



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

Teaching and Evaluation Scheme for Final Year B. Tech

Department of Electrical Engineering
Semester: VII




Head of the Department
Electrical Engineering
SHARAD INSTITUTE OF TECHNOLOGY
COLLEGE OF ENGINEERING,
Yadrav (Ichalkaranji), Dist. Kolhapur



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

Department: Electrical Engineering

Rev: Course Structure/00/2023-24

Class: Final Year B. Tech

Semester: VII

Course Code	Type of Course	Course	Teaching Scheme				Evaluation Scheme					
			L	T	P	Total Hrs.	CA1	CA2	MSE	ESE	Total	Credits
23EE4701	PCC	High Voltage Engineering	3	-	-	3	10	10	30	50	100	3
23EE4702	PCC	Switchgear and Protection	2	-	-	2	10	10	30	50	100	2
23EE4703X	PEC	Program Elective Course-III	3	-	-	3	10	10	30	50	100	3
23EE4704X	PEC	Program Elective Course-IV	3	-	-	3	10	10	30	50	100	3
23EE4705	RM	Research Methodology	3	-	-	3	10	10	30	50	100	3
23EE4706	PCC	High Voltage Engineering Laboratory	-	-	2	2	15	15	-	20	50	1
23EE4707	PCC	Switchgear and Protection Laboratory	-	-	2	2	15	15	-	20	50	1
23EE4708	PROJ	Mega Project Phase -II	-	-	4	4	25	25	-	50	100	2
23EE4709	MC	Constitution of India	1	-	-	1	25	25	-	-	50	Audit
23EE4710	RM	Seminar	-	-	2	2	-	-	-	50	50	1
23EEMDXX	MDM	Multidisciplinary Minor-V	3	-	-	3	10	10	30	50	100	3
Total			18	-	10	28	140	140	180	440	900	22

Multidisciplinary Minor-V

Electrical System Design (Basket - A)	Automation and IOT (Basket - B)	Renewable Energy Sources and Grid Integration (Basket - C)
Earthing Design (23EEMDA5)	IoT Implementation and Practical Applications (23EEMDB5)	Power Quality Improvement (23EEMDC5)

Program Elective Course-III		Program Elective Course-IV	
23EE4703A	Digital Control Systems	23EE4704A	Modern Control Theory
23EE4703B	Switched Mode Power Supplies	23EE4704B	Electricity Markets
23EE4703C	FACTS and HVDC	23EE4704C	Power System Reliability
23EE4703D	Electric Vehicle Battery and Chargers	23EE4704D	Electric Vehicles: Design, Dynamics and Testing



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High Voltage Engineering

23EE4701	PCC	High Voltage Engineering	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1:10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Electrical Engineering Materials, Power Systems

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

CO1	Explain electric Stress with conduction and breakdown in gases.
CO2	Explain conduction and breakdown in liquid dielectrics.
CO3	Explain conduction and breakdown in solid dielectrics.
CO4	Compare different techniques of generation in high voltages and currents.
CO5	Illustrate different techniques employed for measurement of high voltages and currents
CO6	Explain insulation coordination and high voltage testing of electrical equipment's.

Course Contents:

Unit 1: Conduction and Breakdown in gaseous dielectrics: Electric Field Stresses, Finite Difference Method for electric field computation, Gases as insulating media, Collision Processes, Ionization Processes, Townsend Current Growth Equation, Current Growth in the presence of secondary processes, Townsend's Criterion for Breakdown, Time lags for Breakdown. Streamers Theory for breakdown on gases, Paschens Law, Breakdown in non-uniform fields and Corona discharges.	[7]
Unit 2: Conduction and Breakdown in Liquid dielectrics: Liquids as Insulators- Pure and Commercial liquids, Conduction and Breakdown in Commercial liquids- Purification of Transformer fluids, Conduction and Breakdown in Commercial Liquids, Testing of Insulating Oils (Transformer Fluids).	[6]
Unit 3: Conduction and Breakdown in Solid Dielectrics: Breakdown mechanisms in Solid Dielectrics -Intrinsic Breakdown, Electromechanical Breakdown, Thermal Breakdown, Chemical and Electrochemical Deterioration and Breakdown, Breakdown due to Treeing and Tracking and Internal discharges, Breakdown in Composite Dielectrics- Properties of Composite Dielectrics, Examples of Solid Dielectrics used in practice.	[7]
Unit 4: Generation of High Voltages and Currents: Generation of High Direct Current Voltages- Half and Full wave rectifiers, Voltage Doublers Circuits, Voltage Multiplier Circuits- Cockcroft Walton voltage multiplier, Generation of High Alternating Voltages- Cascaded Transformer Connection, Resonant Transformers, Generation of High Frequency AC High Voltages, Multistage Impulse Generators- Marx Circuit.	[7]



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Unit 5: Measurement of High Voltages and Currents: High Ohmic Series Resistance with Micro ammeter, Resistance Potential Divider for DC Voltages, Measurement of High AC and Impulse voltages, Measurement of High-Power frequency alternating currents.	[3]
Unit 6: High Voltage Testing in Electrical Apparatus. Overvoltage's due to Lightning phenomenon and Switching Surges, Principles of Insulation Coordination on High Voltage power systems, Testing of Insulators and Bushings, Testing of Isolators and Circuit Breakers, Testing of Cables, Testing of Transformers and Surge Arresters.	[6]
Textbooks 1. M S Naidu and V Kamaraju, High Voltage Engineering, Mc Graw Hill Publishing Company Ltd.- Sixth Edition. 2. C L Wadhwa, High Voltage Engineering, New Age International Publishers, 3 rd Edition.	
Reference Books: 1. Subir Ray, An Introduction to High Voltage Engineering, PHI-Second Edition. 2. E Kuffel, W.S.Zaengl, J Kuffel, High Voltage Engineering Fundamentals, Newnes,-Second Edition. 3. Ravindra Arora and Wolfgang Mosch, High Voltage Insulation Engineering, New Age International Publishers	




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Switchgear and Protection

23EE4702	PCC	Switchgear and Protection	2-0-0	2 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 2 hrs/week	CA1:10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

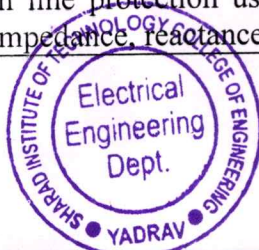
Pre-Requisites: Power System, DC and AC Machines

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

CO1	Explain Principle of Circuit Interruption
CO2	Explain Circuit Breakers
CO3	Explain Protective relaying used for power system protection
CO4	Explain Digital and Numerical Protection
CO5	Select Protection schemes used for protection of Alternator and Transformer
CO6	Select Protection schemes used for protection of Bus bar, Feeder and Transmission line

Course Contents:

Unit 1: Circuit Interruption: Voltage-current characteristics of arc, arc phenomenon, Restricting and recovery voltage. Arc quenching methods, Current Chopping, Resistance Switching, Auto reclosing.	[4]
Unit 2: Circuit Breakers: Classification, Construction, working and application of Air blast, Bulk Oil, Minimum Oil, SF ₆ and Vacuum circuit breakers, Circuit breaker ratings.	[5]
Unit 3: Protective Relaying: Desirable qualities of protective relaying, Classification of relays, working of attracted armature, balanced beam, induction disc and cup type relays, Current Setting and Time setting of overcurrent relay, Time-current characteristics of over current Relays; Directional Relay.	[4]
Unit 4: Digital and Numerical Protection: Introduction, Advantages and Disadvantages of Numerical relays, Numerical relaying algorithms techniques Numerical over current protection, Numerical Distance protection, Numerical Differential protection.	[4]
Unit 5: Protection of Alternators and Transformers: Alternators: Stator fault protection, Percentage differential protection, Negative phase sequence [NPS] protection, Excitation Failure and Protection against motoring. Transformer: Use of Buchholz relay, differential protection, restricted earth fault protection, Generator-Transformer unit protection.	[5]
Unit 6: Protection of Bus bar, Feeder and Transmission line: Busbar protection, Transmission line protection using over current & differential relay. Principles of distance relaying, impedance, reactance and mho type relay.	[4]



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Textbooks /Reference Books:

1. Sunil S. Rao, Switchgear Protection and Power Systems (Theory, Practice and Solved Problems), Khanna Publications.
2. B.Ram and B.N.Vishwakarma, Power System Protection and Switchgear, Tata McGraw Hill Education Private Limited, New Delhi.
3. Patara Basu and Chaudhary, Power System Protection, New Delhi Oxford and IBH.
4. L.P.Singh, Digital Protection Protective Relaying from Electromechanical to Microprocess, New Age International Publishers, 2nd Edition, 2017



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Program Elective Course-III: Digital Control Systems

23EE4703A	PEC	Digital Control Systems	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1:10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Control Systems.

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

CO1	Explain basic concepts of Z and Laplace transform related to digital control systems.
CO2	Design of digital control system using Root locus, Controllers, compensators.
CO3	Explain state space representation and its forms.
CO4	Illustrate state space equations, state transition matrix.
CO5	Design of controller by using Pole placement.
CO6	Design of observer by using Pole placement.

Course Contents:

Unit 1 - Digital Control System Review of Z transforms, Z transform method for solving difference equation, Impulse Sampling and Data Hold, Pulse Transfer Function, Sampling Theorem, Mapping between S Plane and Z Plane, Stability Analysis, Transient and Steady State Analysis	[6]
Unit 2 - Design of Digital Control System Construction of Root Locus, Design based on Root Locus, P, PI, PD, PID Controllers, Lead, Lag, Lead-Lag Compensators, Frequency Response Analysis, Bode Diagram.	[6]
Unit 3 - State Space Analysis of Digital Control System I State Space representation of Digital System, Controllable Canonical form, Observable Canonical form, Diagonal form, Jordan form.	[6]
Unit 4- State Space Analysis of Digital Control System II State Space Equations, solving State Space Equations, State Transition Matrix, Properties of State Transition Matrix, Pulse Transfer Function Matrix. Discretization of Continuous Time State Space Equation.	[6]
Unit 5 - State Space Design for Controller Controllability, Controller Design in State Space, Design via Pole Placement for Controller Design, Ackermann's Formula for Controller Design.	[6]
Unit 6 – State space Design for Observer Observability, Observer Design, Design via Pole Placement for Observer Design, Ackermann's Formula for Observer Design, Deadbeat Design, Design for Deadbeat Response.	[6]



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Textbooks:

1. K. Ogata, "Discrete Time Control Systems", Second Edition, Pearson Education, 2005
2. C.L. Phillips, J.M. Parr, "Feedback Control Systems", Fifth Edition, Pearson Education, 2013

Reference Books:

1. I.J. Nagrath, M.Gopal "Control Systems Engineering", New Age International, Sixth Edition, 2018,
2. B.C. Kuo, "Digital Control Systems", Oxford University Press, Second Edition, 2012



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Program Elective Course-III: Switched Mode Power Supplies

23EE4703B	PEC	Switched Mode Power Supplies	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1:10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

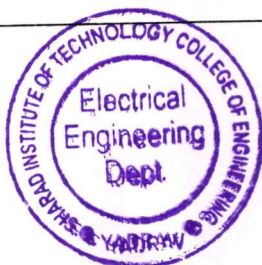
Pre-Requisites: Power Systems, Power Electronics

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

CO1	Explain the working principles of different types of SMPS topologies.
CO2	Analyze DC-DC converters used in SMPS.
CO3	Evaluate control strategies for voltage regulation in SMPS.
CO4	Model SMPS circuits for performance validation.
CO5	Identify power quality and EMI issues in SMPS systems.
CO6	Analyze thermal design principles, protection mechanisms, and fault diagnostics techniques to enhance the reliability and efficiency of power supply systems.

Course Contents:

Unit 1: Introduction to SMPS Need and advantages of SMPS over linear power supplies; Classification and applications; Overview of components: inductors, transformers, MOSFETs, diodes; Efficiency and compactness benefits.	[6]
Unit 2: DC-DC Converter Topologies Buck, Boost, Buck-Boost converters: operating modes, waveforms, voltage/current equations; Continuous and discontinuous modes; Cuk and SEPIC converters; Design examples.	[6]
Unit 3: Isolated Converters Forward, Flyback, Push-Pull, Half-Bridge, Full-Bridge converters; Transformer design considerations; Core selection; Leakage inductance and snubbers; Voltage regulation techniques.	[6]
Unit 4: Control of SMPS Voltage mode and current mode control; Feedback loop design and compensation; PWM control techniques; Error amplifiers; Transfer function modeling and Bode plot analysis.	[6]



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Unit 5: Power Quality and EMI Considerations Input/output filters; Conducted and radiated EMI; EMC standards and compliance; Soft-switching techniques (ZVS, ZCS); Effect on power factor and harmonic mitigation.	[6]
Unit 6: Thermal Management and Protection Thermal design: heat sinks, airflow, thermal modeling; Protection mechanisms: overcurrent, overvoltage, short circuit, thermal shutdown; Fault diagnostics and isolation techniques.	[6]
Textbooks: 1. Rashid, M. H., Power Electronics: Circuits, Devices and Applications, Pearson. 2. Kassakian, J. G., Principles of Power Electronics, Addison Wesley. 3. Mohan, Undeland and Robbins, Power Electronics: Converters, Applications and Design, Wiley.	
Reference Books: 1. Pressman, Abraham I., Switching Power Supply Design, McGraw-Hill. 2. Billings, Keith, Switched Mode Power Supply Handbook, McGraw-Hill. 3. NPTEL Course, Switching Power Converters, IIT Kharagpur.	



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Program Elective Course-III: FACTS and HVDC

23EE4703C	PEC	FACTS and HVDC	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1:10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

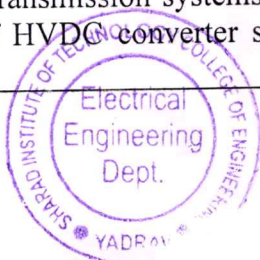
Pre-Requisites: Power System, Power Electronics

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

CO1	Classify different types of FACTS devices.
CO2	Explain the Static shunt compensators.
CO3	Explain the Static series compensators.
CO4	Explain the combined compensators.
CO5	Compare AC and DC transmission system.
CO6	Explain the control schemes for HVDC transmission systems.

Course Contents:

Unit 1: Introduction to FACTS Opportunities for FACTS, Flow of power in AC system, Basic types of FACTS Controllers, Brief description and definitions of FACTS controllers: Shunt connected controllers, Series connected controllers, Combined Shunt and Series connected controllers, Benefits from FACTS Technology	[6]
Unit 2: Static Shunt Compensators Objectives of shunt compensation, Methods of controllable VAR generation: Variable Impedance Type, Switching Converter Type, Construction and Working of : Hybrid VAR Generators, Static VAR compensators - SVC and STATCOM, Comparison between SVC and STATCOM	[6]
Unit 3: Static Series Compensators Objectives of Series compensation, Construction and Working of: Thyristor switched series capacitor (TSSC), Thyristor Controlled series capacitor (TCSC), GTO Thyristor Controlled series capacitor (GCSC), Switching converter type series compensators: Static synchronous series compensator (SSSC), Power angle characteristics, Basic operating control schemes	[6]
Unit 4: Combined Compensators Introduction, unified power flow controller (UPFC): Basic operating principle, independent real and reactive power flow control, control structure, Unified Power Quality Conditioner (UPQC), Interline power flow controller (IPFC): Basic operating principle, control structure	[6]
Unit 5: HVDC System and Converters Comparison of AC-DC transmission systems, Benefits of DC transmission, Types of DC Links, Typical layout of HVDC converter station, Line commutated converter Voltage source converter	[6]



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Unit 6: HVDC System Control

Principles of DC Link control, converter control characteristics, system control hierarchy, firing angle control, current and excitation angle control, starting and stopping of DC Link, Generation of Harmonics, Introduction of Filters

[6]

Textbooks:

1. Narain. G.Hingorani, Laszlo Gyugyi, Understanding FACTS: Concepts and Technology of Flexible AC Transmission systems, IEEE press, Wiley India
2. K R Padiyar, HVDC Power transmission systems, New Age International.

Reference Books:

1. R. Mohan Mathur, Rajiv K. Varma, Thyristor Based Controllers for Electrical Transmission Systems, Wiley India.
2. Vijay K. Sood, HVDC and FACTS Controllers applications of static converters in power systems, Kluwer Academic Publishers.




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Program Elective Course-III: Electric Vehicle Battery and Chargers

23EE4703D	PEC	Electric Vehicle Battery and Chargers	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1:10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

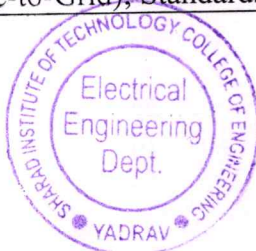
Pre-Requisites: E-Mobility

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

CO1	Understand the fundamentals of batteries used in electric vehicles.
CO2	Analyze battery characteristics and performance parameters.
CO3	Select and size batteries for EV applications.
CO4	Describe different types of battery management systems and charging techniques.
CO5	Design EV charging infrastructure and evaluate charging strategies.
CO6	Evaluate the safety, standards, and regulations for EV battery systems.

Course Contents:

Unit 1: Basics of EV Batteries Battery types: Li-ion, NiMH, Lead-acid; Electrochemistry; Construction and working; Battery specifications: energy density, power density, SOC, DOD, efficiency, C-rating.	[6]
Unit 2: Battery Modeling and Sizing Battery equivalent circuit modeling; Dynamic behaviour and thermal modeling; Sizing batteries for EV performance and range; Cell configurations (series-parallel); Lifecycle analysis.	[6]
Unit 3: Battery Management Systems (BMS) Functions of BMS: monitoring, balancing, protection; SOC/SOH estimation techniques; Passive and active balancing; BMS communication protocols; Safety features in BMS.	[6]
Unit 4: Charging Techniques and Architectures Types of charging: AC/DC, Level 1/2/3; Constant current and constant voltage charging; Fast and wireless charging techniques; On-board and off-board chargers; Converter topologies for charging.	[6]
Unit 5: EV Chargers and Infrastructure Charger architecture and control; Smart charging systems; Grid integration; Load management and V2G (Vehicle-to-Grid); Standards: IEC 61851, CHAdeMO, CCS, GB/T.	[6]



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Unit 6: Battery Safety and Standards Thermal runaway; Battery fire safety and protection; Safety testing standards (UN 38.3, ISO 26262); Recycling and disposal of EV batteries; Regulatory norms and certification.	[6]
Textbooks: 1. Husain, Iqbal – 'Electric and Hybrid Vehicles: Design Fundamentals'. CRC Press. 2. Linden and Reddy – 'Handbook of Batteries'. McGraw-Hill. 3. Mourad, A. – 'Battery Management Systems for Large Lithium Ion Battery Packs'. Wiley.	
Reference Books 1. Tuttle, D., EV Charging Technology and Standards. SAE Publications. 2. Plett, G. L., Battery Management Systems, Vol. 1 and 2, Artech House. 3. NPTEL Course, Battery Storage Systems for EVs. IIT Madras.	



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Program Elective Course-IV: Advanced Control Theory

23EE4704A	PEC	Advanced Control Theory	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1:10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Control Systems

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

CO1	Estimate State Feedback Gain Matrix and Observer Gain matrix with pole placement techniques.
CO2	Design of Lag, Lead, Lag-Lead Compensator Design Using Bode Plot and Root Locus Technique
CO3	Explain Linear Models of Physiological Systems
CO4	Analyze nonlinear system using Describing function approach and Phase plane analysis

Course Contents:

UNIT-1: POLE PLACEMENT TECHNIQUE

Introduction, Pole Placement Design, Necessary and Sufficient conditions for Arbitrary Pole Placement, Evaluation of State Feedback Gain Matrix-using Transformation Matrix, Direct Substitution Method, Ackermann's Formula; Concept of State Observer, Selection of suitable value of Observer Gain matrix-Numerical problems.

[7]

UNIT-2: COMPENSATORS-1:

Introduction, Classification: Series or cascade compensation, Feedback or parallel compensation, Load or series-parallel compensation, State feedback compensation, Forward compensation with series compensation, Feed-forward compensation

Lag Compensator: Determination of Maximum Phase Angle, Electrical Representation, Effects, Limitations, Design of Lag Compensator Design Using Bode Plot, Design of Lag Compensator Using Root Locus Technique.

[7]

UNIT-3: COMPENSATORS-2:

Lead Compensator: Determination of Maximum Phase Angle, Electrical Representation, Effects, Limitations, Design of Lead Compensator, Design of Lead Compensator Using Bode Plot, Design of Lead Compensator Using Root Locus Technique.

Lag-Lead Compensator: Electrical Representation, Effects, Design of Lag-Lead Compensator, Design of Lag-Lead Compensator Using Bode Plot, Design of Lag-Lead Compensator Using Bode Plot.

[7]

UNIT-4: PHYSIOLOGICAL CONTROL SYSTEMS:

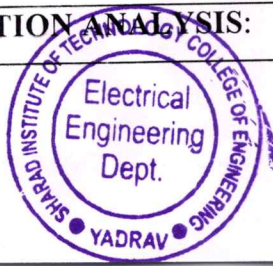
Introduction, Properties of Physiological Control Systems: Target of the Homeostasis, Imbalance in the Homeostasis, Homeostasis Control Mechanisms, Block Diagram of the Physiological Control System: Types of Control Mechanism, Differences between Engineering and Physiological Control Systems, Linear Models of Physiological Systems: Lung Mechanism, Skeletal Muscle

[6]

UNIT-5: DESCRIBING FUNCTION ANALYSIS:

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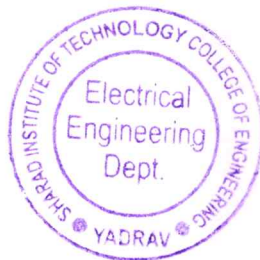




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Introduction to nonlinear systems, Types of nonlinearities, Non Linear Systems – Types of Nonlinearities – Saturation – Dead-Zone – Backlash – Jump Phenomenon, Linearization of nonlinear systems, Singular Points and its types describing functions, describing function analysis of nonlinear control systems.	[6]
UNIT-6: PHASE-PLANE ANALYSIS: Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase-plane analysis of nonlinear control systems.	[6]
Textbook/Reference Books: 1. M. Gopal, Modern Control System Theory, New Age International Publishers, 2nd edition, 1996. 2. S. Salivahanan, R. Rengaraj, G.R.Venkatakrishnan, Control Systems Engineering, Pearson Education. 3. K. Ogata, Modern Control Engineering, Prentice Hall of India, 3rd edition, 1998 4. I.J. Nagarath and M.Gopal, Control Systems Engineering, New Age International (P) Ltd. 5. U A Bakshi, M V Bakshi, Modern Control Theory, Technical Publications	




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Program Elective Course-IV: Electricity Markets

23EE4704B	PEC	Electricity Markets	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1:10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Power Systems

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

CO1	Explain the fundamentals of electricity markets, including market structures, operating mechanisms, and various market types such as commodity, power, energy, and ancillary services.
CO2	Analyze the modeling, operation, and equilibrium of electricity markets to assess the impact of market dynamics on pricing and competition.
CO3	Evaluate the formulation of market structures, price drivers, carbon markets, and the influence of renewables, seasonality, and cross-border transmission capacity on market performance.
CO4	Apply electricity pricing methodologies, including market clearing price (MCP), spot and real-time pricing, and dispatch-based pricing to optimize power flow and market efficiency.
CO5	Design effective strategies for power system operation in restructured markets, addressing congestion management, imbalance settlement, and transmission constraints through dynamic methodologies.
CO6	Assess the significance of ancillary services in electricity markets, including contingency reserves, voltage security, and procurement mechanisms across various market structures.

Course Contents:

UNIT-1: Fundamentals of Electricity Markets Market structure and operating mechanisms, bilateral and multi-lateral markets. Perfect Competition, Oligopolistic Market, Theories of Oligopoly. Market Types- Commodity, Power, Energy, Ancillary Services, Transmission.	[6]
UNIT-2: Modelling and Analysis of Electricity Market Equilibrium Modelling, operation and analysis of electricity markets, Market Equilibrium.	[6]
UNIT-3: Market Structure Formulation of the market, Price formulation and drivers, Merit order, Carbon markets (emission rights), Impact of renewables, Mean reversion and Seasonality, Cross-border transmission capacity, Market participants (producers, suppliers, TSOs), Exchange members, Dispatch and asset-backed trading, Balancing, Intraday / prompt markets, Market coupling, Day ahead markets and Daily auctions, Hedging, Forward markets and the application of power futures.	[6]
UNIT-4: Electricity Markets Pricing Electricity price basics, Market Clearing price (MCP), Zonal and locational MCPs. Dynamic, spot pricing and real time pricing, Dispatch based pricing, Power flows and prices. Optimal power flow, Spot prices for real and reactive power. Unconstrained real spot prices, constraints and real spot prices.	[6]
UNIT-5: Power System Operation in Restructured Markets Coordinated real time dispatch through balancing mechanism, Imbalance settlement methodologies. Transmission Congestion Management and Methodologies.	[6]



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Effect of congestion on LMPs, Transmission Losses, Limits and Congestion, Country Practices, Dynamic Congestion Management. Available Transfer Capability Evaluation and Methodologies- market splitting, counter-trading. New Unit Commitment-Price based OPF in restructured markets.	
UNIT-6: Ancillary Services Classifications and definitions, Market for AS, AS management in various markets, Forward AS auction, country practices, Contingency reserves: Pricing and procurement, Voltage security and reactive power management.	[6]
Textbooks/Reference Books: 1. M. Shahidehpour, H. Yamin, and L. Zuyi, Market Operations in Electric Power Systems, New York: Wiley, 2002. 2. Yong-Hua Song and Xi-Fan Wang (Eds.), Operation of Market-oriented Power Systems, Springer-Verlag London Limited, 2003 3. D. S. Kirschen and G. Strbac, Fundamentals of power system economics, John Wiley and Sons, 2004 4. K. Bhattacharya, M.H.J. Bollen and J.E. Daalder, Operation of restructured power systems, Kluwer Academic Publishers, 2001.	



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Program Elective Course-IV: Power System Reliability

23EE4704C	PEC	Power System Reliability	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1:10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

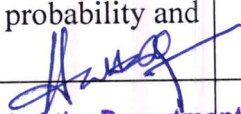
Pre-Requisites: Power Systems

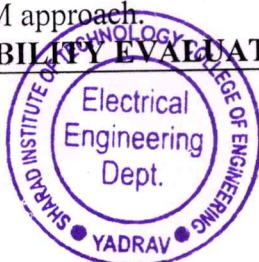
Course Outcomes: At the end of the course, students will be able to:

CO1	Explain fundamental concepts of probability theory, including probability distributions, density functions, and reliability measures such as Mean Time to Failure (MTTF) and Mean Time Between Failures (MTBF).
CO2	Analyze generating system reliability through capacity outage probability tables, recursive model building, and loss of load and energy indices to assess system performance.
CO3	Evaluate operating reserve methodologies, including risk indices, PJM methods, and security function approaches, to determine power system stability and reliability.
CO4	Apply interconnected system reliability analysis techniques, including probability array methods, effects of tie capacity, and Markov models, to improve system resilience.
CO5	Assess distribution system reliability by evaluating performance indices, customer-oriented metrics, and energy loss indices for effective system planning and operation.
CO6	Design strategies for substation and switching station reliability, incorporating preventive maintenance, circuit breaker models, and short-circuit failure analysis for enhanced system reliability.

Course Contents:

UNIT-1: BASIC PROBABILITY THEORY: Elements of probability, probability distributions, Random variables, Density and Distribution functions- Binomial distribution- Expected value and standard deviation - Binomial distribution, Poisson Distribution, normal distribution, exponential distribution. DEFINITION OF RELIABILITY: Definition of terms used in reliability, Component reliability, Hazard rate, derivation of the reliability function in terms of the hazard rate. Hazard models - Bath tub curve, Effect of preventive maintenance. Measures of reliability: Mean Time to Failure and Mean Time between Failures.	[6]
UNIT-2: GENERATING SYSTEM RELIABILITY ANALYSIS Generation system model – capacity outage probability tables – Recursive relation for capacitive model building – sequential addition method – unit removal – Evaluation of loss of load and energy indices – Examples. Frequency and Duration methods – Evaluation of equivalent transitional rates of identical and non-identical units – Evaluation of cumulative probability and cumulative frequency of non-identical generating units	[6]
UNIT-3: OPERATING RESERVE EVALUATION Basic concepts - risk indices – PJM methods – security function approach – rapid start and hot reserve units – Modeling using STPM approach. BULK POWER SYSTEM RELIABILITY EVALUATION	[6]

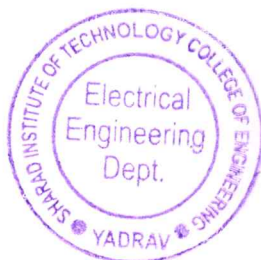

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Basic configuration – conditional probability approach – system and load point reliability indices – weather effects on transmission lines – Weighted average rate and Markov model – Common mode failures.	
UNIT-4: INTER CONNECTED SYSTEM RELIABILITY ANALYSIS Probability array method – Two inter connected systems with independent loads – effects of limited and unlimited tie capacity - imperfect tie – Two connected Systems with correlated loads – Expression for cumulative probability and cumulative frequency	[6]
UNIT-5: DISTRIBUTION SYSTEM RELIABILITY ANALYSIS Basic Techniques – Radial networks –Evaluation of Basic reliability indices, performance indices – load point and system reliability indices – customer oriented, loss and energy oriented indices – Examples.	[6]
UNIT-6: SUBSTATIONS AND SWITCHING STATIONS Effects of short-circuits - breaker operation – Open and Short-circuit failures – Active and Passive failures – switching after faults – circuit breaker model – preventive maintenance – exponential Maintenance times.	[6]
Textbooks: 1. R. Billinton, R.N.Allan, Reliability Evaluation of Power systems, BS Publications, 2007. 2. J. Endrenyi, Reliability Modelling in Electric Power Systems, John Wiley and Sons, 1978	
Reference Books: 1. Alessandro Birolini, Reliability Engineering: Theory and Practice, Springer Publications. 2. Charles Ebeling, An Introduction to Reliability and Maintainability Engineering, TMH Publications. 3. E. Balaguruswamy, Reliability Engineering, TMH Publications. 4. Elsayed A. Elsayed, Reliability Engineering, Prentice Hall Publications.	




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Program Elective Course-IV: Electric Vehicles: Design, Dynamics and Testing

23EE4704D	PEC	Electric Vehicles: Design, Dynamics and Testing	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1:10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

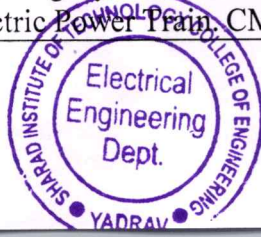
Pre-Requisites: E-Mobility, EV Battery and Chargers

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

CO1	Analyze the effects of body loads, material selection, and manufacturing criteria on the design and structural integrity of electric vehicle chassis.
CO2	Evaluate vehicle dynamics and stability parameters, including tyre properties, aerodynamic forces, and load distribution, to enhance control and performance.
CO3	Apply homologation and testing standards to ensure compliance with safety regulations and performance benchmarks for electric vehicles.
CO4	Assess the testing methodologies for hybrid electric vehicles and retro-fitment, focusing on battery performance, regenerative braking, and type approvals.
CO5	Interpret vehicular safety regulations, government policies, and road safety systems to ensure adherence to industry norms and occupant protection.
CO6	Design efficient EV infrastructure solutions, including battery management systems, swapping mechanisms, and charging station networks, for sustainable adoption.

Course Contents:

Unit-1: Design and Manufacturing Criteria Introduction to body loads: Load cases and load factor, road loads. Driving dynamics and comfort, strength and stiffness of chassis, design features, frame sections, types of frames. Material selection, Fabrication, joining methods, types of joints, welding and brazing, pierce riveting and clinching.	[6]
Unit-2: Vehicle Dynamics and Stability Wheels and Tyres: Introduction, Types of wheel rims, wheel dimension, properties of tyre, construction, Tread patterns, Types of tyres, Specifications of tyre. Drag, lifts, resistance, body loads and load calculation, Study principles of Rolling, Pitch and Yaw velocity and moments, aesthetics and ergonomics consideration for stability and control.	[6]
Unit-3: Vehicle Testing and Homologation Need of vehicle testing and homologation, testing organizations, testing standards (AIS), Hierarchy of testing: Individual component approval/testing, System level approval and Whole vehicle approval/testing. Conformity of production tests, Crash test, side impact test, rollover test, Impact test, Track testing	[6]
Unit-4: Testing Standards For Hybrid Electric vehicle and Retro-fitment Method for Measuring the Electricity Balance of the Battery of OVC and NOVC HEVS. CMVR Type Approval for L Category Hybrid Electric Vehicles: types of test and conditions. Requirements for Regenerative Braking System. Method of Measuring the Electric Range of Vehicles Powered by A Hybrid Electric Power Train. CMVR Type Approval for Hybrid Electric Vehicle	[6]



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Vehicles of M and N Category: Related terms, types of tests, requirements. Retrofitment standards on Vehicles of L, M and N Category having different weight criteria, types of test and procedures.	
Unit-5: Vehicular Safety and Government norms Road and Automotive Safety Systems: Active and passive safety, Safety Regulations for vehicular application, occupant protection, Traffic signs, traffic rules. Government Norms, Regulations and Policies: Motor vehicle act: control of transport, RTO and other regulations, offences, penalties and procedures.	[6]
Unit-6: EV Infrastructure Management Comparison between EV and ICE vehicles, Battery management system, Battery swapping, vehicle charging system, Charging stations.	[6]
Textbooks/Reference Books: 1. Mehrdad Ehsani, Yimin Gao, Sebestian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric, and Fuel cell vehicles, Fundamentals, Theory, and Design, CRC Press, 2005. 2. Chan, C.C. and Chau, K.T., Modern Electric Vehicle Technology, Oxford University Press, 2001. 3. Das, Shuvra, Modeling for Hybrid and Electric Vehicles Using Simscape, Springer, 2021. 4. Du, H., Cao, D., Zhang, H., Modeling, Dynamics, and Control of Electrified Vehicles, Woodhead Publishing, 2017. 5. Scrosati, B., Garche, J., Tillmetz, W., Advances in Battery Technologies for Electric Vehicles, Woodhead Publishing, 2015. 6. Guiggiani, M., The Science of Vehicle Dynamics: Handling, Braking, and Ride of Road and Race Cars, Springer, 2018. 7. Thomas D. Gillespie, Fundamentals of Vehicle Dynamics, Society of Automotive Engineers. 8. Donald E. Malen, Fundamentals of Automobile Body Structure Design, SAE International 9. P.S.Gill, A Textbook of Automobile Engineering-II, S.K.Kataria and Sons.	




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Research Methodology

23EE4705	RM	Research Methodology	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1:10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

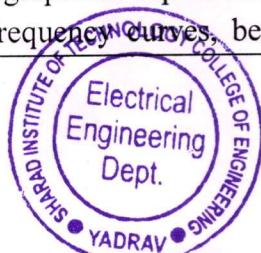
Pre-Requisites: E-Mobility, EV Battery and Chargers

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

CO1	Explain fundamental concepts of research, including the characteristics of good research, research problems, hypotheses, and the importance of reviewing literature to develop a strong research foundation.
CO2	Distinguish various types of research, including basic and applied, qualitative and quantitative, while examining research designs such as exploratory, descriptive, and causal methodologies to determine their appropriate applications.
CO3	Apply appropriate sampling techniques, data collection methods, and statistical analysis tools to classify and visually represent research data for meaningful insights.
CO4	Organize research reports, journal articles, abstracts, theses, and bibliographies while following academic writing standards for clarity and accuracy.
CO5	Evaluate ethical considerations in research, including plagiarism, copyright infringement, collaborative work, and the essential qualities of a responsible researcher.
CO6	Utilize ICT tools such as Mendeley, Endnote, statistical software, and web search engines to effectively manage research data and enhance the research process.

Course Contents:

Unit-1: Introduction to Research The concept of research, characteristics of good research, Application of Research, Meaning and sources of Research problem, characteristics of good Research problem, Research process, outcomes, application of Research, Meaning and types of Research hypothesis, Importance of Review of Literature, Organizing the Review of Literature.	[6]
Unit-2: Types of Research Types of research, pure (basic, fundamental) and applied research, qualitative and quantitative. Research Design: Meaning, need, types of research design – Exploratory, Descriptive, Casual research Design, Components of research design, and Features of good Research design. Experiments, surveys and case study Research design.	[6]
Unit-3: Sampling, Data Collection and analysis Types and sources of data – Primary and secondary, Methods of collecting data, Concept of sampling and sampling methods – sampling frame, sample, characteristics of good sample, simple random sampling, purposive sampling, convenience sampling, snowball sampling, classification and tabulation of data, graphical representation of data, graphs and charts. Histograms, frequency polygon and frequency curves, bell shaped curve and its properties.	[6]

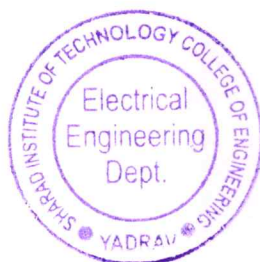


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Statistical Methods for Data Analysis : Applications of Statistics in Research, measures of central tendency and dispersion	
Unit-4: Research Report Research report and its structure, journal articles – Components of journal article. Explanation of various components. Structure of an abstract and keywords. Thesis and dissertations, components of thesis and dissertations. Referencing styles and bibliography.	[6]
Unit-5: Ethics in Research Plagiarism - Definition, different forms, consequences, unintentional plagiarism, copyright infringement, collaborative work. Qualities of good Researcher.	[6]
Unit-6: ICT Tools for Research Role of computers in research, maintenance of data using software such as Mendeley, Endnote, Tabulation and graphical presentation of research data and software tools. Web search: Introduction to Internet, use of Internet and WWW, using search engines and advanced search tools.	[6]
Textbooks/Reference Books: 1. Donald Cooper and PS Schindler, Business Research Methods, 9th Edition, Tata McGraw Hill, 2009. 2. Kothari C. R, Research Methodology, New Age International Publishers. 3. Uma Sekaran, Research Methods for Business, 4th Edition, Wiley, 2010. 4. Ranjit Kumar, Research Methodology, 2nd Edition, Pearson Education, 2009. 5. Naresh Malhotra and S Dash, Marketing Research, 5th Edition, Pearson Prentice Hall, 2009.	



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High Voltage Engineering Laboratory

23EE4706	PCC	High Voltage Engineering Laboratory	0-0-2	1 Credit
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Teaching Scheme	Evaluation Scheme
Practical: 2 hrs/week	CA1: 15 Marks CA2: 15 Marks End Semester Exam: 20 Marks

Pre-Requisites: Basic Electrical Engineering, Electrical Engineering Materials, Power System
Course Outcomes: At the end of the course, students will be able to:

CO1	Determine dielectric high voltages withstand capability of gaseous medium.
CO2	Determine dielectric high voltages withstand capability of liquid medium.
CO3	Determine dielectric high voltages withstand capability of solid medium.

Course Contents:

- List of Experiments:** Minimum of 8 experiments should be performed from the list.
1. Demonstrate Horn Gap arrangement as surge diverter for corona arc discharge.
 2. Measure audible sound in db and visible temperature using Thermal Imaging Camera in Faraday's cage arrangement.
 3. Determine the effect of gap length on breakdown strength of liquid insulating Material (Transformer Oil).
 4. Measure High Voltage Withstand capability of cables at DC Voltages (Max up to 10KV).
 5. Determine Breakdown Voltage for Solid Composite Insulating Materials (30KV, 30mA test setup with jig).
 6. Measure High Voltage with-stand capability of cables at Power Frequency AC Voltages (Max up to 30KV).
 7. Demonstrate development of Tracks and Trees of polymeric insulation.
 8. Determine the effect of change in gap length over breakdown voltage in the air medium using sphere gap assembly.
 9. Study Impulse voltage generator using Virtual Laboratory.
 10. Visit to High Voltage Laboratory and to generate report over Layout and Components of High Voltage Laboratory.



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Switchgear and Protection Laboratory

23EE4707	PCC	Switchgear and Protection Laboratory	0-0-2	1 Credit
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Teaching Scheme	Evaluation Scheme
Practical: 2 hrs/week	CA1: 15 Marks CA2: 15 Marks End Semester Evaluation: 20 Marks

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

CO1	Select overcurrent relay for different applications.
CO2	Explain microprocessor based impedance relay.
CO3	Demonstrate Power system protection equipment's.

Course Contents:

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

1. Experimental study of working of electromechanical over current relay.
2. Experimental study of working of a Directional over current relay.
3. Experimental realization of microprocessor based over current relay.
4. Experimental study of working of microprocessor based impedance relay.
5. Demonstration of LT Switchgear by Industrial visit
6. Demonstration of operation of protection systems for Feeder, Transmission lines by Industrial visits
7. Study of Transformer protection system in substation by Industrial visits.
8. Study of Generator protection system by field visit.
9. Study of Substation equipment's in power system by field system.




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Mega Project Phase-II

23EE4708	PROJ	Mega Project Phase-II	0-0-4	2 Credits
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Teaching Scheme	Evaluation Scheme
Practical: 4 hrs/week	CA1:25 Marks CA2: 25 Marks End Semester Exam: 50 Marks

Pre-Requisites:

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

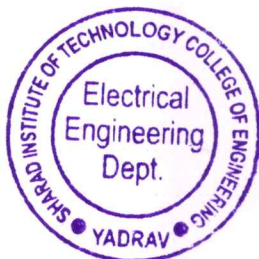
CO1	Build an engineering project.
CO2	Discuss with engineers and the community at large in written and oral forms.
CO3	Demonstrate the knowledge, skills and attitudes of a professional engineer.

Since Mega Project Phase-II is in continuation to Mega Project Phase-I, the students are expected to complete the total project by the end of semester VII. After completion of project work, they are expected to submit the project report including the work done in Phase-I and Phase-II.

The report shall be comprehensive and presented typed on A4 size sheets and **hard bound**. The number of copies to be submitted is number of students plus two. The assessment would be carried out by the panel of examiners (Guide and Project Evaluation Members) for both, term work and oral Evaluations.

The project work should be published in any one of the national/international quality conference or reputed journal.

Report shall summarize the literature survey; spell out the scope of work, methodology and results. Viva-voce Evaluation shall be based on work carried out by the student.



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Constitution of India

23EE4709	MC	Constitution of India	1-0-0	Audit
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Teaching Scheme	Evaluation Scheme
Lecture: 1hr/week	CA-I: 25 Marks CA-II: 25 Marks

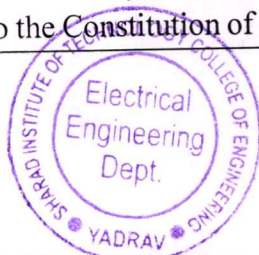
Pre-Requisites: Nil

At the end of the course, students will be able to

CO1	Explain the genesis, meaning, salient features, components, functions, constitutionalism, and basic structure of the Indian Constitution, including the Preamble, Citizenship, Fundamental Rights, Fundamental Duties, and Directive Principles of State Policy.
CO2	Examine the structure and functions of local self-government institutions, including Panchayats, Municipalities, Cooperative Societies, and the provisions related to SC/ST affirmative action and Union Territories.
CO3	Illustrate the composition, powers, and functions of the organs of government at the Union and State levels, including the Executive, Legislature, Judiciary, Governor, Chief Minister, Council of Ministers, High Courts, and Subordinate Courts.
CO4	Analyze the constitutional provisions governing Union-State relations, legislative and administrative relations, finance, property, rights, liabilities, constitutional amendments, and the Right to Property.

Course Contents:

Unit-1: The Indian Constitution: meaning, genesis of the Indian Constitution, Preamble-Salient features, Components, types of Constitution, Functions, Basic Structure of the Constitution, Constitutionalism.	[2]
Unit-2: The Union and its Territory, Citizenship, Fundamental Rights, and Fundamental Duties, Directive Principles of State Policy, The Union Territory.	[2]
Unit-3: The Panchayats, The Municipalities, Composition, Wards, Cooperative societies, definition, number and term of members of Board and its Office Bearers, relationship between the Union and the State, The SC/ST-Affirmative Action.	[2]
Unit-4: Organs of Government; The Executive, The Legislative Union, and The Judiciary.	[2]
Unit-5: The States: The Executive, The Governor – Executive Power of the State, Appointment of Governor, Terms of Office of Governor, Qualifications for appointment as Governor, conditions of Governor's Office, Council of Ministers, Duties of Chief Minister, Judiciary High Court, Subordinate High Court.	[2]
Unit-6: Relation between the Union and the State; Legislative relations, and administrative relations, Finance, Property, Contracts, Rights, Liabilities, Obligations, Suits, Right to Property, Amendment of the Constitution.	[2]
Textbooks/Reference Books: 1. Agarwal R. C., Indian Political System, New Delhi, S. Chand & Company, 1977. 2. Basu D., Introduction to the Constitution of India. New Delhi, Prentice Hall of India, 2008.	



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3. Chakravarthy B., Indian Constitution and Politics, New Delhi, Sage India, 2008
4. Ghosh, Peu. (2017). Indian Government and Politics, New Delhi, Prentice Hall of India Learning, 2017.
5. Pandey J., The Constitution of Law of India, Allahabad, Central Law Agency, 2018.
6. Pylee M. V., An Introduction to the Constitution of India. 4th Edition. New Delhi. Vikas Publishing House, 2005.



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An Autonomous Institute
Yadav (Ichalkaranji), Dist: Kolhapur, Maharashtra-416121

Seminar

23EE4709	RM	Seminar	0-0-2	1 Credit
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Teaching Scheme	Evaluation Scheme
Practical: 2 hrs/week	End Semester Exam: 50 Marks

Pre-Requisites:

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

CO1	Identify and select relevant seminar topics based on the syllabus, while conducting a thorough literature review to establish a strong research foundation.
CO2	Analyze state-of-the-art methodologies, including simulation, experimentation, mathematical modelling, and analysis, to determine their applicability to the chosen topic.
CO3	Formulate a problem statement and define the methodology, scope, and objectives to ensure a structured approach toward achieving result-oriented solutions.
CO4	Evaluate quantified results and present concluding remarks that align with predefined objectives, while effectively communicating findings through a final report and presentation.

Guidelines for Seminar Conduction:

The evaluation of the seminar report is proposed with the following stages.

Stage-I

In this stage the student is expected to deliver the following:

1. Topic selection
2. Literature review
3. State of the art related to the topic of interest (Simulation/Experimentation/Mathematical modelling/analysis, etc.)

Stage-II

1. Problem statement (It must be result oriented solution for specific issues)
2. Methodology
3. Scope and objectives

Stage-III

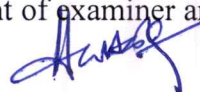
1. Quantification of results
2. Concluding remarks or summary (must be relevant to the specified objectives)

Stage-IV

1. Final report
2. Final presentation/viva

The student has to make a presentation in front of the evaluators from faculty of department at the end of semester. During end semester examination internal examiner (preferably the guide) and External examiners jointly, evaluate his/her work. During the process of monitoring, project guide will monitor his/her performance. The final presentation shall be taken in front of examiner and to be evaluated for 50 marks.




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Contents of the Seminar report

The contents of the seminar report as mentioned in stage-IV are expected to include the following:

- Abstract/Summary
- Introduction: Scope and Methodology
- Literature review: The review should be conducted from at least 10/15 reputed / renowned research papers published during last five years.
- Case study
- References

Instructions for seminar report writing:

It is important that the procedures listed below be carefully followed by all the students.

1. Prepare two spiral bound copies of your Seminar report.
2. Limit your seminar report to preferably 20 to 25 pages only.
3. Header for e.g. Title of the seminar- right aligned
4. The footer for e.g. page numbers-right aligned and Dept. of EE, SITCOE-left aligned.
- 5 The report shall be prepared using Latex preferably (default font throughout) with double spacing throughout on A4 page.

Page	Left margin	Right margin	Top margin	Bottom margin
A-4 (8.5×11 inch)	1.5"	1"	1"	1"

7. Section titles should be bold typed in all capital letters and should be left aligned.
8. Sub-Section headings should be aligning at the left, bold and Title Case (the first letter of each word is to be capitalized).
9. Figure No. at bottom and Title at top with 10 pt; Legends below the title in 10 pt.
10. Please use SI system of units only.
11. References should be either in order as they appear in the report or in alphabetical order.




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Multidisciplinary Minor -V: Earthing Design

23EEMDA5	MDM	Earthing Design	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1:10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

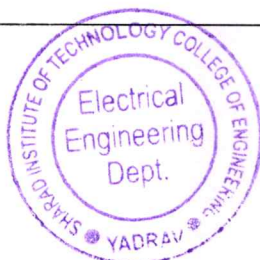
Pre-Requisites: Electrical System Planning and Design, Electrical Estimation and Costing, Lighting System Design, Industrial System Design

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

CO1	Explain the fundamental principles and objectives of earthing systems.
CO2	Analyze soil resistivity and grounding resistance measurements.
CO3	Design grounding systems in substations and industries as per IEEE/IS standards.
CO4	Evaluate the effectiveness of lightning and surge protection systems.
CO5	Simulate and validate earthing systems using engineering software.
CO6	Comply with safety regulations and interpret simulation results.

Course Contents:

Unit-1: Introduction to Grounding Purpose and need for earthing; Types of grounding systems: system and equipment; Earth potential and safety; Soil resistivity and its measurement using Wenner and Schlumberger methods; Impact of soil parameters on design.	[6]
Unit-2: Design of Earthing Electrodes Types of earth electrodes: pipe, plate, rod, strip; Factors affecting electrode resistance; Depth, spacing, backfill materials; IS 3043 and IEEE 80 design guidelines; Resistance calculations for parallel electrodes.	[6]
Unit-3: Ground Resistance Measurement Techniques Measurement techniques: Fall-of-potential method, 62% rule, Slope method, Clamp-on method; Earth tester working principle; Interference effects and mitigation techniques; Safety considerations.	[6]
Unit-4: Substation and Industrial Earthing Design Grid design principles; Step and touch potentials; Earthing conductor sizing; Earthing of transformers, circuit breakers, GIS, control panels; Special design considerations in EHV substations.	[6]



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Unit-5: Lightning and Surge Protection Grounding Lightning basics and risk assessment; Lightning protection zones; Surge protection devices (SPD); Earthing for masts, down conductors, and shield wires; Coordination with functional earthing.	[6]
Unit-6: Software Tools and Case Studies ETAP, CYME, NEPLAN modules for earthing analysis; Simulation of mesh voltage, ground potential rise, current dissipation; Real-world substation case studies; Design validation and reports.	[6]
Textbooks: 1. Gupta, J. B. A Course in Electrical Installation Estimating and Costing, S. K. Kataria and Sons. 2. IEEE Std 80-2013, Guide for Safety in AC Substation Grounding. 3. Kothari, D.P., Electric Power Systems. Tata McGraw-Hill.	
Reference Books: 1. IEC 60364, Electrical Installations for Buildings. 2. Ramasamy Natarajan, Switchgear and Protection. 3. ETAP User Manual, Ground Grid Module Guide.	




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Multidisciplinary Minor -V: IoT Implementation and Practical Applications

23EEMDB5	MDM	IoT Implementation and Practical Applications	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1:10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

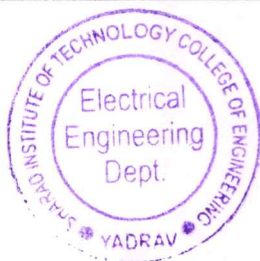
Pre-Requisites: Introduction to Internet of Things

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

CO1	Describe the architecture and fundamental components of IoT systems.
CO2	Compare various IoT communication protocols and their application suitability.
CO3	Interface sensors and actuators with microcontrollers for data acquisition.
CO4	Design and implement IoT applications using open-source platforms.
CO5	Evaluate IoT security risks and propose mitigation techniques.
CO6	Deploy real-time IoT systems with efficient data communication and monitoring.

Course Contents:

Unit-1: IoT Fundamentals Definition and evolution of IoT; Architecture layers – perception, network, application; IoT ecosystems and platforms; Role of embedded systems and cyber-physical systems; Edge, fog, and cloud computing paradigms.	[6]
Unit-2: IoT Communication Protocols Application layer protocols: MQTT, CoAP, HTTP, AMQP; Transport and network layer protocols: TCP, UDP, IPv4/IPv6; Wireless technologies: WiFi, BLE, Zigbee, LoRa, NB-IoT; Protocol stack comparisons and use-cases.	[6]
Unit-3: Sensors, Actuators, and Hardware Platforms Types of sensors and actuators; Interfacing using GPIO, ADC, PWM; Hardware platforms: NodeMCU, ESP32, Raspberry Pi, Arduino; I2C and SPI communication; Power management in IoT devices.	[6]
Unit-4: IoT Platforms and Cloud Integration Overview of IoT platforms: ThingSpeak, Blynk, Firebase, ThingsBoard; Real-time data visualization; Cloud integration using REST APIs; Device-to-cloud and cloud-to-device communication; Dashboard design.	[6]



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Unit-5: Practical Applications of IoT Smart home automation, Smart agriculture, Industrial IoT (IIoT); Wearables and health monitoring; GPS-based asset tracking; Real-time sensor data logging; End-to-end project implementation examples.	[6]
Unit-6: Security and Deployment in IoT IoT security challenges: eavesdropping, data tampering, device hijacking; Authentication and encryption (TLS, OAuth); Secure firmware updates; Over-the-air (OTA) updates; Secure deployment strategies.	[6]
Textbooks: 1. Vijay Madisetti and Arshdeep Bahga, Internet of Things: A Hands-On Approach. 2. Raj Kamal, Internet of Things: Architecture and Design, McGraw-Hill. 3. Jeeva Jose, Internet of Things, Khanna Publishing House.	
Reference Books: 1. Pethuru Raj and Anupama C. Raman, Architecting the Internet of Things, Wiley. 2. Donald Norris, The Internet of Things: Do-It-Yourself Projects, McGraw-Hill. 3. Marco Schwartz, Internet of Things Projects with ESP32, Packt Publishing.	




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Multidisciplinary Minor -V: Power Quality Improvement

23EEMDC5	MDM	Power Quality Improvement	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1:10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

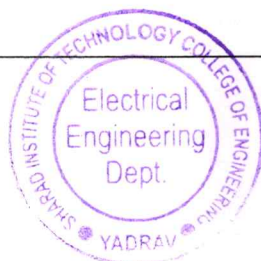
Pre-Requisites: --

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

CO1	Define and classify different power quality issues based on standards.
CO2	Analyze the causes and effects of voltage disturbances and harmonics.
CO3	Evaluate the performance of passive and active filtering solutions.
CO4	Design power quality improvement schemes using custom power devices.
CO5	Simulate and assess power quality disturbances using software tools.
CO6	Interpret measurement data and suggest appropriate mitigation techniques.

Course Contents:

Unit-1: Introduction to Power Quality Definition and scope of power quality; Power quality indices; Causes and classification of disturbances; Standards: IEEE 519, IEC 61000; Economic impact of poor power quality; Overview of power quality events.	[6]
Unit-2: Voltage Disturbances Types of disturbances: sags, swells, interruptions, flicker; Voltage imbalance; Sources and effects on equipment; Motor derating; Detection and characterization methods; Power quality monitors.	[6]
Unit-3: Harmonics and Their Analysis Harmonic generation from nonlinear loads; Fourier analysis and THD; Effects on transformers, motors, and capacitors; IEEE limits; Resonance in power systems; Harmonic spectrum and measurement tools.	[6]
Unit-4: Filter Design for Harmonics Passive filters: series and shunt; Design and tuning; Active power filters: shunt, series and hybrid; Compensation strategies; Real-time control of filters; Comparison and case-based selection.	[6]



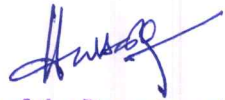
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Unit-5: Custom Power Devices for PQ Improvement DVR: working, configuration and control; DSTATCOM: reactive power injection and voltage stabilization; UPQC: dual compensation strategy; Modeling and simulations; Installation considerations.	[6]
Unit-6: Simulation and Case Studies Using MATLAB/Simulink, ETAP or PSCAD for PQ simulation; Harmonic source modeling; Effectiveness of filtering solutions; Voltage sag mitigation analysis; Industry-specific case studies.	[6]
Textbooks: 1. Arindam Ghosh and Gerard Ledwich, Power Quality Enhancement Using Custom Power Devices, Springer. 2. Roger C. Dugan, et al. Electrical Power Systems Quality, McGraw-Hill. 3. Math H. Bollen, Understanding Power Quality Problems, IEEE Press.	
Reference Books: 1. IEEE Std 519-2014, Harmonic Control in Electric Power Systems. 2. Ewald F. Fuchs and Mohammad A.S. Masoum, Power Quality in Power Systems and Electrical Machines, Elsevier. 3. Bhim Singh, Power Quality: Problems and Mitigation Techniques, PHI Learning.	




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Teaching and Evaluation Scheme for Final Year B. Tech

Department of Electrical Engineering
Semester: VIII




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Department: Electrical Engineering

Rev: Course Structure/00/2023-24

Class: Final Year B. Tech

Semester: VIII

Course Code	Course Type	Course	Teaching Scheme				Evaluation Scheme					Credits
			L	T	P	Total Hrs	CA1	CA2	MSE	ESE	Total	
23EE4801	PEC	Self-Learning Course-1	4	-	-	4	10	10	30	50	100	4
23EE4802	PEC	Self-Learning Course-2	4	-	-	4	10	10	30	50	100	4
23EE4803	INT	Internship	-	-	20	20	50	50	-	100	200	10
Total			8	-	20	28	70	70	60	200	400	18

Self-Learning Course-1		Self-Learning Course-2	
A	Foundations of Accounting and Finance	A	Introduction to Embedded System Design
B	Financial Management for Managers	B	Cloud Computing
C	Principles of Management	C	Smart Grid: Basics to Advanced Technologies
D	Financial Accounting	D	Operations and Planning of Power Distribution Systems




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Self-Learning Course-1: Foundations of Accounting and Finance

23EE4801A	PEC	Foundations of Accounting and Finance	4-0-0	4 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: NA	CA1 :10 Marks CA2 :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Course Contents:

Week 1:
Conceptual Basis of Financial Accounting, Concepts and Interactions of Financial Statements, Terminologies in Financial Accounting

Week 2:
Financial Statements: Balance sheet, Financial Statements: Income Statement, Financial Statements: Cash flow Statement

Week 3:
Financial Statement Analysis, Reading financial statements, Financial Ratios

Week 4:
Conceptual basis of Cost Accounting, Cost behaviour, Elements of cost and preparation of cost statement, Cost Classification, Direct and Indirect cost, Overhead allocation / absorption, Traditional Method, Primary and Secondary Distribution, Activity Based Costing

Week 5:
Cost-Volume-Profit Analysis, Contribution Margin, Break-Even Point, Marginal Costing, Operating Leverage, Decision making using Marginal Costing

Week 6:
Performance Evaluation, Budgeting, Flexible Budget, Production Budget, Sales Budget Master Budget, Variance Analysis

Week 7:
Introduction to Corporate Finance, Time Value of Money, Discounted Cash Flows

Week 8:
Valuing Bonds, Valuation of Stocks as Investments,

Week 9:
Valuing Projects NPV and IRR, Valuing Projects Risk Analysis

Week 10:
Risk, Return and the Capital Asset Pricing Model

Week 11:
Cost of Debt, Equity, WACC, Capital Budgeting, Capital Market Efficiency, Capital Structure and Cost of Capital

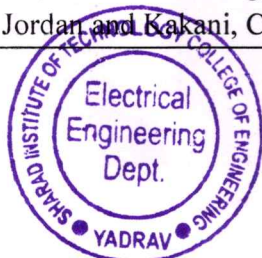
Week 12:
Dividends and other Payouts, Course Summary

Textbooks/ Reference Books:

- Robert N Anthony, David F Hawkins and Kenneth A Merchant, Accounting: Text and Cases, McGraw Hill Education.
- Horngren, Foster and Dattar, Cost Accounting, PHI Publication
- Ross, Westerfield, Jaffe, Jordan and Kakani, Corporate Finance, McGraw Hill Education

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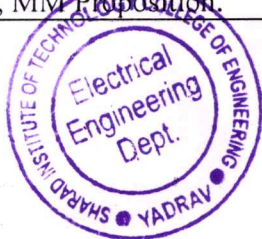
Self-Learning Course-1: Financial Management for Managers

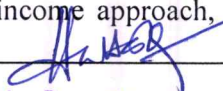
23EE4801B	PEC	Financial Management For Managers	4-0-0	4 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: NA	CA1 :10 Marks CA2 :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Course Contents:

Week 1: Financial management-an overview, Financial decisions in the firms, the fundamental principles of finance, goals of financial management, building blocks of modern finance.
Week 2: Risk-return trade off, Organization of finance functions, Emerging role of financial managers' in India, Over view of financial statements – Income statement, Balance Sheet, Cash flow statement, Analysis of financial statements
Week 3: Financial Planning and forecasting, Tools and techniques of Financial Planning and Forecasting, Sources of finance.
Week 4: Time Value of Money, Future value of a single amount, Present value of a single amount, Future value of Annuity, Present value of Annuity and Perpetuity.
Week 5: Capital Budgeting –Concept and overview, Capital budgeting process, Project classification, Techniques of capital budgeting, Investment criteria
Week 6: Net present value, internal rate of return, Modified Internal rate of return, Benefit cost ratio, Pay-back period method.
Week 7: Accounting rate of return, Investment appraisal in practice, Estimation of project cash flows – overview, Estimation of project cash flows-tools and techniques, Estimation of project cash flows-tools and techniques
Week 8: Accounting rate of return, Investment appraisal in practice, Estimation of project cash flows – overview, Estimation of project cash flows-tools and techniques, Estimation of project cash flows-tools and techniques.
Week 9: Break-even analysis, some other models and tools of risk analysis, Project selection under risk, cost of Capital-Overview, Cost of debt and preference capital.
Week 10: Cost of equity, Determining the proportions, WACC, WA Marginal cost of capital, Determining the optimum capital budget.
Week 11: Capital structure of firms-An overview, Net income approach, Net operating income approach, Traditional proposition, MM Proposition.




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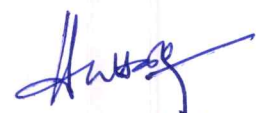
Week 12:

Dividend decisions-An overview, Relevance of dividend, Dividend policy formulation, Dimensions of dividend policy, Legal and procedural aspects of dividend decisions.

Textbooks/Reference Books:

1. Prasanna Chandra, Financial Management: Theory and Practice, 9th Edition, McGraw Hill Education Publishers.
2. Van Horne, J.C, Fundamentals of Financial Management, 13th Edition, Prentice Hall Publishers.
3. Brealey and Myers, Principles of Corporate Finance, 11th Edition, McGraw Hill Education Publishers
4. Pandey I.M., Financial Management, 11th Edition, Vikas Publishers.
5. Khan, M.Y. and Jain, P.K., Financial Management, 7th Edition, McGraw-Hill Education Publishers.




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Self-Learning Course-1: Principles of Management

23EE4801C	PEC	Principles of Management	4-0-0	4 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: NA	CA1 :10 Marks CA2 :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Course Contents:

Week 1:

Introduction to Management: Management – An Emerging Profession, Definition, Nature, Scope, Purpose, and characteristics of Management, Functions, roles, skills of an effective Manager.

Week 2:

Evolution of Management Thought : Classical Theory, Scientific Management , Management Process or Administrative Management, Bureaucracy, Behavioural Science Approach, Quantitative Approach, Systems Approach, Contingency Approach, Operational Approach

Week 3:

Planning: Types of Plans, Planning Process, Introduction to Strategic Management, Types of Strategies, Understanding environment of business: Environmental appraisal – Industry Analysis - Porter's Model of competitive advantage, analysis of organizational resources and capabilities

Week 4:

Forecasting and Premising : Introduction to Forecasting, Essential Components in Business Forecasting, Determinants of Business Forecasts, Benefits of Forecasting, Techniques of Forecasting, Limitations of Forecasting

Week 5:

Decision-making: Introduction, Components of Decision-making, Decision-making Process, Group Decision-making, Creativity Problem-solving.

Week 6:

Management by Objectives and Styles of Management : Core Concepts of MBO, Characteristics of Management by Objectives, Process of MBO, Defining the Goal, Action Plan, Final Review, Benefits of Management by Objectives, Limitations of Management by Objectives, Styles of Management, American Style of Management, Japanese Style of Management, Indian Style of Management

Week 7:

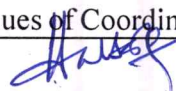
Organizing and Directing: Introduction, Organizational Design, Hierarchical Systems , Organization Structure, Types of Organization Structure, Formal and Informal Organization, Factors Determining Span of Management, Centralization and Decentralization, Span of control, Understanding authority and responsibility, Principles of Delegation, Authority, Developing a culture of Innovation and performance.

Week 8:

Staffing and Coordination: Introduction, Human Resource Management, Recent Trends in HRM, Technology in HRM, Economic Challenges, Workforce Diversity, Concept of Coordination, Need for Coordination, Importance of Coordination, Principles of Coordination, Coordination Process, Types of Coordination, Issues and Systems Approach to Coordination, Techniques of Coordination.

Week 9:




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Career Development Strategy: Introduction, Concept and Elements of Career, Overview of Career Development, Significance and Advantages of Career Development, Objectives of Career Development, Types of Career Development Programmes, Different Stages or Cycles of Career Development Process, Career Anchors, Steps in the Career Planning Process.

Week 10:

Leadership styles of Managers: Leadership Concept, Nature, Importance, Attributes of a leader, Role of a leader in demonstrating awareness of legal, personnel, and strategic issues relating to globalization, culture and gender diversity in an organization, Role of leader in conflict resolution and negotiations

Week 11:

Organizational Communication: Communication in Organizations: Introduction, Importance of Communication in the Workplace; Understanding Communication Process, Barriers to Communication, Use of tone, language and styles in Communication, Role of Perception in influencing communication, Role of culture in communication

Week 12:

Change management: Concept of change, change as a natural process, Importance and Causes of change – social, economic, technological, organizational, Developing a climate for learning, Concept of learning organizations Challenges of Contemporary Business: Role of Ethics, Corporate social responsibility, and environmental issues

Textbooks/ Reference Books:

1. Stephen P. Robbins, David A. Decenzo, Fundamentals of Management, Pearson Education, 9th Edition, 2016.
2. Harold Koontz, O'Donnell and Heinz Weihrich, Essentials of Management. New Delhi, 9th edition, Tata McGraw Hill, 2012.
3. Management Fundamentals: Concepts, Applications, and Skill Development, 6th Edition, Sage, 2014
4. Richard L. Daft, Principles Of Management, Cengage Learning, 2009.
5. Robbins, Management, 9th edition Pearson Education, 2008.



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Self-Learning Course-1: Financial Accounting

23EE4801D	PEC	Financial Accounting	4-0-0	4 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: NA	CA1 :10 Marks CA2 :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Course Contents:

Week 1: A primer on business organizations and need for accounting

Introduction to Financial Accounting, Definition of accounting, Course contents, Preparation of financial statements: Accounting cycle, Decision making using financial statements, Accounting: An art or a science?, Environment of financial reporting, Company form of business, 1What is a company?, 2Types of companies, Private company vs Public company, Visuals test to identify public companies, Accounting as an information system, Business and information requirement, Stakeholders of a business, Information: Tip of accounting ice-berg, Key accounting terms: Assets, Liabilities, Income, Expenses, Four key terms in accounting, Sources of funds, Use of funds, The sources vs The uses , Types of Assets, Types of Liabilities, Types of Incomes, Types of Expenses, Tutorial: Key accounting terms: Assets, Liabilities, Income, Expenses, Identifying the category and sub category of various accounting terms.

Week 2: Accounting equation, GAAP Principle and Fundamentals of double entry system

Accounting equation, What is the accounting equation?, Working of accounting equation, Example: accounting equation, Summary: accounting equation, Walkthrough of Balance Sheet I, Walkthrough of Balance Sheet II, Walkthrough of Balance Sheet III, Walkthrough of Income Statement , Generally Accepted Accounting Principles I, Business Entity Concept, Money Measurement Concept, Going Concern Concept, Accounting Period Concept, Cost Concept, Generally Accepted Accounting Principles II, Conservatism Concept, Accrual Concept, Matching Concept, Full Disclosure Concept, Materiality, Recap and way forward, Types of accounts, What is an account?, What are types of accounts?, Tutorial - Types of accounts.

Week 3:

Planning: Types of Plans, Planning Process, Introduction to Strategic Management, Types of Strategies, Understanding environment of business: Environmental appraisal – Industry Analysis - Porter's Model of competitive advantage, analysis of organizational resources and capabilities

Week 4:

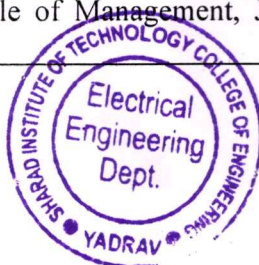
Forecasting and Premising : Introduction to Forecasting, Essential Components in Business Forecasting, Determinants of Business Forecasts, Benefits of Forecasting, Techniques of Forecasting, Limitations of Forecasting

Week 5:

Decision-making: Introduction, Components of Decision-making, Decision-making Process, Group Decision-making, Creativity Problem-solving.

Week 6:

Management by Objectives and Styles of Management : Core Concepts of MBO, Characteristics of Management by Objectives, Process of MBO, Defining the Goal, Action Plan, Final Review, Benefits of Management by Objectives, Limitations of Management by Objectives, Styles of Management, American Style of Management, Japanese Style of Management, Indian Style of Management



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Week 7:

Organizing and Directing: Introduction, Organizational Design, Hierarchical Systems, Organization Structure, Types of Organization Structure, Formal and Informal Organization, Factors Determining Span of Management, Centralization and Decentralization, Span of control, Understanding authority and responsibility, Principles of Delegation, Authority, Developing a culture of Innovation and performance.

Week 8:

Staffing and Coordination: Introduction, Human Resource Management, Recent Trends in HRM, Technology in HRM, Economic Challenges, Workforce Diversity, Concept of Coordination, Need for Coordination, Importance of Coordination, Principles of Coordination, Coordination Process, Types of Coordination, Issues and Systems Approach to Coordination, Techniques of Coordination.

Week 9:

Career Development Strategy: Introduction, Concept and Elements of Career, Overview of Career Development, Significance and Advantages of Career Development, Objectives of Career Development, Types of Career Development Programmes, Different Stages or Cycles of Career Development Process, Career Anchors, Steps in the Career Planning Process.

Week 10:

Leadership styles of Managers: Leadership Concept, Nature, Importance, Attributes of a leader, Role of a leader in demonstrating awareness of legal, personnel, and strategic issues relating to globalization, culture and gender diversity in an organization, Role of leader in conflict resolution and negotiations

Week 11:

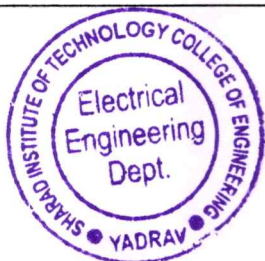
Organizational Communication: Communication in Organizations: Introduction, Importance of Communication in the Workplace; Understanding Communication Process, Barriers to Communication, Use of tone, language and styles in Communication, Role of Perception in influencing communication, Role of culture in communication

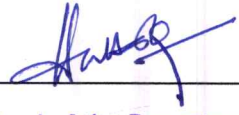
Week 12:

Change management: Concept of change, change as a natural process, Importance and Causes of change – social, economic, technological, organizational, Developing a climate for learning, Concept of learning organizations Challenges of Contemporary Business: Role of Ethics, Corporate social responsibility, and environmental issues

Textbooks/Reference Books:

1. Stephen P. Robbins, David A. Decenzo, Fundamentals of Management, Pearson Education, 9th Edition, 2016.
2. Harold Koontz, O'Donnell and Heinz Weihrich, Essentials of Management. New Delhi, 9th Edition, Tata McGraw Hill, 2012.
3. Management Fundamentals: Concepts, Applications, and Skill Development, 6th edition, Sage. 2014
4. Richard L. Daft, Principles of Management, Cengage Learning, 2009.
5. Robbins, Management, 9th Edition, Pearson Education, 2008.




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Self-Learning Course-2: Introduction to Embedded System Design

23EE4802A	PEC	Introduction to Embedded System Design	4-0-0	4 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: NA	CA1 :10 Marks CA2 :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Course Contents:

Week 1: Introduction to Embedded Systems and Computer Systems Terminology. Modular approach to Embedded System Design using Six-Box model: Input devices, output devices, embedded computer, communication block, host and storage elements and power supply.
Week 2: Microcontroller Based Embedded System Design. Salient Features of Modern Microcontrollers. Elements of Microcontroller Ecosystem and their significance.
Week 3: Design of Power Supply for Embedded Systems. Linear Regulator Topologies. Switching Power Supply Topologies. Power Supply Design Considerations for Embedded Systems.
Week 4: Introduction to MSP430 Microcontroller. MSP430 CPU Architecture. Programming Methods for MSP430. Introduction to Lunchbox Platform.
Week 5: Fundamentals of Physical Interfacing. Connecting Input Devices: Switches, Keyboard and Output devices: LEDs, Seven Segment Displays (SSD). Assignment: MCQ/MSQ
Week 6: Advanced Physical Interfacing: Driving load - high side, low side and H-bridge. Multiplexing displays including Charlieplexing. Shaft encoder.
Week 7: Programming the MSP430. Basics of version control system - Git. Installing and using Code Composer Studio (CCS). Introduction to Embedded C. Interfacing LEDs and Switches with MSP430 using Digital Input and Output.
Week 8: MSP430 Clock and Reset System. MSP430 Clock sources and distribution. Types of Reset sources. Handling Interrupts in MSP430. Writing efficient Interrupt Service Routine (ISR).
Week 9: Interfacing Seven Segment Displays and Liquid Crystal Displays with MSP430. Low Power Modes in MSP430. Introduction to MSP430 Timer Module and its Modes of Operation.
Week 10: Generating Pulse Width Modulation (PWM) using Timer Capture Mode. ADC operation in MSP430. Interfacing analog inputs. Generating random numbers using LFSR and other methods. Adding DAC to MSP430. Custom Waveform generation using MSP430.
Week 11: Timer Capture Modes. Measuring frequency and time period of external signals and events. Serial Communication Protocols: UART, SPI, I2C. Interfacing Universal Serial Communication Interface



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(USCI) Module of the MSP430 for UART Communication. Advanced Coding Exercises based on Interrupt driven Programming. Building an Electronics Project.

Week 12:

Circuit Prototyping techniques. Designing Single Purpose Computers using Finite State Machine with Datapath (FSMD) approach. MSP430 Based Project Design and Implementation. Recap of Course Coverage.

Textbooks/Reference Books:

1. John Catsoulis, Designing Embedded Hardware, 2nd Edition, Shroff Publishers and Distributors.
2. Tony Givargis and Frank Vahid, Embedded System Design: A Unified Hardware / Software Introduction, Wiley.
3. John H. Davies, MSP430 Microcontroller Basics, Elsevier.
4. Micheal Barr, Programming Embedded Systems in C and C++, Shroff Publishers and Distributors.




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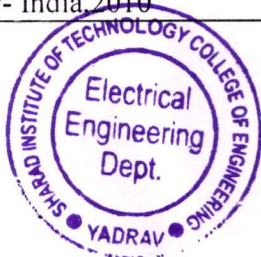
Self-Learning Course-2: Cloud Computing

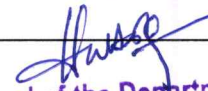
23EE4802B	PEC	Cloud Computing	4-0-0	4 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: NA	CA1 :10 Marks CA2 :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Course Contents:

Week 1: Introduction to Cloud Computing
Week 2: Cloud Computing Architecture.
Week 3: Service Management in Cloud Computing.
Week 4: Data Management in Cloud Computing.
Week 5: Resource Management in Cloud
Week 6: Cloud Security
Week 7: Open Source and Commercial Clouds, Cloud Simulator.
Week 8: Research trend in Cloud Computing, Fog Computing
Week 9: VM Resource Allocation, Management and Monitoring
Week 10: Cloud-Fog-Edge enabled Analytics
Week 11: Serverless Computing and FaaS Model
Week 12: Case Studies and Recent Advancements.
Textbooks/Reference Books: 1. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Cloud Computing: Principles and Paradigms, Wiley,2011 2. Gautam Shroff, Enterprise Cloud Computing - Technology, Architecture, Applications, Cambridge University Press, 2010 3. Barrie Sosinsky, Cloud Computing Bible, Wiley-India, 2010 4. Ronald L. Krutz, Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Wiley- India,2010




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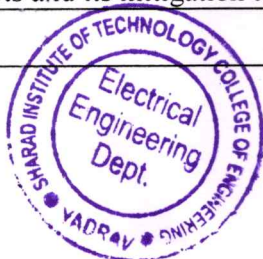
Self-Learning Course-2: Smart Grid: Basics to Advanced Technologies

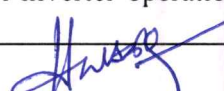
23EE4802C	PEC	Smart Grid: Basics to Advanced Technologies	4-0-0	4 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: NA	CA1 :10 Marks CA2 :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Course Contents:

Week 1: Introduction to Smart Grid-I., Introduction to Smart Grid-II., Architecture of Smart Grid system, Standards for Smart Grid system, Elements and Technologies of Smart Grid System-I
Week 2: Elements and Technologies of Smart Grid System-II, Distributed Generation Resources-I, Distributed Generation Resources-II, Distributed Generation Resources-III, Distributed Generation Resources-I
Week 3: Introduction to energy storage devices Different types of energy storage technologies, Analytical modelling of energy storage devices, Optimal sizing and siting of storages, Battery management system (BMS)
Week 4: Wide area Monitoring Systems-I, Wide area Monitoring Systems-II, Phasor Estimation-I, Phasor Estimation-II, Digital Relays for Smart Grid Protection.
Week 5: Islanding Detection Techniques-I, Islanding Detection Techniques -II, Islanding Detection Techniques -III, Smart Grid Protection-I, Smart Grid Protection-II
Week 6: Smart Grid Protection-III, Smart Grid Protection-IV, Modelling of storage devices, Modelling of DC smart grid components, Operation and control of AC Microgrid-I
Week 7: Operation and control of AC Microgrid -II, Operation and control of DC Microgrid -I, Operation and control of DC Microgrid -II, Operation and control of AC-DC hybrid Microgrid -I, Operation and control of AC-DC hybrid Microgrid -II
Week 8: Phasor measurement unit placement, Cyber security and resiliency, Virtual inertia and ancillary support, Demand side management of smart grid, Demand Response Analysis of smart grid
Week 9: Demonstration of solar power generation, Demonstration of wind power generation, Demonstration of Battery Management System, Demonstration of EV charging system, Hierarchical control techniques in hybrid ac-dc microgrid
Week 10: Simulation and case study of AC Microgrid, Simulation and case study of DC Microgrid, Simulation and case study of AC-DC Hybrid microgrid, Demonstration of parallel inverter operation in AC microgrid, Harmonic effects and its mitigation techniques.
Week 11:




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Energy management, Design of Smart Grid and Practical Smart Grid Case Study-I, Design of Smart Grid and Practical Smart Grid Case Study-II, System Analysis of AC/DC Smart Grid, Demonstration of grid-connected DC microgrid.

Week 12:

Demonstration of energy management in microgrid, Demonstration of PHIL experimentation for symmetric and asymmetric fault analysis of grid-connected DFIG wind turbine, Demonstration of ancillary support from virtual synchronous generator, Demonstration on peak energy management using energy storage system, Conclusions.

Textbooks/ Reference Books:

1. A Keyhani, M Marwali., Smart Power Grids
2. Arun Phadke, Computer Relaying for Power Systems.
3. Nikos Hatziairgiou , Microgrids Architecture and control.
4. Fang Lin Luo, Hong Ye, Renewable Energy Systems.
5. Amirnaser Yazdani, Reza Iravani, Voltage-Sourced Converters in Power Systems Modeling, Control, and Applications.



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Self-Learning Course-2: Operations and Planning of Power Distribution Systems

23EE4802D	PEC	Operations and Planning of Power Distribution Systems	4-0-0	4 Credits
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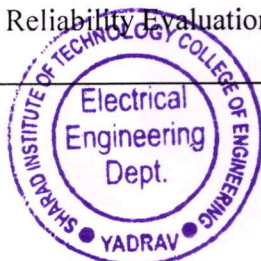
Teaching Scheme	Evaluation Scheme
Lecture: NA	CA1 :10 Marks CA2 :10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Course Contents:

Week 1: Introduction, overview, and Load modelling
Week 2: Load modelling
Week 3: Basic features of distribution systems
Week 4: Basic features of distribution systems.
Week 5: Reliability and Power quality assessment of distribution systems
Week 6: Reliability and Power quality assessment of distribution systems
Week 7: Distribution system load flow approach
Week 8: Reactive power compensation in distribution systems
Week 9: Distribution system planning and reconfiguration: Different approaches
Week 10: Distribution system planning and reconfiguration: Different approaches.
Week 11: Active distribution networks with the integration of Distributed Generation (DG)
Week 12: Distribution system automation and smart grid

Textbooks/Reference Books:

1. T. Gonen. Electric Power Distribution System Engineering; CRC Press, 3rd Edition, 2014.
2. H. Lee. Willis. Power Distribution Planning Reference Book; CRC press; 2nd Edition, Revised and Expanded, 2004.
3. S. Pabla, Electric Power Distribution; Tata Mcgraw-Hill Publishing Company Ltd., 5th Edition, 2007.
4. Math Bollen and Fainan Hassan, Integration of Distributed Generation in the Power System; IEEE Press, 2011.
5. R. Billington and R. Allan, Reliability Evaluation of Power Systems; Springer, Berlin, 2nd Edition, 1996.



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Internship

23EE4803	INT	Internship	0-0-20	10 Credits
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Teaching Scheme	Evaluation Scheme
Practical: 20 hours/week	CA-I: 50 Marks CA-II: 50 Marks End Semester Exam: 100 Marks

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

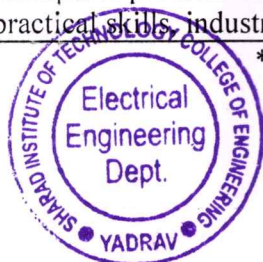
CO1	Apply foundational engineering knowledge to effectively address real-world industrial challenges during the internship.
CO2	Demonstrate heightened interpersonal communication skills by interpreting and expressing ideas effectively within various professional environments.
CO3	Apply a comprehensive understanding of industry activities and functions, showcasing the ability to navigate and contribute effectively in professional engineering settings.
CO4	Analyze and synthesize experiences, observations, and learned concepts from the internship to compose technically proficient reports for effective communication.
CO5	Apply professionalism, punctuality, and responsible task completion as manifestations of a strong work ethic within the internship.
CO6	Synthesize initiative, curiosity, and active engagement, creating a mindset conducive to meaningful contributions to assigned tasks during the internship period.

Description:

An essential step in bridging the knowledge gap between academic study and practical application for engineering students is the internship program. Minimum eighteen-week internship program begins at the end of the seventh semester and allows students to interact with industries, associations for professionals, or research facilities. Strong communication skills and a basic comprehension of technical topics are essential qualities. The course outcomes place a strong emphasis on developing interpersonal communication skills, confirming technical knowledge in real-world situations, comprehending industry processes in depth, and writing thorough technical reports. It is encouraged of students to be on time, act professionally, and take initiative in their internships.

Guidelines emphasize the need of communication and call on students to promptly and politely discuss any problems they may have with coordinators and supervisors. Additionally stressed are initiative, enthusiasm, and timely execution of duties assigned. After the internship, students must put together a thorough report that is an invaluable tool. This report is evaluated according to standards including uniqueness, sufficiency, structure, and real-world application of principles learnt. In addition, a panel of experts evaluates the quality, efficiency, and organization of students' content delivery when assessing their presenting abilities.

A comprehensive assessment of the students' performance is provided by the overall evaluation, which also includes departmental reports and attendance records. The internship program's all-encompassing strategy attempts to promote engineering students' overall growth as they enter the workforce by instilling practical skills, industry understanding, and good communication.



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