Shri Shamrao Patil (Yadravkar) Educational & Charitable Trust's
Sharad Institute of Technology College of Engineering
(An Autonomous Institute)
Yadrav (Ichalkaranji), Dist: Kolhapur, Maharashtra-416121

Teaching and Evaluation Scheme

B. Tech in Electrical Engineering

Abbreviations

L: Lecture

T: Tutorial

P: Practical

CA1- Continuous Assessment 1

CA2- Continuous Assessment 2

MSE: Mid Semester Exam

ESE: End Semester Exam

BSC -Basic Science Courses

ESC: Engineering Science Courses

AEC: Ability Enhancement Courses

IKS: Indian Knowledge System

VSEC: Vocational and Skill Enhancement Course

PCC: Program Core Course

PEC: Program Elective Course

HSMC: Humanities, Social Sciences, and Management Course

CC: Co-curricular Courses

Teaching and Evaluation Scheme for TY B. Tech.

Department of Electrical Engineering

Semester: V

Department: Department of Electrical Engineering **Rev:** Course Structure/00/2023-24

Class: T.Y. B. Tech **Semester:** V

Course Code	Type of Course	Course	Teaching Scheme				Evaluation Scheme					Credits
			L	T	P	Total Hrs	CA1	CA2	MSE	ESE	Total	
23EE3501	PCC	Power Electronics	3	-	-	3	10	10	30	50	100	**3**
23EE3502	PCC	Power System Stability & Control	3	-	-	3	10	10	30	50	100	**3**
23EE3503	PCC	Electrical Machine Design	3	-	-	3	10	10	30	50	100	**3**
23EE3504	PEC	Elective- I	3	-	-	3	10	10	30	50	100	**3**
23EE3505	PCC	Power Electronics Laboratory	-	-	2	2	15	15	-	20	50	**1**
23EE3506	PCC	Industrial Automation Laboratory	-	-	2	2	15	15	-	20	50	**1**
23EE3507	PCC	Electrical Machine Design Laboratory	-	-	2	2	25	25	-	-	50	**1**
23EE3508	CEP	Mini Project-IV	-	-	2	2	25	25	-	-	50	**Audit**
23EEMDX3	MDM	**Multi-Disciplinary Minor-III**	3	-		3	10	10	30	50	100	**3**
23OEEE33	OEC	**Open Elective-III**	3	-		3	10	10	30	50	100	**3**
23HSSM05	VEC	Aptitude Skills-III	2	-		2	25	25	-	-	50	**Audit**
23HSSM06	VEC	Language Skills-III	-	-	2	2	25	25	-	-	50	**Audit**
23EE3509	CEP	Industrial Training	-	-	-	-	-	-	-	50	50	**Audit**
Total			**20**	-	**8**	**28**	**190**	**190**	**180**	**340**	**900**	**21**

Multi-Disciplinary Minor Course-III

Electrical System Design **(Basket - A)**	Automation & IOT **(Basket - B)**	Renewable Energy Sources & Grid Integration **(Basket - C)**
Lighting System Design (23EEMDA3)	Industrial Automation (23EEMDB3)	Smart Grid (23EEMDC3)

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Power Electronics

23EE3501	PCC	Power Electronics	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week Tutorial: -	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic Electrical Engineering; Basic Electronics Engineering

Course Outcomes: At the end of the course, students will be able to:

CO1	Analyze power semiconductor devices, including diodes, rectifiers, MOSFETs, BJTs, and IGBTs, emphasizing their characteristics, switching operations, and applications in power electronics.
CO2	Develop single-phase and three-phase controlled rectifier circuits for various load conditions.
CO3	Evaluate thyristor characteristics, their models, and operational mechanisms, including protection techniques such as di/dt and dv/dt, along with firing circuits and triggering methods like DIACs and UJTs.
CO4	Demonstrate the ability to analyze and operate DC-DC converters (choppers) and DC-AC converters (inverters), emphasizing bridge configurations, harmonic reduction, and current source inverters
CO5	Apply the principles of phase control and integral cycle control to single-phase and three-phase full-wave controllers for resistive and inductive loads.
CO6	Analyze cycloconverter operations, including single-phase, three-phase, and load-commutated configurations, with emphasis on output voltage equations and harmonic reduction techniques.

Course Contents:

Unit 1: Power Semiconductor Devices Power Diodes: Introduction, Diode Characteristics, Reverse Recovery Characteristics, Power Diode Types, Silicon Carbide Diodes, Silicon Carbide Schottky Diodes, Freewheeling diodes, Freewheeling diodes with RL load. Diode Rectifiers: Introduction, Diode Circuits with DC Source connected to R and RL load, Single-Phase Full-Wave Rectifiers with R load, Single-Phase Full-Wave Rectifier with RL Load. Power Transistors: Introduction, Power MOSFETs – Steady-State Characteristics, Switching Characteristics Bipolar Junction Transistors – Steady-State Characteristics, Switching Characteristics, Switching Limits, IGBTs, MOSFET Gate Drive, BJT Base Drive, Isolation of Gate and Base Drives, Pulse transformers and Opto-couplers	[6]
Unit 2: Phase Controlled Rectifiers Controlled Rectifiers: Introduction, Single phase half-wave circuit with RL Load, Single phase half-wave circuit with RL Load and Freewheeling Diode, Single phase half-wave circuit with RLE Load, Single-Phase Full Converters with RLE Load, Single-Phase Dual Converters, Principle of operation of Three- Phase duel Converters.	[6]

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Unit 3 : Thyristors Thyristors: Introduction, Thyristor Characteristics, Two-Transistor Model of Thyristor, Thyristor Turn-On, Thyristor Turn-Off, A brief study on Thyristor Types, Series Operation of Thyristors, Parallel Operation of Thyristors, di/dtProtection, dv/dtProtection, DIACs, Thyristor Firing Circuits, Unijunction Transistor..	[6]
Unit 4 : Choppers and Inverters DC-DC Converters: Introduction, the principle of a step-down and step-up chopper with RL load, performance parameters, DC-DC converter classification. DC-AC Converters: Introduction, the principle of operation single-phase bridge inverters, three-phase bridge inverters, voltage control of single-phase inverters, Harmonic reductions, Current source inverters.	[6]
Unit 5: AC Voltage Controllers Introduction, Principle of phase control & Integral cycle control, Single-Phase Full-Wave Controllers with Resistive Loads, Single- Phase Full-Wave Controllers with Inductive Loads, Three-Phase Full-Wave Controllers.	[6]
Unit 6 : Cycloconverters Introduction; Basic Principle; Single to single-phase cycloconverters; Three-phase half-wave cycloconverters; Cycloconverters for three phase output; Output voltage equation; Output harmonics in cycloconverter; Comparison between cycloconverter and DC link Converter; Load Commutated cycloconverter	[6]

Text Books:

1. Mohammad H Rashid, Power Electronics: Circuits Devices and Applications, Pearson 4th Edition, 2014.

Reference Books:

1. P.S. Bimbhra, Power Electronics, Khanna Publishers, 5th Edition, 2012
2. Ned Mohan et al, Power Electronics: Converters, Applications and Design, Wiley 3rd Edition, 2014.
3. Daniel W Hart, Power Electronics, McGraw Hill 1st Edition, 2011.
4. Philip T Krein, Elements of Power Electronics, Oxford Indian Edition, 2008.

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Power System Stability & Control

23EE3502	PCC	Power System Stability & Control	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week Tutorial: -	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Power System Analysis, AC Machines

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain the fundamental concepts of power system stability, including rotor angle stability, voltage stability, and frequency stability.
CO2	Evaluate load flow methods, including Gauss-Seidel and Newton-Raphson techniques, to solve power flow equations and optimize system operations
CO3	Apply the principles of symmetrical components and sequence networks to calculate sequence impedances and construct power system models.
CO4	Examine fault analysis techniques for symmetrical and unsymmetrical faults using sequence voltages, bus impedance matrices, and general procedures.
CO5	Explain the concept of voltage stability and voltage collapse in power systems and voltage stability improvement techniques.
CO6	Analyze frequency stability under various conditions, incorporating inertia dynamics, governor response, AGC, and the impact of renewable energy.

Course Contents:

Unit 1: Introduction to Power System Stability Basic concepts and definitions, Types of Stability: Rotor Angle Stability, Voltage Stability, Frequency Stability, Classification: Steady State, Transient, and Dynamic Stability, Power angle curve, An elementary view of transient stability ,swing equation ,M and H constant, Equal Area Criterion and its applications, critical clearing angle, Rotor angle stability, Importance of Power System Stability, Factors Affecting Power System Stability.	[6]
Unit 2: Power Flow Analysis Bus classification, Bus admittance matrix, General form of power flow equations, Gauss-Seidel and Newton-Raphson methods, Comparison of load flow methods	[6]
Unit 3: Symmetrical Components Symmetrical components, Dr. Fortescue Theorem, Component synthesis, Component analysis, Sequence impedances and Sequence networks, Sequence impedances of transmission lines, transformers, and synchronous machines, Construction of sequence network of a power system.	[6]
Unit 4: Symmetrical and Unsymmetrical Faults Symmetrical Faults: Classification, Effect of faults, Balanced three phase fault, Short circuit capacity, Symmetric fault analysis using bus impedance matrix. Unsymmetrical Faults: Assumptions, Sequence voltages of generator, General procedure for analysis of various faults, Analysis of unsymmetrical faults.	[8]

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Unit 5: Voltage Stability Concept of Voltage Stability and Voltage Collapse, Classification of Voltage Stability: Short Term and Long Term Voltage Stability, Factors Affecting Voltage Stability, Voltage Stability Improvement Techniques.	[6]
Unit 6: Frequency Stability Concept of Frequency Stability, Inertia and Frequency Dynamics, Primary Frequency, Control: Governor Response, Secondary Frequency Control: Automatic Generation Control (AGC), Impact of Renewable Energy on Frequency Stability, Frequency Stability under Islanding Conditions.	[6]

Text Books:

1. I.J. Nagrath and D.P. Kothari, Power System Analysis, TMH Publication
2. Hadi Saadat, Power System Analysis, TMH.
3. B.S.R. Murty, Power System Analysis, B.S. Publications.

Reference Books:

1. Glover, Sharma, Overbye, Thompson, Power Systems Analysis and Design, 5th Ediction, Cengage Learning, 2012.
2. Stevenson W.D., Elements of Power System Analysis, TMH.
3. Prabha Kundur, Power System Stability and Control, McGraw Hill Professional, 2022.

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Electrical Machine Design

23EE3503	PCC	Electrical Machine Design	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week Tutorial: -	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: DC Machine and Transformers, AC Machines

Course Outcomes: At the end of the course, students will be able to:

CO1	Analyze the ratio of iron loss to copper loss and its impact on efficiency.
CO2	Solve for no-load current, equivalent circuit parameters, and performance characteristics of transformers.
CO3	Determine the main dimensions, winding configurations, and stator slot design for efficiency improvement.
CO4	Analyze the operating characteristics of three-phase induction motors, including no-load current, magnetizing current, short-circuit current, and performance parameters obtained using the circle diagram, to evaluate static torque, maximum torque, output, power factor.
CO5	Determine diameter and length using output equations and analyze the effect of short circuit ratio on performance.
CO6	Analyze machine designs as per Indian Standards (IS) and international testing methodologies.

Course Contents:

Unit 1: Constructional Details And Design of Transformers Output equation, EMF per turn. Ratio of iron loss to copper loss, Relation between core area and weights of iron and copper, optimum designs, Core design. Design of windings.	[6]
Unit 2: Performance Evaluation of Transformer Calculation of no-load current. Equivalent circuit and performance characteristics. Temperature rise. Design of tank and radiators.	[6]
Unit 3: Constructional Details And Design of Three Phase Induction Motors Output equation. Specific electric and magnetic loadings. Efficiency and power Factor, main dimensions. Type of winding and connection .Turns per phase, shape of stator slots. Number of stator slots, design of stators.	[7]
Unit 4: Operating Characteristics of Three Phase Induction Motors No load current Magnetizing current, loss component short circuit current. Use of circle diagram to obtain performance figures. Calculation of static torque, maximum torque, maximum output, maximum power factor. Dispersion coefficient.	[7]
Unit 5: Design of Synchronous Machines Construction of water wheel and turbo alternators. Different parts and materials used for Synchronous machine, choice of electric and magnetic loadings, Output equation. Determination of diameter and length, effect of short circuit ratio on machine performance.	[7]

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Unit 6: Computer Aided Design of Electrical Machines Benefits of computer in machine design, methods of approach, optimization and computer aided design of induction motor and three phase transformer, Testing as per IS.	[6]

Text Books:

1. A. K. Sawhney, A Course in Electrical Machine Design, Dhanpat Rai and Sons, Delhi.
2. V.N. Mittle and A. Mittle, Design of Electrical Machines, Standard Publications & Distributors, Delhi.

Reference Books:

1. R. K. Agarwal, Principles of Electrical Machine Design, S. K. Kataria and Sons, Delhi.
2. S.K. Sen, Principles of Electrical Machine Design with Computer Programmes, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

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Energy Audit & Conservation

23EE3504A	PEC	Energy Audit & Conservation	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3hrs./week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Engineering Physics, Basic Electrical Engineering

Course Outcomes: At the end of the course, students will be able to:

CO1	Evaluate global environmental issues and international frameworks like UNFCC, Kyoto Protocol, and COP to assess sustainable development practices.
CO2	Apply energy audit approaches and benchmarking techniques to optimize energy usage and system efficiencies.
CO3	Assess the performance of boilers, pumps, cooling towers, and cogeneration systems to identify energy conservation opportunities.
CO4	Apply strategies for electrical load management, power factor improvement, and the use of energy-efficient technologies to enhance system performance.
CO5	Evaluate financial analysis techniques and performance contracts to support investment decisions and energy conservation initiatives.
CO6	Develop energy conservation projects through planning, implementation, monitoring, and evaluation based on industrial and commercial case studies.

Course Contents:

Unit 1: Global Environmental Concerns: Global Environmental Issues, United Nations Framework Convention on Climate, Change (UNFCC), Kyoto Protocol, Conference of Parties (COP), Clean Development, Mechanism (CDM), Prototype Carbon Fund (PCF), Sustainable Development.	[5]
Unit 2: Energy Management & Audit: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments.	[6]
Unit 3: Thermal & Mechanical Systems: Boilers: Types, Combustion in boilers, Performances evaluation- Direct Method & Indirect Method of Boiler Efficiency, Energy conservation opportunities; Pumps and Pumping System: Types, Performance evaluation, Energy conservation opportunities; Cooling Tower: Types and performance evaluation, Energy saving opportunities; Cogeneration: Definition, Need, Application, Advantages, Classification, Saving potentials.	[8]
Unit 4: Electrical Systems: Electricity billing, Electrical load management and maximum demand control, Power factor improvement and its benefit, Selection and location of capacitors, Performance assessment of PF capacitors, Automatic power factor controllers, Energy efficient motors,	[7]

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Soft starters with energy saver, Variable speed drives, Energy efficient transformers, Electronic ballast, Occupancy sensors, Energy efficient lighting controls	
Unit 5: Financial Management: Investment-need, Appraisal and criteria, Financial analysis techniques-Simple payback period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis; Financing options, Energy performance contracts and role of ESCOs.	[6]
Unit 6: Case Studies Planning, Implementation & monitoring of energy conservation project, Case studies on various Industrial Sectors and Commercial Establishments.	[4]

Text Books:

1. Anil Kumar, Om Prakash, Prashant Singh Chauhan, Samsher Gautam, Energy Management Conservation and Audits, CRC Press, 2020.
2. Charles M Gottschalk, Industrial Energy Conservation, John Willey and Sons.
3. Paul O Callagham, Energy Management Handbook, Tata Mc Graw Hill.
4. S. Rao and B. Parulekar, Energy Technology, Khanna Publishers.

Reference Books:

1. Wayne C. Turner, Energy Management Handbook, Fairmont Press, Incorporated, 2018.

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Industrial Safety

23EE3504B	PEC	Industrial Safety	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 Hrs / week Tutorial: - Practical: -	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Examination: 30 Marks End Semester Examination: 50 Marks

Pre-Requisites: Nil

Course Outcomes: At the end of the course, students will be able to:

CO1	Demonstrate an understanding of electrical hazards, including the effects of electric shock, safe practices, and protection techniques such as earthing and earth leakage circuit breakers.
CO2	Apply fire prevention measures by identifying the causes of fire and utilizing various fire extinguishers and fire detection systems effectively.
CO3	Apply the principles of accident prevention to effectively minimize hazards and errors in various environments.
CO4	Develop the ability to administer first aid for various injuries and emergencies, such as electric shocks, chemical burns, suffocation, fractures, and heat strokes.
CO5	Identify the need, classification, and selection of PPE based on specific body parts and hazards in various work environments.
CO6	Apply tailored safety measures for industries such as automobile, cement, chemical, electronics, food, petroleum, and sugar to enhance workplace safety.

Course Contents:

Unit 1: Electrical Hazards & Safety Concept of Electric Shock, Effects of shock on human body, Safe limits of amperages, safe distance from electrical lines, Overload and Short circuit protection, concept & Types of Earthing (Pipe & Plate), Earth Leakage circuit Breaker, Protection against voltage fluctuations, Concept of static electricity, Concept of Step & Touch Potential.	[6]
Unit 2: Fire Hazards Causes of Fire & Remedial Measures, classification of fire and extinguishers, Statutory Provisions, fire prevention and protection systems, Fire Detection and Alarm Systems, Types of Fire Extinguishers-Soda Acid (Water Type) Extinguisher, Foam Extinguisher, CO_2 (Compressed gas) Extinguisher, Dry Chemical Powder (DCP) Extinguisher, Fire Hydrants.	[6]

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Unit 3: Principles of Accidents Prevention Need For Safety, Reasons For Accident Prevention:- Humanitarian, Economic Or Costs, Social, Productivity, Etc. Definition: Incident, Accident, Injury, Dangerous Occurrences, Unsafe Acts, Unsafe Conditions, Hazards, Error, Oversight, Mistakes Etc. Principles Of Accident Prevention, Unsafe Conditions, Remedies And Responsibilities	[6]
Unit 4: First Aid Need of First aid, Injuries And First Aid at a Glance:- Electric Shock, Eye-Wounds, Chemical Burns of the Eyes, Suffocation, Heart Attack, Bleeding Nose, Bleeding Ear, Infection, Heat stroke etc. Fractures, Foreign Body in the Body Part, Dressing & Bandaging, Electrical Injuries, Artificial Respiration, Burns and Scalds	[6]
Unit 5: Personal Protective Equipment's Need, Selection and Classification of PPE according to the body part and hazards, Head and Hair Protection, Ear Protection, Face and Eye Protection, Hand and Arm Protection, Foot and Leg Protection, Body, Skin and Fall Protection, Training, Maintenance, Precaution and Care of PPE.	[6]
Unit 6: Safety Measures in Industry Safety Measures In :Automobile Industry, Cement Industry, Chemical Industry, Electronics Industry, Food Industry, Glass Industry, Paper Industry, Petroleum Refinery And LPG Bottling Plants, Plastics Industry, Sugar Industry	[6]

Text/Reference Books:

1. Dr. K. U. Mistry, Fundamentals of Industrial Safety & Health, Siddharth Prakashan, Ahmedabad.
2. Ratan Raj Tatiya, Elements of Industrial Hazards, Health, Safety, Environment and Loss Prevention, CRC Press Publication.
3. John Cadick, Mary Capelli-Schellpfeffer, Dennis K. Neitzel, Al Winfield, Electrical Safety Handbook, Mc Graw Hill Publication.
4. R. Craig Schroll, Industrial Fire Protection Handbook, CRC Press Publication.

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Signals & Systems

23EE3504C	PEC	Signals & Systems	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 Hrs / week Tutorial: - Practical: -	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Examination: 30 Marks End Semester Examination: 50 Marks

Pre-Requisites: Engineering Mathematics-I and II, Network Analysis

Course Outcomes: At the end of the course, students will be able to:

CO1	Classify continuous and discrete signals and systems based on characteristics such as linearity, time invariance, causality, stability, and dynamics.
CO2	Analyze the zero-state and zero-input responses, convolution operations, and graphical representation of convolution for continuous and discrete-time systems.
CO3	Analyze periodic and aperiodic signals in the frequency domain using Fourier series and Fourier transforms, emphasizing properties like duality and time reversal.
CO4	Solve differential equations and perform system analysis using Laplace transforms to determine transfer functions, poles, and zeroes.
CO5	Apply Nyquist Sampling Theorem and discrete-time Fourier transform to represent and analyze aperiodic sequences in the time and frequency domains.
CO6	Evaluate discrete time signals and systems using Z-transforms to determine transfer functions, poles, zeroes, and the behavior of FIR and IIR systems.

Course Contents:

Unit 1 :Introduction to Signals and Systems Continuous and Discrete - Introduction, standard signals, signal, representation, classification of signals, systems – representation, classification, Linear, Time invariant, causal, BIBO stable, Static, dynamic	[8]
Unit 2: Time Domain Analysis of Continuous and Discrete Time Systems Zero state and Zero input response, Impulse response, Convolution and its properties, Convolution integral, Properties of Convolution integral, Convolution sum, Properties of Convolution sum, graphical representation of convolution	[6]
Unit 3: Fourier Domain Analysis of Continuous Time Signal Trigonometric Fourier series, Compact Trigonometric Fourier series, Exponential form, Dirichlet Conditions, Frequency domain representation of periodic signals, Fourier Transform representation of aperiodic signals, Properties of CFT duality, time reversal, Convolution – time and frequency domain	[6]

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Unit 4 Laplace Transform Analysis of Signals and System Definition, Properties, Solution of differential equation. Transfer function, Poles and Zeroes, System analysis using Laplace Transform.	[6]
Unit 5: Fourier Domain Analysis of Discrete Time Signal Representation of CT signals using Samples, Nyquist Sampling Theorem, Discrete time Fourier Transform, Representation of aperiodic sequence, Properties of DTFT: time reversal, Linear Convolution – time and frequency domain, conjugate symmetry.	[6]
Unit 6: Z- Transform Analysis of Discrete Time Signals and Systems Definition, Properties, Solution of difference equation. Transfer function, Poles and Zeroes, System analysis using Z-Transform, FIR, IIR systems.	[6]

Text Books:

1. A.V. Oppenheim, A.S. Wilsky, S.H. Nawab, Signals and Systems, 2nd Edition, Pearson, 2015.
2. B. P. Lathi, Principles of Linear Systems and Signals, 2nd Edition, Oxford University Press, 2005.
3. A. Anand Kumar, Signals and Systems, 3rd Edition, PHI, 2013.

Reference Books:

1. M. J. Roberts, Signals and Systems, 3rd Edition, Tata McGraw Hill, 2011.
2. Simon Haykin, Barry Van Veen, Signals and Systems, 2nd Edition, Wiley Publications, 2007.

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Optimization Techniques

23EE3504D	PCC	Optimization Techniques	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week Tutorial: -- Practical: --	Continuous Assessment-I: 10 Marks Continuous Assessment-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisite: Engineering Mathematics-I and II

Course Outcomes: At the end of the course, the students will be able to:

CO1	Classify optimization problems based on design constraints, objective function characteristics, and design variable properties and also evaluate the physical structure, equations, and deterministic nature of these problems.
CO2	Utilize classical optimization techniques, including the methods of Lagrange multipliers and Kuhn–Tucker conditions, to solve multivariable problems and demonstrate the use of simplex algorithms and duality principles in linear programming.
CO3	Develop effective strategies using advanced linear programming techniques, such as decomposition principles, sensitivity analysis, and Karmarkar's interior method and apply these strategies to solve transportation and quadratic programming challenges.
CO4	Construct optimization models employing nonlinear programming methods like dynamic programming, Pontryagin's Maximum Principle, and heuristic algorithms such as Particle Swarm Optimization (PSO) and Ant Colony Optimization.

Course Contents:

Unit-1: Introduction to Optimization Introduction, Engineering Applications of Optimization, Statement of an Optimization Problem: Design, Design Constraints, Constraint Surface, Objective Function, Objective Function Surfaces, Classification of Optimization Problems: Classification Based on: the Existence of Constraints, the Nature of the Design Variables, the Physical Structure of the Problem, the Nature of the Equations Involved, the Permissible Values of the Design Variables, the Deterministic Nature of the Variables, the Separability of the Functions, the Number of Objective Functions, Optimization Techniques	[6]
Unit-2: Classical Optimization Techniques Introduction, Single-Variable Optimization, Multivariable Optimization with No Constraints: Semidefinite Case, Saddle Point, Multivariable Optimization with Equality Constraints: Solution by Direct Substitution, the Method of Constrained Variation, the Method of Lagrange Multipliers, Multivariable Optimization with Inequality Constraints: Kuhn–Tucker Conditions, Constraint Qualification	[6]
Unit-3: Linear Programming-I Introduction, Standard Form of a Linear Programming Problem, Geometry of Linear	[7]

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Programming Problems, Definitions and Theorems, Solution of a System of Linear Simultaneous Equations, Motivation of the Simplex Method, Simplex Algorithm: Identifying an Optimal Point, Improving a Nonoptimal Basic Feasible Solution, Two Phases of the Simplex Method	
Unit-4: Linear Programming-II Introduction, Duality in Linear Programming: Symmetric Primal–Dual Relations, General Primal–Dual Relations, Primal–Dual Relations When the Primal Is in Standard Form, Duality Theorems, Dual Simplex Method, Decomposition Principle; Transportation Problem, Karmarkar's Interior Method: Statement of the Problem, Conversion of an LP Problem into the Required Form, Algorithm; Quadratic Programming	[7]
Unit-5: Dynamic Programming Introduction, Multistage Decision Processes: Definition and Examples, Representation of a Multistage Decision Process, Conversion of a Non serial System to a Serial System, Types of Multistage Decision Problems; Concept of Sub optimization and Principle of Optimality, Computational Procedure in Dynamic Programming, Example Illustrating the Calculus Method of Solution.	[6]
Unit-6: Mathematical Optimization Techniques Introduction, Quadratic Forms, Unconstrained Optimization, Constrained Optimization, Pontryagin's Maximum Principle, Functional Analytic Optimization Technique: The Minimum Norm Theorem, Simulated Annealing Algorithm (SAA), Particle Swarm Optimization (PSO) Algorithm: Basic Fundamentals of PSO Algorithm, General PSO Algorithm, Ant Colony Optimization.	[7]

Text/Reference Books:

1. Singiresu S. Rao, Engineering Optimization: Theory and Practice, 4th Edition, John Wiley & Sons, Inc.2009.
2. Soliman Abdel-Hady Soliman, Abdel-Aal Hassan Mantawy, Modern Optimization Techniques with Applications in Electric Power Systems, Springer, 2012.
3. H.A. Taha, Operations Research: An Introduction, 5th Edition, Macmillan, New York, 1992.
4. K. Deb, Optimization for Engineering Design Algorithms and Examples, Prentice-Hall of India Pvt. Ltd., New Delhi, 1995
5. G. Hadley, Linear Programming, Narosa Publishing House, New Delhi, 1990.

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Power Electronics Laboratory

23EE3505	PCC	Power Electronics Laboratory	0-0-2	1 Credit

Teaching Scheme	Evaluation Scheme
Lecture: - Tutorial: - Practical: 2hr/week	CA-I: 15 Marks CA-II: 15 Marks End Semester Exam: 20 Marks

Pre-Requisites: Basic Electrical Engineering

Course Outcomes: At the end of the course, students will be able to:

CO1	Analyze the static characteristics of key semiconductor devices such as SCRs, MOSFETs, IGBTs, and TRIACs, emphasizing their operational principles and applications in power electronics.
CO2	Design control circuits, including SCR turn-on circuits, digital triggering circuits, and AC voltage controllers using TRIAC-DIAC combinations, tailored to various types of loads.
CO3	Apply techniques such as semi-converters, choppers, and PWM inverters to control the speed of DC motors, stepper motors, and universal motors

Course Contents:

List of Experiments: Minimum 8 experiments should be performed from the following list.

1. Static Characteristics of SCR.
2. Static Characteristics of MOSFET and IGBT.
3. Characteristic of TRIAC.
4. SCR turn on circuit using synchronized UJT relaxation oscillator.
5. SCR digital triggering circuit for a single phase controlled rectifier and ac voltage regulator.
6. Single phase controlled full wave rectifier with R load, R –L load, R-L-E load with and without freewheeling diode
7. AC voltage controller using TRIAC and DIAC combination connected to R and RL loads.
8. Speed control of DC motor using single semi converter.
9. Speed control of stepper motor.
10. Speed control of universal motor using ac voltage regulator.
11. Speed control of a separately excited D.C. Motor using an IGBT or MOSFET chopper.
12. Single phase MOSFET/IGBT based PWM inverter.
13. To conduct survey field visit to study applications of rectifier, inverter, chopper & ac voltage controller

Text/Reference Books:

1. Mohammad H Rashid, Power Electronics: Circuits Devices and Applications, Pearson 4th Edition, 2014.
2. P.S. Bimbhra, Power Electronics, Khanna Publishers, 5th Edition, 2012.
3. Ned Mohan et al, Power Electronics: Converters, Applications and Design, Wiley 3rd Edition, 2014
4. Daniel W Hart, Power Electronics, McGraw Hill 1st Edition, 2011

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Industrial Automation Laboratory

23EE3506	PCC	Industrial Automation Laboratory	0-0-2	1 Credit

Teaching Scheme	Evaluation Scheme
Lecture: -	CA-I: 15 Marks
Tutorial: -	CA-II: 15 Marks
Practical: 2hr/week	End Semester Exam: 20 Marks

Pre-Requisites: ---

Course Outcomes: At the end of the course, students will be able to:

CO1	Analyze the architecture and functionalities of Distributed Control Systems (DCS), Programmable Logic Controllers (PLC), and interface modules (AI, AO, DI, DO) to understand their roles in industrial automation systems.
CO2	Develop ladder logic programs using logic gates, timers, counters
CO3	Develop real-time PLC-based control applications such as traffic light control, servo motor operation, automatic bottle filling, and water level control systems for efficient automation.

Course Contents: Minimum 8 experiments should be performed from the following list.

List of Experiments:

1. Study hardware and software platforms for DCS
2. Study of PLC
3. Study of PLC field device interface modules (AI,AO,DI,DO modules)
4. Programming Logic Gates in PLC
5. Study, understand and perform experiments on timers and counters using PLC
6. Traffic Light Control using PLC
7. Automatic water level control system using PLC
8. Direct On line (DOL) Starting of Induction Motor with/without latching
9. Servo motor control using PLC
10. Automatic Forward and Reverse Control
11. Automatic bottle filling machine using PLC

Text Books/ Reference Books:

1. George Nikolakopoulos & Stamatios Manesis, Introduction to Industrial Automation, CRC Press, 1st Edition, 2020.
2. A.K. Gupta & S.K. Arora, Industrial Automation and Robotics: An Introduction, Mercury Learning & Information, 1st Edition, 2016.
3. Kaushik Kumar & B. Sridhar Babu, Industrial Automation and Robotics: Techniques and Applications, CRC Press, 1st Edition, 2023.

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4. Richard L. Shell, Handbook of Industrial Automation, CRC Press, 1st Edition, 2000.
5. R.G. Jamkar, Industrial Automation Using PLC, SCADA & DCS, Global Education Limited, 2nd Edition, 2018.

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Electrical Machine Design Laboratory

23EE3507	PCC	Electrical Machine Design Laboratory	0-0-2	1 Credit

Teaching Scheme	Evaluation Scheme
Lecture: - Tutorial: - Practical: 2hr/week	CA-I: 10 Marks CA-II: 10 Marks End Semester Exam: 50 Marks

Pre-Requisites: DC Machines and Transformers, AC Machines

Course Outcomes: At the end of the course, students will be able to:

CO1	Design electrical components such as chokes, starters, transformers, and three-phase induction motors, along with detailed design reports and general assembly sheets.
CO2	Develop detailed drawing sheets for simplex lap winding, wave winding, and AC lap winding, utilizing computer-aided design software like AutoCAD.
CO3	Analyze the use of symbols in electrical engineering and their application in designing and assembling electrical systems and components.

Course Contents: Minimum 8 experiments should be performed from the following list.

1. Symbols used in Electrical Engineering
2. Design and assembly of Choke with design report.
3. Design and assembly of Starter with design report.
4. Design and layout of simplex lap winding (Detailed Drawing Sheet)
5. Design and layout of wave winding (Detailed Drawing Sheet)
6. Design and layout of ac lap winding (Detailed Drawing Sheet)
7. Design and assembly of transformer with design report. (Detailed Sheet for General Assembly of transformer)
8. Design and assembly of three phase induction Motor with design report.(Detailed Sheet for General Assembly of Induction Motor)
9. Complete any two drawings sheets with the help of Computer Aided Design Software like AUTOCAD)

Text Books:

1. A. K. Sawhney, A Course in Electrical Machine Design, Dhanpat Rai and Sons, Delhi.
2. V.N. Mittle and A. Mittle, Design of Electrical Machines, Standard Publications & Distributors, Delhi.

Reference Books:

1. R. K. Agarwal, Principles of Electrical Machine Design, S. K. Kataria and Sons, Delhi.
2. S.K. Sen, Principles of Electrical Machine Design with Computer Programmes, Oxford and

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IBH Publishing Co. Pvt. Ltd., New Delhi.

Mini Project-III

23EE3508	CEP	Mini Project III	0-0-2	01 Credit

Teaching Scheme	Evaluation Scheme
Practical: 2 hrs/week	Continuous Assessment-I: - 25 Marks Continuous Assessment-II: -25 Marks

Pre-Requisites: Mini Project, Mini Project II

About Hackathon

The project is a part of addressing societal and industrial needs. Hackathon is one of the platforms where students will solve real world challenges. This Course focuses on the selection of methods/engineering tools/analytical techniques for problem solving.

Through this course, students will gain the understanding of engineering basics and ideas, gain practical experience, have the opportunity to display their skills and learn about teamwork, financial management, communication skills and responsibility

Course Outcomes: At the end of the course, students will be able to:

CO1	Select the appropriate method for solving the problem
CO2	Make use of various engineering techniques and tools to give a solution
CO3	Justify the methods /tools used to develop the solution
CO4	Design / simulate the model/ project work
CO5	Describe the solution with help of a project report and presentation
CO6	Conclude the outcomes of project.

Course Contents:

Week 1: Survey Design-1 • Ensure case study group students have made necessary communication and done a preparatory visit. • Watch the lecture on survey design and study the notes. • Prepare a questionnaire and try it out with your group members as mock.	[2]
Week 2: Survey Design-2 • Review survey questionnaire prepared by case study groups. • Decide sampling strategy. • Prepare a detailed schedule for fieldwork	[2]
Week 3: **Fieldwork** • Data Collection: Collect quantitative data (e.g., statistics, usage metrics) and qualitative data (e.g., user stories, testimonials). • Use data collection tools like questionnaires, observation checklists, and digital analytics. • Ensure data accuracy and reliability through proper sampling and recording methods.	[2]

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• 25% Presentation has to be conducted by mentor/guide based on above activity.	
Week 4: Trails and Experimentation-1 • Initial Setup and Configuration • Concept Validation • Feasibility Testing	[2]
Week 5: Trails and Experimentation-2 • Prototyping • Functionality Testing	[2]
Week 6: Trails and Experimentation-3 • Bug Identification and Fixing • Integration Testing • Security Testing • 75% Presentation has to be conducted by mentor/guide based on above activity.	[2]
Week 7 : Results • Coordinator has to check and verify below points in term of result: • Functional Performance • Accuracy and Precision • Efficiency • Safety	[2]
Week 8: Validation • Coordinator has to check and verify below points in term of validation: • Testing and Verification • Compliance with Standards • 75% Presentation has to be conducted by mentor/guide based on above activity.	[2]
Week 9: Integration Testing • Validate that the hardware integrates seamlessly with other systems or components as intended • Perform compatibility tests with software, other hardware, and network systems.	[2]
Week 10: Documentation and Reporting • Maintain comprehensive documentation of design, development, testing, and validation processes • Provide detailed reports on test results, issues found, and corrective actions taken.	[2]
Week 11: Final Presentation • 100% Presentation has to be conducted by mentor/guide based on above activity. • Prototype/Final Software solution is mandatory at the time of final presentation along with report	[2]
Week 12: Exhibition • Mini project exhibition will be schedule with interdepartmental evaluation.	[2]

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Lighting System Design

23EEMDA3	MDM	Lighting System Design	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week Tutorial: --	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Electrical System Planning & Design, and Electrical Estimation & Costing

Course Outcomes: At the end of the course, students will be able to:

CO1	Analyze the physics of light and color, human vision response, photometric quantities, and mechanisms of light generation like incandescence and luminescence.
CO2	Compare various lighting technologies, including incandescent, fluorescent, LED, HID, and laser-based sources, in terms of efficiency, spectral characteristics, and lifetime.
CO3	Select appropriate light sources and luminaires for different applications.
CO4	Apply advanced lighting control systems, including dimmers, timers, motion sensors, and IoT-based protocols like DALI, KNX, and DMX, to enhance energy efficiency and integrate renewable energy sources such as solar lighting.
CO5	Evaluate energy efficiency metrics, eco-friendly lighting solutions, and sustainable practices by applying standards like ASHRAE, LEED, and IEC.
CO6	Apply lighting simulation tools and international standards to design real-world lighting systems.

Course Contents:

Unit 1: Fundamentals of Lighting Nature of Light: Physics of Light and Color, Human Vision and Eye Response, Illuminance, Luminance, and Luminous Efficacy, Photometric Quantities: Lumens, Lux, Candela, Basics of Light Generation (Incandescence, Luminescence).	[6]
Unit 2: Light Sources and Luminaires Incandescent, Fluorescent, LED, HID, and Laser-Based Lighting, Luminous Efficiency and Spectral Characteristics of Light Sources, Luminaire Components and Optical Design, Comparison of Lighting Technologies in Terms of Efficiency and Lifetime, Case Studies on LED vs. Traditional Lighting.	[6]
Unit 3: Lighting System Design Principles Indoor vs. Outdoor Lighting Considerations, Residential, Commercial, and Industrial Lighting Design, Lumen Method and Point-by-Point Method for Illumination Calculation, Lighting for Specific Applications (Offices, Stadiums, Roads, Theaters), Role of Reflectors, Diffusers, and Refractors in Luminaires.	[6]
Unit 4: Lighting Control System Role of Lighting Controls in Energy Efficiency, Dimmers, Timers, Motion Sensors, and Daylight Sensors, Smart Lighting and IoT-Based Controls, Basics of DALI, KNX, and DMX Lighting Protocols, Integration of Renewable Energy (Solar Lighting).	[6]
Unit 5: Energy Efficiency & Sustainability Energy Codes and Standards (ASHRAE, IEC, BIS, LEED), Energy Audits and Lighting	[6]

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Efficiency Metrics, LED Retrofits and Cost-Benefit Analysis, Light Pollution and Eco-Friendly Lighting, Case Study: Sustainable Lighting Projects.	
Unit 6: Lighting Simulation & Standards Introduction to Lighting Simulation Software (DIALux, Relux, AGi32) , Interpretation of Photometric Data Files (IES, LDT) , International Lighting Standards and Guidelines (IESNA, CIE, EN 12464-1) , Safety and Regulatory Compliance in Lighting Design , Final Project: Lighting System Design for a Real-World Application.	[6]

Text Books/Reference Books:

1. Mark Karlen, Christina Spangler, James R. Benya, Lighting Design Basics, Wiley, 4th Edition, 2024
2. Gary Gordon, Interior Lighting for Designers, Wiley, 5th Edition, 2015.
3. David L. DiLaura, Kevin W. Houser, Richard Mistrick, Gary Steffy, The IES Lighting Handbook, Illuminating Engineering Society, 10th Edition, 2011.
4. Mark Karlen, Christina Spangler, Lighting Design Basics, Wiley, 3rd Edition, 2017.

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Industrial Automation

23EEMDB3	MDM	Industrial Automation	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week Tutorial: -	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Introduction to PLC, SCADA and HMI

Course Outcomes: At the end of the course, students will be able to:

CO1	Apply knowledge of industrial automation types, pyramid structure, and process control to assess manufacturing systems effectively.
CO2	Analyze the working principles and industrial applications of sensors and actuators, including pneumatic, hydraulic, and electric systems.
CO3	Develop programmable logic controller (PLC) systems using ladder logic, timers, counters, and communication interfaces for industrial automation.
CO4	Summarize industrial communication protocols and networks, such as Fieldbus, Ethernet, and wireless systems, to ensure cybersecurity and efficient communication.
CO5	Develop SCADA and HMI systems for effective data logging, alarm management, and remote monitoring of industrial operations.
CO6	Apply Industry 4.0 concepts, including IoT, AI, cloud computing, digital twin technology, and predictive maintenance, to enhance automation and implement smart manufacturing solutions.

Course Contents:

Unit 1: Introduction to Industrial Automation Definition and Need for Industrial Automation, Types of Automation: Fixed, programmable, and Flexible Automation , Advantages & Challenges in Industrial Automation, Industrial Automation Pyramid: Sensors, Controllers, and Actuators , Overview of Process Control and Manufacturing Automation	[6]
Unit 2: Sensors and Actuators Types of Industrial Sensors (Proximity, Temperature, Pressure, Optical, Ultrasonic), Working Principles and Applications of Sensors, Actuators: Pneumatic, Hydraulic, and Electric Actuators , Signal Conditioning and Data Acquisition , Industrial Applications of Sensor-Actuator Systems	[6]
Unit 3: Programmable Logic Controllers Introduction to PLCs: Architecture, Operation, and Types , Ladder Logic Programming and PLC Programming Languages (IEC 61131-3), Timers, Counters, Relays, and Data Handling in PLCs, PLC Communication Interfaces (RS232, RS485, Ethernet), PLC Applications in Industrial Automation	[6]
Unit 4: Industrial Communication & Networks Basics of Industrial Communication, Fieldbus Protocols: Profibus, Modbus, CAN, DeviceNet, Industrial Ethernet: PROFINET, EtherCAT, Ethernet/IP, Wireless	[6]

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Communication in Industrial Automation , Cybersecurity in Industrial Networks	
Unit 5: SCADA and HMI Systems Introduction to Supervisory Control and Data Acquisition (SCADA) , SCADA Components: RTUs, MTUs, HMIs , Human-Machine Interface (HMI) Design Principles Data Logging, Alarm Management, and Remote Monitoring, Case Study: SCADA Applications in Power Plants and Manufacturing	[6]
Unit 6: Industry 4.0 and Smart Manufacturing Introduction to Industry 4.0: IoT, AI, and Cloud Computing in Automation , Digital Twin Technology, Industrial Robotics and Collaborative Robots (Cobots), Predictive Maintenance using Machine Learning, Industrial Case Study: Smart Factory Implementation.	[6]

Text/ Reference Books:

1. George Nikolakopoulos & Stamatios Manesis, Introduction to Industrial Automation, CRC Press, 1st Edition, 2020.
2. A.K. Gupta & S.K. Arora, Industrial Automation and Robotics: An Introduction, Mercury Learning & Information, 1st Edition, 2016.
3. Kaushik Kumar & B. Sridhar Babu, Industrial Automation and Robotics: Techniques and Applications, CRC Press, 1st Edition, 2023.
4. Richard L. Shell, Handbook of Industrial Automation, CRC Press, 1st Edition, 2000.
5. R.G. Jamkar, Industrial Automation Using PLC, SCADA & DCS, Global Education Limited, 2nd Edition, 2018.

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Smart Grid

23EEMDC3	MDM	Smart Grid	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week Tutorial: 0 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Energy Storage System, Grid Integration of RES

Course Outcomes: At the end of the course, students will be able to:

CO1	Analyze the evolution, key features, and global implementations of smart grids to understand their role in reliability, efficiency, and sustainability.
CO2	Apply advanced metering infrastructure and demand response programs, including TOU and RTP mechanisms, to optimize consumer participation and energy management.
CO3	Take-part in renewable energy sources like solar and wind, along with energy storage technologies, to address challenges in smart grid implementation.
CO4	Apply communication architectures and IoT-based smart sensors using wireless technologies to enhance smart grid monitoring and operations.
CO5	Evaluate security threats, encryption mechanisms, and data analytics techniques for load forecasting, fault detection, and grid optimization.
CO6	Interpret smart grid standards, policies, and future trends to propose innovative solutions like V2G and transactive energy for smart grid modernization.

Course Contents:

Unit 1: Introduction to Smart Grid Definition and Evolution of Smart Grid, Traditional Grid vs. Smart Grid , Need for Smart Grids: Reliability, Efficiency, and Sustainability, Key Features and Components of Smart Grid , Case Studies of Smart Grid Implementation Worldwide	[4]
Unit 2: Smart Metering and Demand Response Advanced Metering Infrastructure (AMI) and Smart Meters , Demand-Side Management (DSM) and Demand Response Programs , Time-of-Use (TOU) and Real-Time Pricing (RTP) Mechanisms, Net Metering and Consumer Participation , Home Energy Management Systems (HEMS)	[5]
Unit 3: Renewable Energy Integration & Energy Storage Solar, Wind, and Biomass Integration into Smart Grid , Distributed Energy Resources (DERs) and Microgrids , Energy Storage Technologies: Battery Storage, Pumped Hydro, Supercapacitors , Grid-Tied vs. Off-Grid Systems , Challenges and Solutions in Renewable Energy Grid Integration	[5]
Unit 4: Smart Grid Communication & IoT Applications Communication Architectures for Smart Grid , IoT and Smart Sensors in Smart Grids , Wireless Technologies: Zigbee, LoRa, Wi-Fi, 5G, and LPWAN , SCADA for Smart Grid Monitoring , Cloud Computing and Edge Computing in Smart Grid	[3]
Unit 5: Cybersecurity and Data Analytics in Smart Grid Security Threats and Vulnerabilities in Smart Grids , Encryption and Authentication	[3]

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Mechanisms , Blockchain Applications in Smart Grid Security , AI & Machine Learning for Load Forecasting and Fault Detection , Big Data Analytics for Grid Optimization	
Unit 6: Smart Grid Policies, Standards, and Future Trends IEEE, NIST, and IEC Smart Grid Standards , Government Policies and Regulations on Smart Grids , Case Studies on Smart Cities and Grid Modernization , Future Trends: AI-Driven Grids, V2G (Vehicle-to-Grid), Transactive Energy , Smart Grid Business Models and Economic Aspects	[4]

Text / Reference Books:

1. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Smart Grid: Technology and Applications, Wiley, 1st Edition, 2012.
2. Dr. Subir Sen, Mr. Rajesh Kumar, Dr. D.P. Kothari, Smart Grid: Fundamentals & Applications, New Age International (P) Ltd., Publishers, 1st Edition, 2019.
3. Sudip Misra, Samaresh Bera, *Smart Grid Technology: A Cloud Computing and Data Management Approach,* Cambridge University Press, 1st Edition, 2018.
4. Bharat Modi, Anu Prakash, Yogesh Kumar, Fundamentals of Smart Grid Technology, S.K. Kataria & Sons, 2015.
5. James A. Momoh, *Smart Grid: Fundamentals of Design and Analysis,* Wiley-IEEE Press, 1st Edition, 2012.
6. Ali Keyhani, Mohammad N. Marwali, Min Dai, Integration of Green and Renewable Energy in Electric Power Systems, 1st Edition, John Wiley & Sons, 2009.

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Aptitude Skills-III
(Verbal Ability)

23HSSM05	VEC	Aptitude Skills- III	1-0-0	Audit

Teaching Scheme	Evaluation Scheme
Lecture: 1hr Tutorial: NA Practical: NA	Continuous Assessment-I: 25 Marks Continuous Assessment-II: 25 Marks

Pre-Requisites: Aptitude Skills-I and II

Course Outcomes: At the end of the course, students will be able to:

1	Solve the questions on ordering of words & Parts of Speech
2	Organize contents of Business Communications such as CV, emails and letters.
3	Solve the questions based on jumbled paragraphs and reading comprehension.
4	Solve the questions on spotting error and sentence correction.
5	Summarize proceedings of any event or conference.
6	Discuss about current and critical issues during group discussion.

Course Contents:

Unit 1	Parts of Speech, Punctuation Word Family (Using the same word as different Parts of Speech)	**[2]**
Unit 2	Analogy, Letter Writing (Formal), E-Mail Writing, CV Writing	**[2]**
Unit 3	Reading Comprehension, Paragraph Jumbles	**[2]**
Unit 4	Spotting Errors (in different parts of sentence), Subject-Verb Agreement Sentence Correction, Sentence Completion	**[2]**
Unit 5	One Word Substitution, Narrating Events/Reports, Summary/Precis Writing	**[2]**
Unit 6	Dialogue writing Group Discussion, Interview Skills (Using formal notations & gestures etc.)	**[2]**

Text Books:

1. Raymond Murphy, Essential English Grammar with Answers, Murphy
2. Objective General English by R.S. Aggarwal, S Chand Publishing; Revised edition (15 March 2017)

Reference Books:

1. Rao and ,D,V,Prasada, Wren & Martin High School English Grammar and Composition Book, S Chand Publishing, 2017
2. Murphy, Intermediate English Grammar with Answers, Cambridge University Press;Second edition

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Language Skills- III

23HSSM05	HMS06	Language Skill- III	0-0-2	Audit

Teaching Scheme	Evaluation Scheme
Lecture: NA Tutorial: NA Practical: 2 hrs/week	Continuous Assesment-1: 25 Marks Continuous Assesment-2: 25 Marks

Pre-Requisites: Language Skill I & II

Course Outcomes: At the end of the course, students will be able to:

1	Develop a program to read input and return output.
2	Develop a program using data types, Strings and variables
3	Develop a program using Unary, Binary and Ternary operator
4	Develop a program using Conditional and Logical statements.

Course Contents:

1. **Write a Python program to print "Hello, World!"** o Objective: Understand basic syntax, indentation, and output.	**[2]**
2. **Write a program to demonstrate the use of different types of comments in Python.** o Objective: Single-line and multi-line comments.	**[2]**
3. **Write a Python program that declares different types of variables and displays their data types using the type() function.** o Objective: Variables, data types, and type identification.	**[2]**
4. **Write a program to demonstrate type casting and type conversion between int, float, and string.** o Objective: Type conversion, casting functions.	**[2]**
5. **Write a Python script to perform string operations such as slicing, concatenation, upper(), lower(), and len().** o Objective: String manipulation and built-in functions.	**[2]**
6. **Write a program to demonstrate the use of all arithmetic, logical, and bitwise operators.** o Objective: Operator functionality.	**[2]**
7. **Write a Python program to use membership and identity operators with examples.** o Objective: in, not in, is, is not.	**[2]**
8. **Write a Python program using a ternary operator to find the larger of two numbers.** o Objective: Conditional (inline) expressions.	**[2]**

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9. **Write a program that takes user input for age and prints whether the person is a child, teenager, adult, or senior citizen using if-elif-else.** o Objective: Conditional statements and user input.	**[2]**
10. **Write a program to find the sum of the first 10 natural numbers using a while loop.** o Objective: Looping with while.	**[2]**
11. **Write a Python script to display the multiplication table of a number using a for loop.** o Objective: Looping with for and range().	**[2]**
12. **Write a program that uses break, continue, and pass statements in appropriate looping scenarios.** o Objective: Loop control statements.	**[2]**
Text Books: 1. Python Projects (Author: Laura Cassell, Alan Gauld) Wrox publication 2. Murach's Python Programming. Aut.: Michael Urban, Joel Murach, murach's Publication.	
Reference Books: 1. Fundamentals of Python (First Program) Cengage MINDTAP Publication 2nd Edition. Author: K.A. Kambert	

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COLLEGE OF ENGINEERING
Yadrav (Ichalkaranji) Dist.Kolhapur

Teaching and Evaluation Scheme for TY B. Tech.

Department of Electrical Engineering

Semester: VI

Department: Department of Electrical Engineering **Rev:** Course Structure/00/2023-24

Class: T.Y. B. Tech **Semester:** VI

Course Code	Type of Course	Course	Teaching Scheme				Evaluation Scheme					Credits
			L	T	P	Total Hrs	CA1	CA2	MSE	ESE	Total	
23EE3601	PCC	Electric Drives	3	-	-	3	10	10	30	50	100	**3**
23EE3602	PCC	Control Systems	3	-	-	3	10	10	30	50	100	**3**
23EE3603	PCC	Microcontrollers& Applications	3	-	-	3	10	10	30	50	100	**3**
23EE3604	PEC	Elective-II	3	-	-	3	10	10	30	50	100	**3**
23EE3605	VSEC	Financial Literacy	2	-	-	2	25	25	-	-	50	**2**
23EE3606	PCC	Electric Drives Laboratory	-	-	2	2	15	15		20	50	**1**
23EE3607	PCC	Control Systems Laboratory	-	-	2	2	25	25	-	-	50	**1**
23EE3608	PCC	Microcontrollers& Applications Laboratory	-	-	2	2	15	15	-	20	50	**1**
23EE3609	PROJ	Mega Project Phase –I	-	-	4	4	25	25	-	50	100	**2**
23EEMDX4	MDM	**Multi-Disciplinary Minor-IV**	3	-		3	10	10	30	50	100	**3**
23HSSM07	VEC	Aptitude Skills-IV	2	-		2	25	25	-	-	50	**Audit**
23HSSM08	VEC	Language Skills-IV	-	-	2	2	25	25	-	-	50	**Audit**
Total			**19**	**-**	**12**	**31**	**205**	**205**	**150**	**340**	**900**	**22**

Multi-Disciplinary Minor Course-IV

Electrical System Design **(Basket - A)**	Automation & IOT **(Basket - B)**	Renewable Energy Sources & Grid Integration **(Basket - C)**
Industrial System Design (23EEMDA4)	Introduction to Internet of Things (23EEMDB4)	Operation & Planning of Power System (23EEMDC4)

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Electrical Drives

23EE3601	PCC	Electrical Drives	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week Tutorial: -	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Power Electronics

Course Outcomes: At the end of the course, students will be able to:

CO1	Analyze the selection criteria, speed-torque characteristics, and operational modes of electric drives, focusing on steady-state stability and closed-loop speed control.
CO2	Apply speed control, starting, braking, and multi-quadrant operations for DC drives using converters and choppers in various configurations.
CO3	Design speed control methods and VSI/CSI-fed induction motor drives while evaluating torque characteristics and closed-loop speed control systems.
CO4	Apply slip power recovery methods and chopper-controlled resistance techniques for sub-synchronous and super-synchronous speed control of slip ring induction motors.
CO5	Develop open-loop and closed-loop speed control strategies for synchronous and brushless DC motor drives using VSI-fed configurations.
CO6	Evaluate the construction, operating principles, and applications of switched reluctance motors, solar-powered pumps, MPPT, and battery-operated vehicles.

Course Contents:

Unit 1: Fundamentals of Electric Drives Types & parts of the Electrical drives, Selection criteria of drives, motor rating, selection based on duty cycle, selection of converter rating, fundamental torque equation, speed torques characteristics DC motor & Induction motor, multi quadrant operation of the drive, classification of mechanical load torques, steady state stability of the drive, constant torque and constant HP operation of the drive, closed loop speed control.	[6]
Unit 2: DC Motor Drives Methods of speed control, starting and braking operation, single phase and three phases full controlled and half controlled converter fed DC drives, Multi quadrant operation of separately excited DC shunt motor, dual converter fed DC drives, circulating and non – circulating mode of operation, converter fed DC series motor drive, chopper control of DC shunt and series motor drives, four quadrant operation of chopper fed DC shunt motor drive.	[6]
Unit 3: Induction Motor Drives Torque equation, Speed control methods for three phase cage induction motor, braking methods, stator voltage control induction motor drive, VSI fed induction motor drive, constant torque (constant E/F and constant V/F), constant HP operation, closed loop speed control block diagram, Stator current control methods fed induction motor drive, speed torque characteristics of CSI fed drive, closed loop speed control block diagram, comparison of CSI fed and VSI fed induction motor drive.	[7]

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Unit 4: Slip Ring Induction Motor Drives Chopper controlled resistance in rotor circuit, slip power recovery using converter cascade in rotor circuit, sub synchronous and super synchronous speed control, Kramer speed control, cyclo - converter in rotor circuit.	[5]
Unit 5: Synchronous Motor Drives and Brushless DC Motor Drives VSI fed synchronous motor drives, true synchronous and self-control mode, open loop and closed loop speed control of Permanent magnet synchronous machine, brushless DC motor drives.	[6]
Unit 6: Special Drives Construction and operating principle of switched reluctance motors, Current / Voltage control, torque equation, converter circuits, operating modes and applications of switched reluctance motors. Solar panel VI characteristics, solar powered pump, maximum power point tracking and battery-operated vehicles.	[6]
Text Books: 1. G. K. Dubey, Fundamentals of Electrical Drives, Narosa publication.	
Reference Books: 1. N. Mohan T.M. Undel and W. P. Robbins, Power Electronics - Converter Application, John Wiley and sons. 2. Vinod Kumar, Ranjan Kumar Behera, Dheeraj Joshi, Ramesh Bansal, Power Electronics, Drives, and Advanced Applications, CRC Press.	

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Control Systems

23EE3602	PCC	Control Systems	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3hrs/week Tutorial: -- Practical: --	CA1:10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Network Analysis, Engineering Mathematics-I & II

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain the fundamental concepts and classifications of control systems, along with their applications and mathematical representations and solve the transfer function of the system using block diagram reduction techniques and signal flow graph method.
CO2	Analyze time domain responses and feedback characteristics to evaluate system performance.
CO3	Examine the stability of control systems using Routh-Hurwitz method, root locus method, Nyquist plot, Bode plot, and Polar plot.
CO4	Evaluate the impact of PID controllers and compensators on system performance.
CO5	Develop state-space models and control strategies to enhance controllability and observability.

Contents:

Unit 1: Introduction to Control System Importance of Control Systems, Classification of control systems, Open loop system, closed loop system, Applications, Mathematical representation & Transfer function of mechanical, electrical systems, Hydraulic and Pneumatic Systems, Block diagram representation & reduction, Signal flow graph, Mason's gain formula, Numerical Problems	**[8]**
Unit 2: Time Domain Analysis Time Response, Steady state analysis, Transient response analysis, Transient response Specifications, Feedback characteristics of Control System, Numerical Problems.	**[7]**
Unit 3: Stability Analysis Concept of stability, Routh-Hurwitz stability criteria, Special cases of Routh's criteria, Root Locus method, Effect of pole-zero addition on root locus, Numerical Problems.	**[6]**
Unit 4: Frequency Domain Analysis Correlation between time domain and frequency domain specification, Polar plot, Nyquist plot, Bode plot, Numerical Problems.	**[8]**
Unit 5: PID Controller Introduction to P, I & D controller, Individual effect on overall system performance, PI,	**[6]**

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PID controller and effect on overall system performance, Numerical Problems, Introduction to compensators.	
Unit 6: State Space Analysis Representation of system in state space, converting transfer function model in to state space model, Non uniqueness of state space model, State space representation, Solution of state equations, State Transition Matrix, Controllability and Observability Test.	[7]

Text Books:

1. I. J. Nagrath, M. Gopal, Control System Engineering, New Age Int. Publishers, 5th Ed., 2008.
2. M. Gopal, Control System: Principles and Design, Tata Mc Graw-Hill Publication.
3. K. Ogata, Modern Control Engineering, Eastern Economy, 5th Edition, 2011.
4. S. K. Bhattacharya, Control Systems Engineering, Pearson, 2013.
5. A. Nagoor Kani, Control Systems, RBA Publications.

Reference Books:

1. Katsuhiko Ogata, Modern Control Engineering, Prentice Hall, 2010.
2. B. C. Kuo, Automatic Control System, Wiley Publication 8th Edition.
3. Norman S. Nise, Control System Engineering, John Wiley and Sons, 6th Edition, 2014.
4. M. Gopal, Digital Control and State Variable Methods, Tata Mc Graw Hill, 3rd Edition.

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Microcontroller & Applications

23EE3603	PCC	Microcontroller & Applications	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week Tutorial: -	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Analog and Digital Electronics

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain addressing modes and the role of key components like PSW, SFR, ports, and clock circuits
CO2	Develop proficiency in Embedded C programming for basic I/O operations and timer/counter functionalities of the 8051 microcontroller.
CO3	Understand interrupt structures, priorities, and ISR development, showcasing skills in external and timer interrupts programming.
CO4	Analyze Peripheral Interfacing such as LCDs, ADCs, DACs, and stepper motors with microcontrollers, along with relevant programming techniques.
CO5	Demonstrate expertise in interfacing DC motors, temperature sensors, and relays, as well as implementing PWM programming and hardware-in-loop simulations for power electronics applications.
CO6	Evaluate advanced microcontroller platforms like ARM, PIC, and MSP430, focusing on features, architecture, and low-power operation capabilities.

Course Contents:

Unit 1: Microcontroller Basics Overview of 8051, features, Architecture, Pin out and pin functions, program memory, data memory, SFR area, PSW, Code memory space, (Internal/External), Port structure, clock circuit, Addressing Modes.	[6]
Unit 2: Programming Ports and Timers Introduction to Embedded C programming, Basic I/O programming, Development tools for 8051 programs, Programming Timers and counters Timer block diagram and function, Timer modes 0, 1, 2 and their Applications, Timer and Counter Programming.	[6]
Unit 3: Interrupts and Serial Communication Interrupt structure, Writing ISR, interrupt, Interrupt priorities, Programming for external interrupt. Programming timer interrupts. Serial Communication: Serial communication modes, RS232 signals of PC, Programming through Serial communication.	[7]
Unit 4: Peripheral Interfacing- I Interfacing of microcontrollers to external peripherals and programming, LCD interfacing, Interfacing of Analog to Digital Converters and Digital to Analog Converters, Stepper motor interfacing.	[6]
Unit 5: Peripheral Interfacing- II DC motor interfacing, PWM programming using microcontrollers, Use of microcontroller	[6]

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in Power Electronics Applications, Interfacing Temperature Sensors, Relay Interfacing, concept of hardware-in-loop simulation, programming examples.	
Unit 6: Introduction to Advanced microcontrollers Introduction to ARM and PIC processors of MSP 430 microcontroller, 16 bit Micro-controllers, overview, features, architecture, addressing modes, Low power operation feature of MSP 430.	[6]

Text Books:

1. Muhammad Mazidi, Janice Mazidi and Rolin McKinlay, The 8051 Microcontroller and Embedded systems using Assembly and C, Pearson Education, 2007.
2. Kenneth Ayala, 8051 Architecture, Programming and Application, Delmar Thomson Learning, 1999.

Reference Books:

1. Subrata Ghoshal, Embedded Systems and Robots: Projects using the 8051 Microcontroller, 1st Edition, Cengage Learning, 2009
2. Mazidi, Rolin Mc Kinlay and Danny Causey, PIC Microcontroller and Embedded Systems using Assembly and C for PIC18, Pearson Education, 2nd Edition, 2021.
3. Andrew N. Sloss, Dominic Symes, Chris Wright, ARM System Developer's Guide: Designing and Optimizing System Software, Elsevier, 1st Edition, 2004.
4. Texas Instruments MSP 430 microcontroller: Guide and Datasheets

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Utilization of Electrical Energy

23EE3603A	PEC	Utilization of Electrical Energy	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week Tutorial: -	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Nil

Course Outcomes: At the end of the course, students will be able to:

CO1	Analyze the principles, efficiency, and applications of electric heating methods and types of welding in industrial scenarios.
CO2	Evaluate DC and AC traction systems, traction motors, and energy consumption metrics for modern transportation solutions like electric vehicles and high-speed rail.
CO3	Apply advanced energy-efficient motor control techniques to optimize the performance of DC and AC motors controlled by variable frequency drives for industrial applications.
CO4	Analyze power factor correction, energy audit data, and smart grid integration to optimize electrical utilization and address power quality issues for energy conservation.
CO5	Design lighting solutions for residential, industrial, and commercial applications using laws of illumination and advanced smart lighting technologies.
CO6	Evaluate renewable energy systems combined with smart metering, demand response techniques, and digital technologies to enhance energy optimization and sustainability.

Course Contents:

Unit 1: Electric Heating and Welding Principles of resistance heating (Direct & Indirect), Induction heating and applications, Dielectric heating and microwave heating, Efficiency, advantages, and comparison with conventional heating methods, Types of welding: Arc welding, resistance welding, ultrasonic welding, Industrial applications of electric heating and welding	[6]
Unit 2: Electric Traction and Transportation Systems DC vs. AC Traction Systems, Types of Traction Motors: DC Series, Induction, and Synchronous Motors, Speed-time curves and energy consumption in traction, Metro Rail, High-Speed Rail, Maglev, and Electric Vehicles , Comparison with traditional, fuel-based transportation, Battery storage, charging infrastructure , Smart grid integration for electric mobility	[6]
Unit 3: Industrial Electric Drives Types of Electric Drives and Their Applications , Motor Selection for Industrial Applications, DC Motor Speed Control, AC Motor Speed Control (V/F Control), Introduction to Variable Frequency Drives (VFDs), Energy Efficiency in Industrial Motor Applications	[7]
Unit 4: Energy Conservation and Power Quality Importance of Energy Conservation in Electrical Utilization, Power Factor Correction and Improvement, Energy Audits and Demand-Side Management (DSM) , Power Quality Issues and Harmonic Mitigation , Energy-Efficient Appliances and Smart Grid Integration	[6]

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Unit 5: Illumination and Lighting Systems Luminous Flux, Luminous Intensity, Luminance, Lux , Laws of Illumination (Inverse Square Law, Lambert's Cosine Law), Incandescent, Fluorescent, LED, HID Lighting Street Lighting, Industrial Lighting, Commercial Lighting, Smart Lighting and Control Systems	[5]
Unit 6: Renewable Energy and Smart Energy Utilization Solar, wind, and hybrid energy systems, Grid-connected vs. off-grid renewable systems, Smart metering and automation in energy consumption, Demand response techniques in smart grids, AI, blockchain, and digital twin technologies for energy optimization; Smart homes, industries, and smart grid innovations.	[6]

Text / Reference Books:

1. H. Partab, Art and Science of Utilization of Electrical Energy, Dhanpat Rai & Co. (P) Ltd, 1st Edition, 2015
2. E. Openshaw Taylor, Utilization of Electric Energy, Orient Blackswan Private Limited, 1st Edition,2013
3. S. Sivanagaraju, M. Balasubba Reddy, D. Srilatha, Generation and Utilization of Electrical Energy, Pearson Education, 1st Edition, 2010.
4. C.L. Wadhwa, Generation, Distribution and Utilization of Electrical Energy, Publisher: New Age International Pvt Ltd, 1st Edition, 2010.
5. Sunil S. Rao, Utilization, Generation & Conservation of Electrical Energy, Khanna Publishers, 1st Edition, 2016.

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Special Electrical Machines

23EE3603B	PEC	Special Electrical Machines	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week Tutorial: -	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: DC Machines &Transformers and AC Machines

Course Outcomes: At the end of the course, students will be able to:

CO1	Analyze the characteristics, construction, and applications of permanent magnet machines and BLDC motors in industrial drives and consumer electronics.
CO2	Apply open-loop and closed-loop control techniques, including microstepping and PWM, for stepper motor applications in robotics and automation to enhance operational efficiency.
CO3	Evaluate torque production, characteristics, and control methods of switched reluctance motors in industrial and high-speed applications.
CO4	Compare rotary and linear motor systems, including LIM and LSM, to develop solutions for propulsion and material handling applications.
CO5	Design high-efficiency motors and superconducting systems for applications in power generation, wind turbines, and energy storage.
CO6	Apply advanced control techniques, including fuzzy logic and IoT-based monitoring, to optimize the performance and predictive maintenance of special electrical machines.

Course Contents:

Unit 1: Permanent Magnet Machines Types of permanent magnets and their characteristics, Magnetic circuits in permanent magnet machines, Construction and working principle, EMF equation and torque production, Applications in industrial drives and electric vehicles, BLDC motor construction and working, Comparison between BLDC and conventional DC motors, Applications in robotics, aerospace, and consumer electronics	[6]
Unit 2: Stepper Motors and Their Applications Types: Permanent Magnet (PM), Variable Reluctance (VR), and Hybrid Stepper Motors, Step angle, torque-speed characteristics, Open-loop and closed-loop control, Microstepping and pulse-width modulation (PWM) control techniques, Use in robotics, CNC machines, and automation systems	[6]
Unit 3: Switched Reluctance Motors Basic working and torque production, Characteristics and advantages of SRM, Power electronic converters for SRM, Torque ripple reduction and control methods, Industrial automation, electric vehicles, and high-speed applications	[7]
Unit 4: Linear Motors and Actuators Difference between rotary and linear motors, Classification: Linear Induction Motor (LIM), Linear Synchronous Motor (LSM), Propulsion systems (Magley, high-speed trains) , Material handling and conveyor belt drives, Basics of piezoelectric actuators, High-precision positioning systems	[6]

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Unit 5: High-Efficiency and Superconducting Machines High-efficiency standards (IE2, IE3, IE4 motors), Loss reduction techniques, Introduction to superconducting materials, Applications in power generation and high-torque motors Wind turbine generators, Superconducting magnetic energy storage (SMES)	[5]
Unit 6: Control and Emerging Trends in Special Electrical Machines Fuzzy logic and artificial intelligence-based motor control, Sensorless control techniques IoT-enabled motor monitoring and predictive maintenance, Data analytics for fault detection and performance optimization, Soft magnetic materials for high-performance machines, Bio-inspired actuators and robotics applications	[5]

Text Books:

1. K. Venkataratnam, Special Electrical Machines, Universities Press, 1st Edition, 2008
2. R. Krishnan, Electric Motor Drives: Modeling, Analysis, and Control, Pearson Education India, 1st Edition, 2015
3. T. J. E. Miller, Brushless Permanent Magnet and Reluctance Motor Drives, Clarendon Press, 1st Edition, 1999

Reference Books:

1. T.J.E. Miller, Switched Reluctance Motors and Their Control, Oxford University Press, 1st Edition 1993.
2. V. V. Athani, Stepper Motors: Fundamentals, Applications, and Design, New Age International, 1st Edition, 2009.
3. R. Krishnan, Permanent Magnet Synchronous and Brushless DC Motor Drives, CRC Press, 1st Edition, 2016.
4. Jacek F. Gieras, Linear Electric Machines, Drives, and Maglev Transportation, Springer, 1st Edition, 2012.

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Linear Integrated Circuits

23EE3604C	PEC	Linear Integrated Circuits	3-0-0	4 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Analog and Digital Electronics, Circuit Analysis

Course Outcomes: At the end of the course, students will be able to:

CO1	Analyze the internal architecture, characteristics, and operational principles of op-amps, focusing on IC 741 circuit diagrams and performance metrics.
CO2	Apply practical circuits such as instrumentation amplifiers, integrators, differentiators, and converters to solve application-specific challenges effectively.
CO3	Design filter circuits, including low-pass, high-pass, and band-pass filters, alongside amplifiers and signal conditioning devices.
CO4	Evaluate the functionality and specifications of DACs and ADCs, emphasizing their operational modes and applications in signal processing.
CO5	Design waveform generators using sine-wave, triangular, and saw-tooth wave circuits to produce desired signals for various applications.
CO6	Apply IC voltage regulators, switching regulators, and audio power amplifiers to optimize circuits for specific operational requirements.

Course Contents:

Unit-I Basics of OP-AMP: Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, Basic information about op-amps – Ideal Operational Amplifier – General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate.	[7]
Unit II Applications of OP-AMP: Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator.	[6]
Unit III Filter Circuits Using OP-AMP: Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass filters.	[6]
Unit IV Analog To Digital And Digital To Analog Converters: Analog and Digital Data Conversions, D/A converter – specifications – weighted resistor type, R-2 Ladder type, Voltage Mode and Current-Mode R – 2R Ladder types – switches for D/A converters high speed sample-and-hold circuits, A/D Converters – specifications – Flash type – Successive Approximation type	[8]
Unit V Waveform Generators: Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555	[6]
Unit VI Special Function IC's:	[7]

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IC Voltage regulators – Three terminal fixed and adjustable voltage regulators – IC 723 general purpose regulator – Monolithic switching regulator, Low Drop–Out (LDO) Regulators – Switched capacitor filter IC MF10, Audio Power amplifier.	

Text Books:

1. David Bell, Operational Amplifier and Linear Integrated Circuits, Oxford University Press, 3rd Edition, 2011.
2. Ramakant A. Gaikwad, OP-AMPS and Linear Integrated Circuit Technology, Pearson, 2020

Reference Books:

1. Roy Choudhary, Shail B Jain, Linear Integrated Circuits, New Age International Pvt Ltd, 6th Edition, 2022.
2. R. P. Punagin, Linear Integrated Circuits and Applications, I K International Publishing House, 1st Edition, 2013.
3. K. Salivahan, Linear Integrated Circuits, TMH Education, 3rd Edition, 2012.
4. William D Stanley, Operational Amplifier with linear Integrated Circuits, Pearson, 4th Edition, 2001.

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E-Mobility

23EE3604D	PEC	E-Mobility	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week Tutorial: -- Practical: --	CA-I:10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic Electrical Engineering, Electrical Machines, Power Electronics

Course Outcomes: At the end of the course, the students will be able to:

CO1	Analyze the evolution of electric mobility, its impact on the environment, economic dimensions, and the challenges associated with its adoption and technologies.
CO2	Determine the battery parameters used in different batteries with EVs.
CO3	Identify the motors for drive technologies to EVs (BEV, HEV & FCEV).
CO4	Demonstrate the power electronics convertors used for EVs.
CO5	Model vehicle dynamics, including tractive effort, aerodynamics, and range performance parameters, to predict the behavior and efficiency of battery and hybrid electric vehicles.
CO6	Apply communication techniques such as V2V, V2G, and wireless power transfer to improve energy management and infrastructure integration for electric vehicles.

Course Contents:

UNIT-I: INTRODUCTION Understand Mobility and its evolutions, Electric Mobility and Environmental Impact Reduction, Economic Analysis, Electric Mobility and Infrastructures: Technical and Economic Dimensions, Electric Mobility Today, Prospective: The Road to Electrification, Overview of EVs and challenges, and Technologies.	[6]
UNIT-II: BATTERIES **Batteries:** Electrochemical Batteries: Battery Parameters: Battery Capacity, Open Circuit and Terminal Voltages, Charge/Discharge Rate, State of Charge/Discharge, Depth of Discharge, Battery Energy Density and Specific Energy, Battery Power Density and Specific Power, Battery Efficiency, Electrochemical Batteries-Types, Ultracapacitors, Ultrahigh-Speed Flywheels, Numerical Problems.	[6]
UNIT-III: ELECTRIC AND HYBRID POWERTRAIN TECHNOLOGIES Introduction, BEVs, Electric Traction Motors, DC Motors-BLDC Motor, AC Motors-IM, PMSM, SR Motors, Energy sources and Energy carriers, Hybrid Electric Vehicles (HEV), Plug-in Hybrid Electric Vehicles (PHEV), FCEV.	[6]
UNIT-IV: POWER-ELECTRONIC CONVERTERS FOR EV APPLICATIONS DC/DC Converters: Non-isolated converters: buck, boost, buck-boost, Cuk and charge-pump converters; bi-directional converters; Isolated converters: Half-Bridge, Full-Bridge, Fly-back, Forward and Push-Pull DC/DC converters; DC/AC Converter.	[7]
Unit-V: ELECTRIC VEHICLE MODELLING	[7]

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Introduction, Tractive Effort, Rolling resistance force, Aerodynamics, Hill climbing force, Acceleration force, Total tractive effort , Modelling Vehicle Acceleration, Acceleration performance parameters, Modelling the acceleration of an electric scooter, Modelling the acceleration of a small car, Range modelling of battery electric vehicles, Range modelling of hybrid electric vehicles.	
UNIT-VI: EV COMMUNICATION Basic Communication, V2V, V2G and its applications in power system - power saving & coordinated charging - layout of power converters for V2G operation, EV configurations: converted & purpose built EVs components of EV system, Wireless Power Transfer: Principle, Stationary WPT, and Dynamic WPT.	[6]

Text Books:

1. James Larminie and John Lowry, Electric-Vehicle-Technology-Explained, John Wiley & Sons Ltd, 2012.
2. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2010.

Reference Books:

1. Electric and Hybrid Vehicles Power Sources, Models, Sustainability, Infrastructure and the Market Gianfranco Pistoia Consultant, Rome, Italy, Elsevier Publications, 2017.
2. Mehrdad Ehsani, Yimin Gao, Stefano Longo, Kambiz M. Ebrahimi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, CRC Press, 2018.
3. Wei Liu, Hybrid Electric Vehicle System Modelling and Control, John Wiley & Sons, Inc., 2017.

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Yadrav (Ichalkaranji) Dist.Kolhapur

Financial Literacy

23EE3605	VSEC	Financial Literacy	2-0-0	2 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 2 hrs/week Tutorial: -- Practical: --	CA-I: 25 Marks CA-II: 25 Marks Mid Semester Exam: -- End Semester Exam: --

Pre-Requisites: Nil.

Course Outcomes: At the end of the course, the students will be able to:

CO1	Explain key financial concepts, including financial literacy, time value of money, components of the financial system, types of banking services, and financial products such as loans, insurance, and investments, and understand their significance in personal financial planning.
CO2	Apply financial principles to real-world scenarios by calculating values such as present and future worth, comparing financial products and services, analyzing risks and benefits, and making informed decisions about investments, loans, and insurance options based on individual financial goals.
CO3	Evaluate the effectiveness of various financial products and services, critically assess their suitability for different needs, and design comprehensive financial strategies that integrate savings, investment, insurance, and loan options to optimize personal financial security and growth.

Course Contents:

Unit 1: Introduction Meaning, importance and scope of financial literacy; Prerequisites of Financial Literacy – level of education, numerical and communication ability; Time Value of Money – future and present value of a lump-sum and variable amount, annual and multiple compounding and discounting.	[4]
Unit 2: Financial System Concept of financial system, an overview of financial system, brief discussion on components of financial system – Financial Institutions, Financial Markets and Financial Instruments; Concept of Investment and characteristics, and types of risks involved in financial investment; Capital Market – Primary Market and Secondary Market, procedure to make investment in equity in primary and secondary market.	[4]
Unit 3: Banking Services Types of banks; Banking products and services – Various services offered by banks; Types of bank deposit accounts – Savings Bank Account, Term Deposit, Current Account, Recurring Deposit, PPF, NSC etc.; Formalities to open various types of bank accounts, PAN Card, Address proof, KYC norm; Various types of loans – short term, medium term, long	[5]

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term, micro finance, agricultural etc. and related interest rates offered by various nationalized banks and post office; Cashless banking, e-banking, Check Counterfeit Currency; CIBIL, ATM, Debit and Credit Card, and APP based Payment system; Banking complaints and Ombudsman.	
Unit 4: Financial Services from Post Office Post office Savings Schemes: Savings Bank, Recurring Deposit, Term Deposit, Monthly Income Scheme, Kishan Vikas Patra, NSC, PPF, Senior Citizen Savings Scheme (SCSS), Sukanya Samriddhi Yojana/Account (SSY/SSA); India Post Payments Bank (IPPB). Money Transfer: Money Order, E-Money order. Instant Money Order, collaboration with the Western Union Financial Services; MO Videsh, International Money Transfer Service, Electronic Clearance Services (ECS), Money gram International Money Transfer, Indian Postal Order (IPO)	[4]
Unit-5: Protection Related Financial Services: Insurance Services: Life Insurance Policies: Life Insurance, Term Life Insurance, Endowment Policies, Pension Policies, ULIP, Health Insurance and its Plans, Comparison of policies offered by various life insurance companies; Property Insurance: Policies offered by various general insurance companies. Post office life Insurance Schemes: Postal Life Insurance and Rural Postal Life Insurance (PLI/RPLI); Housing Loans: Institutions providing housing loans, Loans under Pradhan Mantri Awas Yojana –Rural and Urban; Motor Insurance, and Home Insurance	[5]
Unit-6: Investment Related Financial Services: Investment avenues in Equity and Debt Instruments: Portfolio Management: Meaning and importance; Share Market and Debt Market, Sensex and its significance; Investment in Shares –selection procedure for investment in shares; Risk element; Investment Management -Services from brokers and Institutions, and self-management and Mutual Funds; Bonds, Public Provident Fund (PPF), National Savings Certificate (NSC), Exchange-Traded Funds (ETFs); Retirement and Pension Products: National Pension Scheme (NPS), Employees' Provident Fund (EPF), Annuities	[5]

Text Books:

1. Gordon & Natarajan, Financial Markets and Services, Himalaya Publishing House Pvt. Ltd, Mumbai, 2015.
2. Kothari, R., Financial Services in India-Concept and Application, Sage Publications India Pvt. Ltd., New Delhi, 2010.
3. Avadhani, V. A., Investment Management, Himalaya Publishing House Pvt. Ltd., Mumbai, 2019.
4. Kevin S, Portfolio Management, PHI, New Delhi.

Reference Books:

1. Prasanna Chandra, Investment Analysis and Portfolio Management, Tata McGraw-Hill Publishing Company Limited, New Delhi.
2. Chandra, P. (2012). Investment Game: How to Win, Tata McGraw Hill Education, New Delhi.

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3. Mittra, S., Rai, S. K., Sahu, A. P., & Starn, H. J., Financial Planning, Sage Publications India Pvt. Ltd., New Delhi, 2015.
4. Zokaityte, A., Financial Literacy Education, Palgrave Macmillan, London, 2017.

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Electrical Drives Laboratory

23EE3606	PCC	Electrical Drives Laboratory	0-0-2	1 Credits

Teaching Scheme	Evaluation Scheme
Practical: 2hr/week	CA-I:15 Marks CA-II: 15 Marks End Semester Exam: 20 Marks

Course Outcomes: At the end of the course, students will be able to:

CO1	Apply speed control techniques for various motors, including single-phase induction motors using VFD, and three-phase slip-ring motors using static Scherbius drives.
CO2	Analyze advanced motor drive systems, including DC-DC converter drives, stepper motor drives, and three-phase induction motor drives, to evaluate their performance.
CO3	Examine the performance of AC & DC drives using simulation tool.

Course Contents: Minimum of 8 experiments should be performed from the following list.

List of Experiments:

1. To study speed control of single phase induction motor using VFD.
2. Speed control of three phase slip-ring motor using static scherbius drive
3. To perform speed control of separately excited dc motor using chopper.
4. Closed loop and open loop speed control of dc motor.
5. To perform Micro controller based speed control of 3 phase induction motor by stator voltage control.
6. Controlled Converter fed stepper motor drive.
7. Simulation of 3 phase induction motor drives.
8. Simulation of DC-DC converter drives.
9. Simulation of Stepper motor drives.

Text/Reference Books:

1. G. K. Dubey, Fundamentals of Electrical Drives, Narosa publication.
2. N. Mohan T.M. Undel and W. P. Robbins, Power Electronics - Converter Application, John Wiley and sons.

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Control Systems Laboratory

23EE3607	PCC	Control Systems Laboratory	0-0-2	1 Credit

Teaching Scheme	Evaluation Scheme
Practical: 2 hrs/ week	CA1-:15 Marks CA2- 15 Marks End Semester Exam- 20 Marks

Pre-Requisites: Network Analysis, Engineering Mathematics-I and Ii

Course Outcomes: At the end of the course, students will be able to:

CO1	Demonstrate the use of MATLAB control system and Simulink toolboxes for analyzing and simulating linear time-invariant systems and block diagram reductions.
CO2	Evaluate the stability of linear systems by employing MATLAB tools such as Root Locus, Bode Plot, Polar Plot, and Nyquist Plot for second- and third-order systems.
CO3	Develop state models, transfer functions, and PID controllers using MATLAB to improve system performance and control strategies.

Course Contents: Minimum of 8 experiments should be performed from the following list.

List of Experiments:

1. Familiarization with MATLAB control system toolbox, MATLAB Simulink toolbox.
2. Linear Time-invariant Systems and Representation using MATLAB
3. Block Diagram Reduction using MATLAB
4. Time Response of Second Order System using MATLAB
5. Simulation of Step response & impulse response for type-0, type-1 & type-2 system with unity feedback using MATLAB
6. Determination of stability by using Root locus using MATLAB for 2^{nd} and 3^{rd} order system of a Linear Time Invariant System.
7. Determination of stability by using Bode plot using MATLAB for 2^{nd} and 3^{rd} order system of a Linear Time Invariant System.
8. Determination of stability by using Polar plot using MATLAB for 2^{nd} and 3^{rd} order system of a Linear Time Invariant System.
9. Determination of stability by using Nyquist plot using MATLAB for 2^{nd} and 3^{rd} order system of a Linear Time Invariant System.
10. State Model for Classical Transfer Function & Vice-Versa Using MATLAB.
11. PID Controller using MATLAB

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Textbooks:

1. I. J. Nagrath, M. Gopal, "Control System Engineering", New Age International Publishers – Fourth edition
2. M. Gopal, Control system: Principles and Design, Tata Mc Graw-Hill Publication
3. K. Ogata, Modern Control Engineering, Eastern Economy, 5th edition 2011.
4. I. J. Nagrath and M. Gopal, Control System Engineering, New Age publication, 5th edition, 2008.

Reference Books:

1. Katsuhiko Ogata, Modern Control Engineering, Prentice Hall, 2010
2. B. C. Kuo, Automatic Control System, Wiley Publication 8th Edition.
3. Norman S. Nise, Control System Engineering, John Wiley and Sons, 6th Edition, 2014.
4. M.Gopal, Digital Control and State Variable Methods, Tata Mc Graw Hill, 3rd Edition.

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Microcontrollers and Applications Laboratory

23EE3608	PCC	Microcontrollers and Applications Laboratory	0-0-2	2 Credits

Teaching Scheme	Evaluation Scheme
Lecture: -	CA-1: 15 Marks
Tutorial: --	CA-2: 15 Marks
Practical: 2hr/week	End Semester Examination: 20 Marks

Pre-Requisites: Analog and Digital Electronics

Course Outcomes: At the end of the course, students will be able to:

CO1	Develop assembly language programs for 8085 microprocessor to perform arithmetic and logical operations.
CO2	Design microcontroller-based systems using 8051 to implement tasks such as rolling displays, LED flashing, motor speed control, and automatic street lighting.
CO3	Develop Arduino-based control systems for applications like IR obstacle detection, relay control, and temperature-controlled fan operations.

Course Contents: Minimum of 8 experiments should be performed from the following list.

List of Experiments:

1. Assembly language program's for 8085 arithmetic operations
2. Assembly language program's for 8085 logical operations
3. Rolling display using 8051 microcontroller
4. led flashing using 8051 microcontroller
5. Speed and direction control of dc motor using 8051 microcontroller
6. Speed and direction of stepper motor using 8051 microcontroller
7. Automatic Street light control using 8051 microcontroller
8. Seven segment display using 8051 microcontroller
9. IR obstacle sensor using Arduino microcontroller
10. Relay control using Arduino microcontroller
11. Temperature controlled fan using Arduino microcontroller

Text/Reference Books:

1. Muhammad Mazidi, Janice Mazidi and Rolin McKinlay, The 8051 Microcontroller and Embedded systems using Assembly and C, Pearson Education, 2007.
2. Kenneth Ayala, 8051 Architecture, Programming and Application, Delmar Thomson Learning, 1999.

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Industrial System Design

23EEMDA4	MDM	Industrial System Design	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week Tutorial: -- Practical: --	CA-I: 25 Marks CA-II: 25 Marks Mid Semester Exam: 30 Marks End Semester Exam: -- 50 Marks

Pre-Requisites: Electrical System Planning & Design, Electrical Estimation & Costing, Lighting System Design

Course Outcomes: At the end of the course, the students will be able to:

CO1	Develop efficient and scalable industrial system designs by applying system engineering concepts and methodologies like top-down and bottom-up approaches.
CO2	Analyze industrial processes using mathematical models and tools like MATLAB, Simulink, and digital twin technology to evaluate system performance.
CO3	Develop industrial control systems using PID controllers, PLCs, and robotics for automation in assembly lines and process plants.
CO4	Apply energy-efficient designs, waste reduction techniques, and sustainable manufacturing practices like lean manufacturing and Six Sigma to enhance industrial processes.
CO5	Evaluate safety standards, reliability engineering metrics, and predictive maintenance strategies using tools like FMEA and IoT sensors.
CO6	Apply CAD/CAM software, simulation tools, and advanced techniques like FEA and CFD to prototype and optimize industrial systems for real-world applications.

Course Contents:

Unit 1: Introduction to Industrial System Design Fundamentals of Industrial Systems and their Classifications, Design Considerations: Efficiency, Performance, and Scalability, Concept of System Engineering and Design Process , Design Methodologies: Top-Down vs. Bottom-Up Approaches, Case Study on an Industrial System Development Lifecycle	[6]
Unit 2: System Modeling & Simulation Mathematical Modeling of Mechanical, Electrical, and Fluid Systems, Transfer Function Representation and State-Space Analysis, Simulation of Industrial Processes using MATLAB, Simulink , Case Study: Modeling and Simulation of a Manufacturing System , Introduction to Digital Twin Technology in System Design	[6]
Unit 3: Industrial Control Systems & Automation Types of Industrial Control Systems: Open-loop vs. Closed-loop , PID Controllers and Their Tuning Methods , PLC-Based Industrial Control Systems , Robotics and Motion Control Systems , Case Study: Automation in Assembly Lines and Process Plants	[6]
Unit 4: Energy-Efficient and Sustainable System Design	[6]

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Principles of Energy-Efficient Industrial Design , Waste Reduction and Sustainable Manufacturing , Optimization Techniques for Industrial Processes , Introduction to Lean Manufacturing and Six Sigma , Case Study: Designing an Energy-Efficient HVAC System	
Unit-5: Safety, Reliability, and Maintenance in Industrial Systems Industrial Safety Standards and Regulations (ISO, OSHA) , Failure Modes and Effects Analysis (FMEA) , Reliability Engineering: MTBF, MTTR, and Fault Tree Analysis Predictive Maintenance using Machine Learning & IoT Sensors , Case Study: Risk Assessment in Industrial System Design	[6]
Unit-6: Software Tools for Industrial System Design CAD/CAM Software for Industrial System Prototyping, Industrial Process Simulation using ANSYS, AutoCAD, SolidWorks, Introduction to Finite Element Analysis (FEA) and Computational Fluid Dynamics (CFD), System Optimization Techniques Using AI & Big Data, Final Project: Design an optimized industrial system for a real-world application.	[6]

Text Books:

1. Benjamin S. Blanchard, System Engineering for Manufacturing, 5th Edition, Pearson, 2010.
2. Michael L. George, Lean Manufacturing and Six Sigma in System Design, 1st Edition, McGraw-Hill Education, 2002

Reference Books:

1. Jerry Banks, Industrial System Simulation and Modeling
2. David R. Gaskell, Industrial System Engineering and Design
3. Thomas J. Allen & David Garlan, Design of Industrial Information Systems,
4. Patrick O'Connor, Reliability and Safety in Industrial Systems

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Introduction to Internet of Things

23EEMDB4	MDM	Introduction to Internet of Things	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week Tutorial: -- Practical: --	CA-I: 25 Marks CA-II: 25 Marks Mid Semester Exam: -- 30 Marks End Semester Exam: -- 50 Marks

Pre-Requisites: Introduction to PLC, SCADA and HMI, Industrial Automation
Course Outcomes: At the end of the course, the students will be able to:

CO1	Analyze the evolution, components, applications, and challenges of IoT across various domains, emphasizing its integration with Industry 4.0.
CO2	Apply embedded systems and sensor technologies, including microcontrollers, actuators, and power management techniques, to develop IoT devices.
CO3	Apply IoT communication protocols and models, such as MQTT, CoAP, Wi-Fi, and LPWAN, to ensure efficient data transmission and cloud connectivity.
CO4	Evaluate cloud platforms, edge computing, and AI-based data analytics to optimize IoT data storage, processing, and decision-making.
CO5	Develop encryption, authentication, and secure communication protocols to mitigate IoT security threats while ensuring compliance with privacy regulations.
CO6	Develop end-to-end IoT projects, integrating AIoT and addressing real-world applications like smart cities, autonomous vehicles, and wearable technologies.

Course Contents:

Unit 1: Introduction to IoT Definition & Evolution of IoT, Components of IoT: Things, Gateway, Cloud, Analytics, User Interface, IoT Applications in Various Domains: Smart Homes, Healthcare, Agriculture, Industry 4.0 , IoT and Industry 4.0 , Challenges & Future Trends in IoT	[6]
Unit 2: IoT Hardware and Sensors Embedded Systems for IoT: Microcontrollers (Arduino, ESP8266, ESP32, Raspberry Pi), Types of Sensors: Temperature, Humidity, Motion, Proximity, Pressure, Gas, Light Actuators and Their Role in IoT , Power Management in IoT Devices	[6]
Unit 3: IoT Communication Technologies IoT Communication Models: M2M vs. IoT, Edge vs. Cloud Processing, Wired and Wireless Communication Protocols: Short-range: Wi-Fi, Bluetooth, Zigbee, LoRa, RFID, NFC, Long-range: 4G, 5G, NB-IoT, LPWAN, MQTT and CoAP Protocols, IoT Data Transmission and Cloud Connectivity	[6]
Unit 4: IoT Cloud & Data Analytics Introduction to Cloud Computing for IoT, IoT Data Storage and Processing, Cloud	[6]

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Platforms for IoT: AWS IoT, Google Cloud IoT, Azure IoT , Edge Computing and Fog Computing in IoT , IoT Data Analytics and AI in IoT	
Unit 5: IoT Security and Privacy IoT Security Threats: Device vulnerabilities, network attacks, data breaches , Encryption and Authentication in IoT Devices , Secure IoT Communication Protocols , Privacy Concerns and GDPR Compliance in IoT	[6]
Unit-6: IoT Applications & Project Development Case Studies on Real-world IoT Implementations , Developing an End-to-End IoT Project , Integration of AI with IoT (AIoT), Future of IoT: Smart Cities, Autonomous Vehicles, Wearable Tech , Final Project Presentation and Evaluation	[6]

Text Books:

1. Raj Kamal, Internet of Things: Architecture, Implementation, and Security, 1st Edition, McGraw-Hill Education
2. David Hanes, Gonzalo Salgueiro, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases, 1st Edition, Cisco Press
3. Peter Waher, Mastering Internet of Things, 1st Edition, Wiley

Reference Books:

1. Maciej Kranz, Building the Internet of Things, 1st Edition, Wiley
2. Colin Do, Hands-On IoT Solutions with Arduino, ESP32, and Raspberry Pi, 1st Edition, Packt Publishing
3. Brian Russell, IoT Security: Practical Guide to Cybersecurity for IoT Systems, 1st Edition, CRC Press

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Operation & Planning of Power System

23EEMDC4	MDM	Operation & Planning of Power System	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 2 hrs/week	CA-I: 25 Marks
Tutorial: --	CA-II: 25 Marks
Practical: --	Mid Semester Exam: 30 Marks
	End Semester Exam: -- 50 Marks

Pre-Requisites: Energy Storage System, Grid Integration of RES, Smart Grid

Course Outcomes: At the end of the course, the students will be able to:

CO1	Analyze the structure, components, and challenges of modern power systems, emphasizing the role of EMS and SCADA in grid operation with renewable energy integration.
CO2	Apply forecasting techniques and economic load dispatch methods, including regression analysis and AI-based models, to optimize generator load distribution.
CO3	Apply reactive power compensation techniques, FACTS devices, and automatic generation control to ensure voltage and frequency stability in power systems.
CO4	Evaluate contingency analysis techniques, state estimation methods, and protection mechanisms to enhance power system reliability and security.
CO5	Design expansion plans and optimization strategies for generation and transmission systems using reliability indices and smart grid planning techniques.
CO6	Apply renewable energy sources and advanced technologies like AI and Big Data to improve microgrid management, demand response, and smart grid operations.

Course Contents:

Unit 1: Introduction to Power System Operation & Planning Power System Components and Structure, Objectives of Power System Operation & Planning, Challenges in Modern Power Systems, Energy Management Systems (EMS) and SCADA in Power System Operation, Renewable Energy Penetration and Its Impact on Grid Operation	[6]
Unit 2: Load Forecasting and Economic Operation Types of Load Forecasting: Short-term, Medium-term, and Long-term, Forecasting Techniques: Regression Analysis, Time Series Methods, Artificial Intelligence-based Models, Economic Load Dispatch (ELD): Optimal Load Distribution among Generators, Classical and Computational Methods (Lambda Iteration, Gradient Search), Unit Commitment: Priority List, Dynamic Programming, and Lagrang Relaxation	[6]
Unit 3: Voltage and Frequency Control in Power Systems Concept of Voltage and Frequency Stability, Reactive Power mpensation Techniques , Shunt & Series Compensation, FACTS Devices (STATCOM, S), Automatic Generation Control (AGC) and Load Frequency Control (LFC) , Primar econdary, and Tertiary Control of Frequency	[6]
Unit 4: Contingency Analysis and Power System Security Concept of Power System Security and Reliability, Contin Analysis Techniques:	[6]

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Single Line Outage, N-1, N-2 Contingency Planning, State Estimation and Real-Time Monitoring, Load Shedding and System Protection Mechanisms	
Unit-5: Power System Reliability and Expansion Planning Reliability Indices: SAIDI, SAIFI, CAIDI, LOLP, LOLE, Generation and Transmission Expansion Planning, Optimization Techniques in Power System Planning, Smart Grid and Distributed Energy Resource (DER) Planning	[6]
Unit-6: Renewable Energy Integration and Smart Grid Planning Impact of Renewable Energy on Power System Operation, Grid Integration of Solar, Wind, and Hybrid Energy Systems , Microgrids and Demand Response Management , Role of Artificial Intelligence & Big Data in Smart Grid Planning, Future Trends in Power System Planning and Operation	[6]

Text Books:

1. P.S.R. Murthy, Power System Operation & Control, Tata McGraw-Hill Education, 1st Edition
2. Allen J. Wood, Bruce F. Wollenberg, Power Generation, Operation, and Control, 3rd Edition, Wiley.
3. Olle I. Elgerd, Electric Energy Systems Theory, 2nd Edition, McGraw-Hill Education.

Reference Books:

1. J. Duncan Glover, Mulukutla S. Sarma, Power System Analysis and Design, 5th Edition, Cengage Learning.
2. D.P. Kothari, I.J. Nagrath, Modern Power System Analysis, 4th Edition, McGraw-Hill Education.
3. James Momoh, Smart Grid: Fundamentals of Design and Analysis, 1st Edition, Wiley.
4. H.L. Willis, Power System Planning: Emerging Practices, 1st Edition, CRC Press.

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Aptitude Skills-IV

23HSSM07	VEC	Aptitude Skills- IV	1-0-0	Audit

Teaching Scheme	Evaluation Scheme
Lecture: 1 Tutorial: NA Practical: NA	Continuous Assessment-I:25 Marks Continuous Assessment-II: 25 Marks

Pre-Requisites: Aptitude Skills-I, II and III

Course Outcomes: At the end of the course, students will be able to:

1	Solve the questions on ordering of words & Parts of Speech
2	Organize contents of Business Communications such as CV, emails and letters.
3	Solve the questions based on jumbled paragraphs and reading comprehension.
4	Solve the questions on spotting error and sentence correction.
5	Summarize proceedings of any event or conference.
6	Discuss about current and critical issues during group discussion.

Course Contents:

Unit 1	Parts of Speech, Punctuation Word Family (Using the same word as different Parts of Speech)	**[2]**
Unit 2	Analogy, Letter Writing (Formal), E-Mail Writing, CV Writing	**[2]**
Unit 3	Reading Comprehension, Paragraph Jumbles	**[2]**
Unit 4	Spotting Errors (in different parts of sentence), Subject-Verb Agreement Sentence Correction, Sentence Completion	**[2]**
Unit 5	One Word Substitution, Narrating Events/Reports, Summary/Precis Writing	**[2]**
Unit 6	Dialogue writing Group Discussion, Interview Skills (Using formal notations & gestures etc.)	**[2]**

Text Books:

1. Raymond Murphy, Essential English Grammar with Answers, Murphy
2. Objective General English by R.S. Aggarwal, S Chand Publishing; Revised edition (15 March 2017)

Reference Books:

1. Rao and ,D,V,Prasada, Wren & Martin High School English Grammar and Composition Book, S Chand Publishing, 2017
2. Murphy, Intermediate English Grammar with Answers, Cambridge University Press;Second edition

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Language Skill- IV

23HSSM08	HMS06	Language Skill- IV	0-0-2	Audit

Teaching Scheme	Evaluation Scheme
Lecture: NA Tutorial:NA Practical: 2 hrs/week	Continuous Assesment-1: 25 Marks Continuous Assesment-2: 25 Marks

Pre-Requisites: Language Skill I, II and III

Course Outcomes: At the end of the course, students will be able to:

CO1	Make use of Function in Python Programming.
CO2	Make use of Python collections.
CO3	Make use of classes and its objects in python.
CO4	Make use of file and it's handling functions.

Course Contents:

1. Write a Python program to define a user-defined function that takes a number as input and returns whether it is even or odd. Call the function and display the result. ○ *Concepts: Function definition, arguments, return value.*	**[2]**
2. Create a Python program to define and call a function with default arguments and keyword arguments. ○ *Concepts: Function calling, argument types.*	**[2]**
3. Write a Python program using a lambda function to compute the square, cube, and factorial of a given number. ○ *Concepts: Lambda function basics*	**[2]**
4. Write a Python program to demonstrate list operations such as creation, adding items, removing an item, slicing, and sorting. ○ *Concepts: List constructor, change, remove, sort, list comprehension*	**[2]**
5. Write a Python program to demonstrate the use of tuples and sets. Perform operations such as checking membership, adding/removing elements (set), and iterating. ○ *Concepts: Tuple immutability, set operations.*	**[2]**
6. Write a Python program to create a dictionary of employees with their ID as key and name as value. Perform operations like adding a new entry, updating existing, and deleting one. ○ *Concepts: Dictionary operations, loop through dictionary.*	**[2]**

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7. Write a Python program to create a class Student with attributes name, roll_no, and a method display(). Create an object and access its members. ○ *Concepts: Class, object, method access.*	**[2]**
8. Create a class with an __init__() constructor to initialize data members and a destructor to display a message when the object is deleted. ○ *Concepts: Constructor, destructor.*	**[2]**
9. Write a program to demonstrate single inheritance where a class Vehicle is inherited by a class Car. Use super() to access base class methods. ○ *Concepts: Inheritance, super().*	**[2]**
10. Write a Python program to open a text file in write mode and write your personal information (name, age, department). Then, read and display the content of the file. ○ *Concepts: File open, write, read, file modes.*	**[2]**
11. Write a program to read a file line by line using readline() and count the number of characters in each line. ○ *Concepts: File reading, character offset.*	**[2]**
12. Create a program to open a file in append mode and add new content. Use exception handling to manage file not found or access errors. ○ *Concepts: File handling with exception management.*	**[2]**

Text Books:

1. Python Projects (Author: Laura Cassell, Alan Gauld) Wrox publication
2. Murach's Python Programming. Aut.:Michael Urban, Joel Murach, murach's Publication.

Reference Books:

1. Fundamentals of Python (First Program) Cengage MINDTAP Publication 2nd Edition. Author: K.A. Kambert.

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