam – Holistic development of personality (cont'd) - Verses 52, 53, 59 (dont's) - Verses 71,73,75 & 78 (do's) - Approach to day to day works and duties.

UNIT-III

Introduction to Bhagavadgeetha for Personality Development - Shrimad Bhagawad Geeta: Chapter 2 – Verses 41, 47, 48 - Chapter 3 – Verses 13,21,27,35 - Chapter 6 – Verses 5,13,17,23,35 - Chapter 18 – Verses 45, 46, 48 Chapter – 6: Verses 5, 13, 17, 23, 35; Chapter – 18: Verses 45, 46, 48

UNIT-IV

Statements of basic knowledge - Shrimad BhagawadGeeta: Chapter 2- Verses 56, 62,68 - Chapter 12 – Verses 13, 14, 15, 16, 17, 18 - Personality of Role model from Shrimad Bhagawat Geeta.

UNIT-V

Role of Bahgavadgeeta in the present scenario - Chapter 2 – Verses 17 - Chapter 3 – Verses 36, 37, 42 - Chapter 4 – Verses 18, 38, 39 - Chapter 18 – Verses 37, 38, 63.

Text Books:

1. "**Srimad Bhagavad Gita"** by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata
2. Bhartrihari's **Three Satakam** (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi

Online Courses:

1. NTPEL: http://nptel.ac.in/downloads/109104115/

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

With effect from the academic year 2020-21

20ECA 101 **VALUE EDUCATION**

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks

Course Objectives:

1. Understand the need and importance of Values for self-development and for National development.
2. Imbibe good human values and Morals
3. Cultivate individual and National character.

Course outcomes: After completion of the Course, Students will be able to:

1. Gain necessary Knowledge for self-development
2. Learn the importance of Human values and their application in day to day professional life.
3. Appreciate the need and importance of interpersonal skills for successful career and social life
4. Emphasize the role of personal and social responsibility of an individual for all-round growth.
5. Develop a perspective based on spiritual outlook and respect women, other religious practices, equality, non-violence and universal brotherhood.

UNIT I: Human Values, Ethics and Morals: Concept of Values, Indian concept of humanism, human values; Values for self-development, Social values, individual attitudes; Work ethics, moral and non- moral behavior, standards and principles based on religion, culture and tradition.

UNIT II: Value Cultivation, and Self-management: Need and Importance of cultivation of values such as Sense-of Duty, Devotion to work, Self-reliance, Confidence, Concentration, Integrity & discipline, and Truthfulness.

UNIT III: Spiritual outlook and social values: Personality and Behavior, Scientific attitude and Spiritual (soul) outlook; Cultivation of Social Values Such as Positive Thinking, Punctuality, Love & Kindness, Avoiding fault finding in others, Reduction of anger, forgiveness, Dignity of labour, True friendship, Universal brotherhood and religious tolerance.

UNIT IV: Values in Holy Books: Self-management and Good health; **and internal & external Cleanliness,** Holy books versus Blind faith, Character and Competence, Equality, Nonviolence, Humility, Role of Women.

UNIT V:Dharma, Karma and Guna: Concept of soul; Science of Reincarnation, Character and Conduct, Concept of Dharma; Cause and Effect based Karma Theory; The qualities of Devine and Devilish; Satwic, Rajasic and Tamasicgunas.

Text Books:

1. Chakroborty, S.K. “Values & Ethics for organizations Theory and practice”, Oxford University Press, New Delhi, 1998.
2. Jaya DayalGoyandaka, “Srimad Bhagavad Gita”, withSanskrit Text, Word meaning and Prose meaning, Gita Press, Gorakhpur, 2017.

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

With effect from the academic year 2020-21

20CEA 101 DISASTER MITIGATION AND MANAGEMENT

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks

Course Objectives: To enable the student

1. To equip the students with the basic knowledge of hazards, disasters, risks and vulnerabilities including natural, climatic and human induced factors and associated impacts. To impart knowledge in students about the nature, causes, consequences and mitigation measures of the various natural disasters

2. To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters. To enable the students to understand and assimilate the impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic, etc.

3. To equip the students with the knowledge of the chronological phases ina disaster management cycle and to create awareness about the disaster management framework and legislations in the context of national and global conventions

Course Outcomes: At the end of the course the student

1. Ability to analyse and critically examine existing programs in disaster management regarding vulnerability, risk and capacity at different levels

2. Ability to understand and choose the appropriate activities and tools and set up priorities to build a coherent and adapted disaster management plan

3. Ability to understand various mechanisms and consequences of human induced disasters for the participatory role of engineers in disaster management

4. To understand the impact on various elements affected by the disaster and to suggest and apply appropriate measures for the same

5. Develop an awareness of the chronological phases of disaster preparedness, response and relief operations for formulating effective disaster management plans and ability to understand various participatory approaches/strategies and their application in disaster management

UNIT- I:

Introduction: Basic definitions- Hazard, Disaster, Vulnerability, Risk, Resilience, Mitigation, Management; classification of types of disaster- Natural and man-made; International Decade for natural disaster reduction (IDNDR); International strategy for disaster reduction (ISDR), National disaster management authority (NDMA).

UNIT- II:

Natural Disasters: Hydro meteorological disasters: Causes, Early warning systems- monitoring and management, structural and non-structural measures for floods, drought and Tropical cyclones; Geographical based disasters: Tsunami generation, causes, zoning, Early warning systems- monitoring and management, structural and non-structural mitigation measures for earthquakes, tsunami, landslides, avalanches and forest fires. Case studies related to various hydro meteorological and geographical based disasters.

UNIT- III:

Human induced hazards: Chemical disaster- Causes, impacts and mitigation measures for chemical accidents, Risks and control measures in a chemical industry, chemical disaster management; Case studies related to various chemical industrial hazards eg: Bhopal gas tragedy; Management of chemical terrorism disasters and biological disasters; Radiological Emergencies and case studies; Case studies related to major power break downs, fire accidents, traffic accidents, oil spills and stampedes, disasters due to double cellar construction in multi-storeyed buildings.

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

UNIT- IV:

Disaster Impacts: Disaster impacts- environmental, physical, social, ecological, economical, political, etc.; health, psycho-social issues; demographic aspects- gender, age, special needs; hazard locations; global and national disaster trends; climate change and urban disasters.

UNIT- V:

Concept of Disaster Management: Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; risk analysis, vulnerability and capacity assessment; Post-disaster environmental response- water, sanitation, food safety, waste management, disease control; Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Text Books:

1. Pradeep Sahni,*" Disaster Risk Reduction in South Asia*", Prentice Hall, 2003.
2. B. K. Singh,*" Handbook of Disaster Management*: *techniques & Guidelines*", Rajat Publication, 2008.

Suggested Reading:

1. Ministry of Home Affairs". *Government of India, "National disaster management plan, Part I and II"*,
2. K. K. Ghosh," *Disaster Management"*, APH Publishing Corporation, 2006.
3. http://www.indiaenvironmentportal.org.in/files/file/disaster_management_india1.pdf
4. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs)
5. Hazards, Disasters and your community: A booklet for students and the community, Ministry of home affairs.

All the problems in the life are because of only one reason; We forget what is to be remembered, we often remember what is to be forgotten!

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

With effect from the academic year 2020-21

20IT A101 **PEDAGOGY STUDIES**

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks

Course Objectives:

1. To present the basic concepts of design and policies of pedagogy studies. To provide understanding of the abilities and dispositions with regard to teaching techniques, curriculum design and assessment practices.
2. To familiarize various theories of learning and their connection to teaching practice.
3. To create awareness about the practices followed by DFID, other agencies and other researchers. To provide understanding of critical evidence gaps that guides the professional development.

Course Outcomes: Upon completing this course, students will be able to:

1. Illustrate the pedagogical practices followed by teachers in developing countries both in formal and informal classrooms.
2. Examine the effectiveness of pedagogical practices.
3. Understand the concept, characteristics and types of educational research and perspectives of research.
4. Describe the role of classroom practices, curriculum and barriers to learning.
5. Understand Research gaps and learn the future directions.

UNIT-I

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT-II

Thematic Overview: Pedagogical practices followed by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT-III

Evidence on the Effectiveness of Pedagogical Practices: Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and Practicum) and the school curriculum and guidance material best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and pedagogic strategies.

UNIT-IV

Professional Development: alignment with classroom practices and follow up support - Support from the head teacher and the community – Curriculum and assessment - Barriers to learning: Limited resources and large class sizes.

UNIT-V

Research Gaps and Future Directions: Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment – Dissemination and research impact.

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Gandipet, Hyderabad-75

Text Books:

1. Ackers J, Hardman F, "Classroom Interaction in Kenyan Primary Schools, Compare", 31 (2): 245 – 261, 2001.
2. Agarwal M, "Curricular Reform in Schools: The importance of evaluation", Journal of Curriculum Studies, 36 (3): 361 – 379, 2004.

Suggested Reading:

1. Akyeampong K, "Teacher Training in Ghana – does it count? Multisite teacher education research project (MUSTER)", Country Report 1.London: DFID, 2003.
2. Akyeampong K, Lussier K, Pryor J, Westbrook J, "Improving teaching and learning of Basic Maths and Reading in Africa: Does teacher Preparation count?, International Journal Educational Development, 33 (3): 272- 282, 2013.
3. Alexander R J, "Culture and Pedagogy: International Comparisons in Primary Education", Oxford and Boston: Blackwell, 2001.
4. Chavan M, "Read India: A mass scale, rapid, 'learning to read' campaign", 2003.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc17_ge03/preview
2. www.pratham.org/images/resources%20working%20paper%202.pdf.

Keep acquaintance with all, friendship with some, but intimacy with only few.
It is hard to find a friend who is highly intelligent, handsome, wise and sweet!
So don't lose ME! My friend has the best friend!

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Gandipet, Hyderabad-75

20EEA101 SANSKRIT FOR TECHNICAL KNOWLEDGE

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks

Course Objectives:
1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. To make the novice Learn the Sanskrit to develop the logic in mathematics, science & other subjects
3. To explore the huge knowledge from ancient literature

Course Outcomes: After completion of this course, students will be able to:
1. Develop passion towards Sanskrit language
2. Decipher the latent engineering principles from Sanskrit literature
3. Correlates the technological concepts with the ancient Sanskrit history.
4. Develop knowledge for the technological progress
5. Explore the avenue for research in engineering with aid of Sanskrit

UNIT-I
Introduction to Sanskrit language: Sanskrit Alphabets-vowels-consonants- significance of Amarakosa-parts of speech-Morphology-creation of new words-significance of synonyms-sandhi-samasa-sutras-active and passive voice-Past/Present/Future Tense-syntax-Simple Sentences (elementary treatment only)

UNIT-II
Role of Sanskrit in Basic sciences: Brahmagupthas lemmas (second degree indeterminate equations), sum of squares of n-terms of AP- sulba_sutram or baudhayana theorem (origination of pythogorous theorem)-value of pie-Madhava's sine and cosine theory (origination of Taylor's series).
The measurement system-time-mass-length-temp, Matter elasticity-optics-speed of light (origination of michealson and morley theory).

UNIT-III
Role of Sanskrit in Engineering-I (Civil, Mechanical, Electrical and Electronics Engineering): Building construction-soil testing-mortar-town planning-Machine definition-crucible-furnace-air blower- Generation of electricity in a cell-magnetism-Solar system-Sun: The source of energy, the earth-Pingala chandasutram (origination of digital logic system)

UNIT-IV
Role of Sanskrit in Engineering-II (Computer Science Engineering & Information Technology): Computer languages and the Sanskrit languages-computer command words and the vedic command words-analogy of pramana in memamsa with operators in computer language-sanskrit analogy of physical sequence and logical sequence, programming.

UNIT-V
Role of Sanskrit in Engineering-III (Bio-technology and Chemical Engineering): Classification of plants-plants, the living-plants have senses-classification of living creatures- Chemical laboratory location and layout-equipment-distillation vessel-kosthi yanthram

Text Books:
1. M Krishnamachariar, History of Classical Sanskrit Literature, TTD Press, 1937.
2. Motilal Banarsidass Publishers, ISBN-13: 978-8120801783, 2015
3. Kpail Kapoor, Language, Linguistics and Literature: The Indian Perspective, ISBN-10: 8171880649, 1994.
4. Pride of India, Samskrita Bharti Publisher, ISBN: 81-87276-27-4, 2007
5. Shri Rama Verma, Vedas the source of ultimate science, Nag publishers, ISBN: 81-7081-618-1, 2005

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Suggested Reading:

1. The Wonder that is Sanskrit, AuroPublications, ISBN: 978-8170601821, 2017
2. Science in Sanskrit, Samskrita Bharti Publisher, ISBN-13: 978-8187276333, 2007
3. A Treasury of Indian Wisdom: An Anthology of Spiritual Learn, ISBN: 978-0143426158, 2016.

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Dept. of EEE, CBIT (A)
Gandipet, Hyderabad-75

Industrial Project / Internship

Guide lines:

To develop advanced knowledge and specific skills required for industrial development, CBIT is implementing the AICTE internship policy guidelines for ME/MTech students from the academic year 2020-21 onwards. Students may choose Industrial problem as Dissertation topic. The proposed Credit Framework for the same is as follows:

S. No	Schedule	Activities	Duration	Credits
1	Semester - III	Industrial Project /Dissertation Phase 1	20 weeks	10
2	Semester - IV	Industrial Project/Dissertation Phase 2	32 weeks	16

Guidelines:

- ✓ The student should submit a synopsis of the proposed work to be done during the internship Programme/Industrial Project/Dissertation/Industrial Dissertation which is examined or evaluated by the departmental Project Review Committee to ensure that the proposed work is equivalent to ME/MTech dissertation work. This synopsis should be submitted to the department before the candidate is relieved.
- ✓ Student has to submit the information about the commencement of internship to the HOD before the registration of the courses in that semester (i.e III/IV).
- ✓ Two supervisors will monitor the internship/ Industry project work, one from the department and another from industry.
- ✓ Industry/Educational Organization must submit the month-wise attendance of the students to the department.
- ✓ Student should regularly present his/her project progress report to their respective internal supervisor(s)
- ✓ The final project presentation is evaluated on the basis of the recommendation given by external supervisor, and further can be evaluated by the institute supervisor.
- ✓ If the internship project is not found to be of high quality, then the student will have to reappear in the next semester for their ME/MTech dissertation work.
- ✓ The student is required to publish internship work in conferences and journals with due permission/consent from the organization/Industry where he/she has undergone the internship.
- ✓ If the student feels that the internship work is not of high quality/not related to that field of interest, then the student should submit the application to the department HoD within THREE weeks and can re-join the institute.
- ✓ Industry/Institute should allow producing results obtained during project/internship period in the project report. The written certificate to this effect from the industry/institute is mandatory before consideration of the proposed project/internship.

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Gandipet, Hyderabad-75