B.E: Electrical and Electronics Engineering

(2020-2021)

Batch: 2017-21

Curriculum Structure

&

Syllabus

(7^{th}& 8^{th} semesters)

Department of Electrical and Electronics Engineering

The National Institute of Engineering

Mysuru-570 008

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING
SCHEME OF TEACHING
VII SEMESTER - B.E

Sl. No	Subject code	Subject	Category	Contact Hrs./Week			No. of Credits
				L	T	P	
1	EE0419	Computer Applications to Power System Studies	FCP	4	0	0	4
2	EE0323	Power Distribution Planning and Control	FCP	3	0	0	3
3	EE0328	High Voltage Engineering	FCP	3	0	0	3
4	EE0348	Electric Drives	GC	3	0	0	3
5	EE0333	Management & Entrepreneurship	GC	3	0	0	3
6	EE03xx	Elective – 4	-	3	0	0	3
7	EE03xx	Elective – 5	-	3	0	0	3
8	EE0109	Power System Simulation Lab	FCP	0	0	3	1.5
9	EE0110	Relay & High Voltage Lab	FCP	0	0	3	1.5
10	EE0204	Mini Project	GC	--	--	4	2
TOTAL				**22**	**0**	**10**	**27**
Total Contact Hrs./Week : 32							

Elective -4

Sl. No	Subject code	Subject	Category	Contact Hrs./Week			No. of Credits
				L	T	P	
1	EE0330	Electrical Power Quality	FEP	3	0	0	3
2	EE0345	Reactive power compensation and Flexible AC Transmission Systems	GE	3	0	0	3
3	EE0332	Electrical power utilization	FEP	3	0	0	3
4	EE0344	Electrical Energy Management	FEP	3	0	0	3
5	IS0333	Nokia offered Elective	GE	3	0	0	3

Elective -5							
Sl. No	**Subject code**	**Subject**	**Category**	**Contact Hrs./Week**			**No. of Credits**
				L	**T**	**P**	
1	EE0305	VLSI Circuits	FEI	3	0	0	3
2	EE0309	Fuzzy Logic and Soft Computing	GE	3	0	0	3
3	EE0334	Microcontroller based system design	GE	3	0	0	3
4	ME0325	Advanced course on Nano technology*	GE	3	0	0	3
5	EE0351	Biomedical Instrumentation	FEI	3	0	0	3
6	EE0XXX	Electric Vehicle and Battery Management Systems	GE	3	0	0	3

*Pre-requisite: Introduction to Nano- Science and Technology (ME0438)

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING
SCHEME OF TEACHING
VIII SEMESTER - B.E

Sl. No	Subject code	Subject	Category	Contact Hrs./Week			No. of Credits
				L	T	P	
1	EE0335	Professional Engineering Practice	GC	3	0	0	3
2	EE0346	Smart Grid	FCP	3	0	0	3
3	EE0304	Power System Operation and Control*	FCP	3	0	0	3
4	EE03xx	Elective – 6	-	3	0	0	3
5	EE0602	Major Project	GC	--	--	12	6
TOTAL				**12**	**00**	**12**	**18**

VIII SEMESTER
DEPARTMENT ELECTIVES

Sl. No	Subject Code	Subject	Category	Contact Hrs./Week			No. of Credits
				L	T	P	
1	EE0337	Insulation of high voltage equipment	FEP	3	0	0	3
2	EE0313	HVDC Transmission	FEP	3	0	0	3
3	EE0338	Finite element analysis of Electrical Machines	FEP	3	0	0	3
4	EE0326	Design of Control Systems**	GE	3	0	0	3
5	EE0342	AI application to Power Systems	FEP	3	0	0	3
6	EE0XXX	Machine Learning	FEP	3	0	0	3

* Pre-requisite: Power System analysis and Stability (EE0418)

** Pre-requisite: Control Systems - I (EE0437), Control Systems- II - (EE0439)

Computer Applications to Power System Studies (4-0-0)

Sub Code : EE0419 **CIE : 50% Marks**

Hrs/week : 4+0+0 **SEE : 50% Marks**

SEE Hrs : 3 **Max marks : 100**

Course Outcomes

On successful completion of the course, the students will be able to:

1. Compute Network matrices for power system networks.
2. Apply numerical techniques to evaluate the power flows and stability of power systems.
3. Analyse stability aspects of power system.

UNIT 1: Network Topology: Introduction, Elementary graph theory – oriented graph, tree, co-tree, basic cut-sets, basic loops; Incidence matrices – Element-node, Bus incidence, branch path, Basic cut-set, Augmented cut-set, basic loop, Augmented loop, problems.

06 Hours

SLE: Primitive networks – impedance form and admittance form.

UNIT 2: Network Matrices: Introduction, Formation of Y_{BUS} matrix by method of inspection (including transformer off-nominal tap setting) and method of singular transformation, Formation of Bus Impedance matrix by step by step building algorithm, problems

07 Hours

SLE: Modification of bus impedance matrix.

UNIT 3: Load Flow Studies: Introduction, Power flow equations, Classification of buses, Operating constraints, Data for load flow, Gauss method - algorithm and flow chart, Gauss - Seidal Method - Algorithm and flow chart for PQ and PV, Acceleration of convergence; Newton Raphson Method – Algorithm and flow chart for NR method in polar coordinates. Algorithm for Fast Decoupled load flow method.

12 Hours

SLE: Comparison of Load Flow Methods.

UNIT 4: Stability Studies: Introduction, steady state stability, power angle equation of synchronous machines, steady state stability of a two machine system, Clarke‘s diagram, methods of improving SSSL, Transient stability, dynamics of a synchronous machine, Swing equations, Swing curve, Equal Area Criterion (EAC), applications of Equal Area Criterion, critical clearing angle.

10 Hours

SLE: Concept of Dynamic Stability.

UNIT 5: Transient Stability Solutions: Numerical solution of Swing Equation – Point-by-point method, Modified Euler's method, Runge-Kutta method, Milne's predictor corrector method. Network performance equations.

10 Hours

SLE: Factors affecting transient stability

UNIT 6: Voltage Stability: Introduction, comparison of angle and voltage stability, reactive power flow and voltage collapse, mathematical formulation of voltage stability problem, voltage stability analysis, voltage stability analysis, prevention of voltage collapse, Numerical.

7 hours

SLE: State of the art, future trends and challenges

Text Books:

1. Stag, G. W., and EI-Abiad, **"*Computer Methods in Power System Analysis*",** A. H.-McGraw Hill International Student Edition. 1968.
2. Nagrath, I. J and Kothari, ***"Modern Power System Analysis",*** D. P, TMH, 3rd Edition, 2003.

Reference Books:

1. Pai, M. A***, "Computer Techniques in Power System Analysis"***, TMH, 2nd edition, 2006.
2. Singh L P, ***"Advanced Power System Analysis and Dynamic"***, New Age International (P) Ltd, New Delhi, 2001.
3. HaadiSadat, ***"Power System Analysis",*** TMH, 2nd Edition, 12th reprint, 2007.

Power Distribution Planning and Control (3-0-0)

Sub Code	**: EE0323**	**CIE:50%Marks**
Hrs/week	**: 3+0+0**	**SEE:50%Marks**
SEE Hrs	**: 3**	**Max. Marks: 100**

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

1. Discuss the distribution system planning and concept of automation
2. Analyze the Performance of substation, primary and secondary distribution systems.
3. Discuss the concept of reactive power compensation and voltage control techniques
4. Discuss the Distribution Automation Control Function

UNIT 1:Distribution System Planning & Automation: Introduction, Distribution system planning, factors affecting system planning, Present technique, Role of computers in distribution planning, concept of Distribution Automation, SCADA –architecture and functions , local energy control center, Typical control applications

06 Hours

SLE: Remote Terminal UNIT.

UNIT 2: Distribution Substation: Introduction; Load characteristics, substation location, Rating a distribution substation, substation services area with 'n' primary feeders, derivation of K constant, substation Application curves, present voltage drop formula.

08 Hours

SLE: Comparison of four and six feeder patterns.

UNIT 3: Primary and secondary distribution systems: Introduction, feeder types and voltage levels, feeder loading , rectangular type development, radial type development application of the A,B,C,D general circuit constants to radial feeders. feeder control equipment.

06 Hours

SLE: Secondary banking

UNIT 4: Reactive power compensation and installation of capacitors: Power-factor Analysis and Basics, Effect of series and shunt capacitors, Power factor correction, Location of Capacitors, Practical procedure to determine best capacitor location, Economic justification for capacitors.

07 Hours

SLE: Ferro-Resonance due to Capacitor Banks

UNIT 5: Distribution system voltage regulation: Quality of service and voltage standards, voltage control, feeder voltage regulators, Line drop compensation, short cut method to calculate voltage dip due to single and three phase motor start.

07 Hours

SLE: Voltage fluctuations

UNIT 6: Distribution Automation Control Function: Demand side management, Feeder Automation- Fault detection, reconfiguration and restoration functions.

06 Hours

SLE: Trouble calls

Text Books:

1. Turan Gonen***, "Electric Power Distribution System Engineering"***, 3rd edition, McGraw Hill, 2014
2. James A Momoh***, "Electrical Power Distribution, automation, protection and control",*** CRC Press Taylor and Francis group, 2008.

High Voltage Engineering (3-0-0)

Sub Code : EE0328 **CIE : 50% Marks**
Hrs/week : 3+0+0 **SEE : 50% Marks**
SEE Hrs : 3 **Max marks : 100**

Course Outcomes

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

1. Discuss the HV insulating media and understand criterion for electrical breakdown of insulating media.
2. Describe the concept of generating HVAC, HVDC, High voltage lightning impulses
3. Discuss principles and constructional aspects of measuring various categories of high voltages, high currents and surges.
4. Describe testing techniques of HV insulation and apparatus.

UNIT 1: Introduction: Introduction to HV technology, advantages of transmitting electrical power at high voltages, need for generating high voltages in laboratory, Electrode configuration, Classification of HV insulating media.
Breakdown phenomena in Liquid dielectrics: Pure and commercial liquids, properties, Suspended particle theory, Cavity breakdown theory, Stressed oil volume theory.

06 Hours

SLE: Degree of Uniformity

UNIT 2: Breakdown phenomena in Gaseous and Solid Dielectrics : Gaseous dielectrics: primary and secondary ionization processes. Criteria for Breakdown and Limitations of Townsend's theory. Streamer's theory, breakdown in non uniform fields. Corona discharges. Electronegative gasses. Breakdown in solid dielectrics: Intrinsic Breakdown, thermal breakdown, Breakdown due to internal discharges.

08 Hours

SLE: Panchen's law, Time lags of Breakdown.

UNIT 3: GENERATION OF HVAC AND DC VOLTAGE: HV transformer; Need for cascade connection and working of cascaded transformers. Series resonant circuit- principle of operation and advantages. Tesla coil. Cock roft- Walton type high voltage DC set. Calculation of voltage regulation, ripple and optimum number of stages for minimum voltage drop.

06 Hours

SLE : Parallel resonant circuit, HVDC- voltage doubler circuit.

UNIT 4: GENERATION OF IMPULSE VOLTAGE AND CURRENT: Introduction to standard lightning and switching impulse voltages. Analysis of single stage impulse generator- expression for Output impulse voltage. Multistage impulse generator, working of Marx circuit. Components and rating of multistage impulse generator. Triggering of impulse

generator by three electrode gap arrangement and Trigatron gap .Generation of high impulse current.

08 Hours

SLE : Generation of switching impulse voltage.

UNIT 5: MEASUREMENT OF HIGH VOLTAGES: Electrostatic voltmeter principle, construction and limitation. Chubb and Fortescue method for HVAC measurement. Generating voltmeter- Principle, construction. Series resistance micro ammeter for HVDC measurements. Standard sphere gap measurements of high voltages. Factors affecting the measurements. Potential dividers-resistance dividers, capacitance dividers. Mixed RC potential dividers.

07 Hours

SLE: Magnetic links.

UNIT 6: HIGH VOLTAGE TESTING TECHNIQUES: Dielectric loss and loss angle measurements using Schering Bridge, Need for discharge detection and PD measurements aspects. Factor affecting the discharge detection. Discharge detection method-straight methods. Definitions of terminologies, tests on insulators, transformers, Mechanism of flash over methods, Pollution phenomenon.

06 Hours

SLE: Test on Cables.

Text Books:

1. M.S.Naidu and Kamaraju, **"High Voltage Engineering",** 3rd edition, THM, 2007.
2. A.Haddad and D.F. Warne "**Advances in High Voltage Engineering**", 1st edition, IEE Power and Energy Series, 2004.

Reference Books:

1. E. Kuffel and W.S. Zaengl**, "*High Voltage Engineering Fundamentals"*,** 2nd edition, Elsevier publication, 2000.
2. C.L.Wadhwa***, "High Voltage Engineering"***, New Age International Private limited, 1995.
3. Mazen Abdel-Salam, Hussein Anis, Ahdab El-Morshedy, Roshdy Radwan **"High-Voltage Engineering Theory and Practice",** 2nd edition, Marcel Dekker Inc. 2000

Electric Drives (3-0-0)

Sub Code	**: EE0348**	**CIE : 50% Marks**
Hrs/week	**: 3+0+0**	**SEE : 50% Marks**
SEE Hrs	**: 3**	**Max. Marks : 100**

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

1. Describe the dynamics of electric drive system.
2. Select and Size the motors and drives for different applications with different torque speed characteristics.
3. Analyse DC motor drives and AC motor drives.

UNIT 1: An introduction to Electrical drives & its dynamics: Electrical drives-advantages, parts and choice of electrical drives.

Dynamics of electrical drives: Fundamental torque equation, speed torque conventions and multiquadrant operation. Equivalent values of drive parameters, components, nature and classification of load torques, calculation of time and energy loss in transient operations, steady state stability, load equalization

8 Hours

SLE: Status and Advantages of AC and DC drives

UNIT 2: Selection of motor power rating: Thermal model of motor for heating and cooling, Classes of motor duty, determination of motor rating.

6 Hours

SLE: Frequency of operations of motors subjected to intermittent loads.

UNIT 3: DC motor drives: Starting, braking, transient analysis, single phase fully controlled rectifier control of separately excited dc motor, Single-phase half controlled rectifier control of separately excited dc motor. Three phase half and fully controlled rectifier control of separately excited dc motor.

7 Hours

SLE: Chopper control of DC separately exited dc motors

UNIT 4: Induction motor drives: Operation with unbalanced source voltages and single phasing, operation with unbalanced rotor impedances, analysis of induction motor fed from non-sinusoidal voltage supply, Starting, braking and transient analysis

7 Hours

SLE: Linear induction motor and its control

UNIT 5: Stator voltage control: Variable frequency control of an induction motor, VSI fed induction motor drives, closed loop speed control for VSI fed induction motor drives, rotor resistance control, slip power recovery.

6 Hours

SLE: Starting methods and types of single-phase induction motors

UNIT 6: Synchronous motor drives: Operation from fixed frequency supply, synchronous motor variable speed drives, variable frequency control of multiple synchronous motors. Self-controlled synchronous motor drive employing load commutated thyristor inverter. **Industrial drives:** Rolling mill drives, cement mill drives, textile mill drives.

6 Hours

SLE: Types of synchronous motors.

Text Book:

1. G.K Dubey, ***"Fundamentals of Electrical Drives"***, Narosa publishing house, 2nd Edition, 2010.

Reference Books:

1. N.K De and P.K. Sen***, "Electrical Drives"***, - PHI, 2009.
2. S.K Pillai, **"*A First Course on Electric Drives"*,** -Wiley Eastern Ltd 1990.
3. V.R. Moorthi***, "Power Electronics, Devices, Circuits and Industrial Applications",*** Oxford University Press, 2005.
4. R. Krishnan, ***"Electric motor drives, modeling, analysis and control"***, PHI, 2008.

Management & Entrepreneurship (3-0-0)

Sub Code: EE0333 **CIE: 50% Marks**

Hrs/week: 3+0+0 **SEE: 50% Marks**

SEE Hrs: 3 **Max marks:100**

Course Outcomes

On successful completion of the course, the students will be able to:

1. Explain the characteristics and functions of management in the contemporary context
2. Discuss different behavioral patterns, various executive training programs and objectives.
3. Discuss various management functions, its relevance and the process of human resource management.
4. Explain the need for project planning, entrepreneurship and traits of an entrepreneur

UNIT 1: INTRODUCTION: Evolution of concept of scientific management, historical perspective, contribution of Taylor, Henry Fayal, Gilbreth and HL Gantt to scientific management: management as science/art: relevance of scientific management in Indian context.

06 Hours

SLE: Relevance of various schools of management thought in the present scenario

UNIT 2: MANAGEMENT AND BEHAVIOURAL APPROACH: Introduction to behavioural school of management thought, understanding past behaviour, predicting future behaviour, directing, changing and controlling present behaviour: Maslow's theory of hierarchical needs and Herzberg's two factor theory, McGregor's Theory X and Theory Y: Integration of organizational goals and needs of employees.

06 Hours

SLE: Relevance of different motivational theories in the present scenario

UNIT 3: MANAGEMENT FUNCTIONS: Planning, organizing, staffing, directing, controlling. Principles of management, managerial skills and skill mix required at different levels, leadership styles.

06 Hours

SLE: Necessity of leadership and management aspects in industry

UNIT 4: HUMAN RESOURCE MANAGEMENT: Selection and recruitment, training of personnel, employer employee relationship, causes and settlement of industrial disputes.

06 Hours

SLE: Necessity of personnel selection criteria

UNIT 5: ENTRENPRENEURSHIP: Definition, evolution of entrepreneurship, Qualities of entrepreneur; barriers to entrepreneurship, economic liberalization and development of entrepreneurship.

SMALL SCALE INDUSTRIES: Definition and objectives of SSI. Government policy and support through different state and central agencies; impact of economic liberalization on SSIs. Ancillary industry and tiny industries.

08 Hours

SLE: Study of women entrepreneurship and its relevance in the Indian context

UNIT 6: PROJECT PLANNING AND CONTROLLING: Definition of project, identification of project, feasibility study from technical, marketing, financial and social angles; preparation of project report, planning commission guidelines; project appraisal-factors to be considered, scheduling

SLE: Study of planning and controlling aspects involved in the recovery from disasters

08 Hours

SLE: Study of planning and controlling aspects involved in the recovery from disasters

Text Books:

1. P.C. Tripathi & P.N. Reddy, *"**Principles of Management''***, Tata Mcgraw Hill, 6th edition, 2017.
2. Poornima M Charanthimath, ***"Entrepreneurship Development"***, Pearson Education – 3rd edition 2018

Reference Books:

1. T. R. Banga, S. Sharma, ***"Industrial Organization and Engineering Economics".***
2. S.S. Khanka, ***"Entrepreneurial Development",*** S. Chand & Co. Ltd. Ram Nagar, New Delhi.

Electrical Power Quality (3-0-0)

Sub Code	**: EE0330**	**CIE : 50%Marks**
Hrs/week	**: 3+0+0**	**SEE : 50%Marks**
SEE Hrs	**: 3**	**Max. Marks :100**

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

1. Discuss the various power quality phenomenon.
2. Interpret and evaluate the voltage sags, interruptions and Transient over voltages
3. Discuss the fundamental, effects of harmonics and mitigation techniques
4. Describe the power quality monitoring and benchmarking process

UNIT-1: **INTRODUCTION -** Power quality concern, Categories and Characteristics of Power System Electromagnetic Phenomena, power quality evaluation procedures, definition and cause of various power quality disturbances.

6 Hours

SLE: CBEMA and ITI Curves

UNIT-2: VOLTAGE SAGS AND INTERRUPTIONS: Sources of sags and interruptions, estimating voltage sag performance, fundamental principles of protection, Solutions at the End-User Level.

6 Hours

SLE: Utility System Fault-Clearing Issues

UNIT-3: TRANSIENTS OVER VOLTAGES: Sources of Transient Over voltages, Ferro-resonance phenomenon, Principles of Overvoltage Protection, Devices for Overvoltage Protection, Utility Capacitor-Switching Transients, Utility System Lightning Protection. Cable protection.

7 Hours

SLE: Computer Tools for Transients Analysis

UNIT-4:FUNDAMENTALS OF HARMONICS: Harmonic Distortion, Voltage versus Current Distortion, Harmonics versus Transients, Harmonic Indices, Harmonic Sources from Commercial Loads and Industrial loads, Locating Harmonic Sources, System Response Characteristics, series and parallel resonance.

7 Hours

SLE: Harmonic sequence

UNIT-5: APPLIED HARMONICS: Harmonic distortion evaluations, principles for controlling harmonics, harmonic studies, modeling of harmonic source, devices for controlling harmonic distortion, harmonic filters.

7 Hours

SLE: Standards on harmonics

UNIT-6: POWER QUALITY MONITORING: Monitoring considerations, power quality measurement equipments, assement of power quality measurement data. Power quality benchmark : Introduction, benchmark process, power quality contract,

7 Hours

SLE: Application of intelligent systems.

TEXT BOOK:

1. Dugan, Roger C, Santoso, Surya, McGranaghan, Mark F Beaty, "**Electric Power Quality,"** H. Wayne McGraw-Hill professional publication 2003.

REFERENCE BOOKS:

1. Math H. J.Bollen, "**Understanding power quality problems voltage sags and interruptions**"-. IEEE Press, 2000.

Reactive Power Compensation and Flexible AC Transmission Systems (3-0-0)

Sub Code : EE0345	**CIE : 50% Marks**
Hrs/week : 3 Hrs	**SEE : 50% Marks**
SEE Hrs : 3 Hrs	**Max marks : 100**

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

1. Describe the concept of load compensation.
2. Analyse the performance of uncompensated and conventionally compensated transmission lines.
3. Evaluate the reactive power problems associated with distribution system.
4. Discuss the basic principle of working of series and shunt FACTS devices and analyze their performance.

Unit-1: Load Compensation: Objectives and specifications –reactive power characteristics –inductive and capacitive approximate biasing –Load compensator as a voltage regulator –phase balancing and power factor correction of unsymmetrical loads.

6 Hours

SLE: Load compensator as a voltage regulator

Unit-2: Steady–State reactive Power Compensation in Transmission System: Uncompensated line –types of compensation –Passive shunt and series and dynamic shunt compensation

Transient State Reactive Power Compensation in Transmission Systems: Characteristic time periods –passive shunt compensation –static compensations-series capacitor compensation –compensation using synchronous condensers.

7 Hours

SLE: Compensation by sectioning

Unit-3: Reactive Power Coordination: Objective–Mathematical modeling –Operation planning –transmission benefits –Basic concepts of quality of power supply –disturbances-steady –state variations –effects of under voltages –frequency –Harmonics, radio frequency and electromagnetic interferences.

8 Hours

SLE: Meters on power system

Unit-4:User Side Reactive Power Management: KVAR requirements for domestic appliances–Purpose of using capacitors –selection of capacitors –deciding factors –types of available capacitor, characteristics and Limitations

Distribution Side Reactive Power Management: System losses –loss reduction methods – examples –Reactive power planning –objectives &Economics, Planning capacitor placement – retrofitting of capacitor banks.

7 Hours

SLE: KVAR based tariffs

Unit-5: Introduction To FACTS: Basic Types of FACTS Controllers, Brief Description and Definition of Shunt, Series and combined Controllers, Benefits from FACTS Technology.

Static Series Compensators: Objectives of series compensation-Variable impedance type series compensation (only TCSC).

6 Hours

SLE: Applications of TCSC

Unit-6: Static Shunt Compensators: Objectives of shunt compensation, Methods of controllable VAR generation, Variable impedance type Static Var Generator, Switching converter type Var Generators, basic operating principle.

6 Hours

SLE: Applications of STATCOM

TEXT BOOKS:

1. "**Reactive power control in Electric power systems**" by T.J.E.Miller, John Wiley and sons, 1982.
2. "**Reactive power Management**" by D. M. Tagare, Tata McGraw Hill, 2004.
3. "**Understanding FACTS Devices**" N.G. Hingorani and L.Guygi IEEE Press Publications 2000.

Electric Power Utilization (3-0-0)

Sub Code	**: EE0332**	**CIE :**	**50%Marks**
Hrs/week	**: 3+0+0**	**SEE :**	**50%Marks**
SEE Hrs	**: 3**	**Max. Marks**	**: 100**

Course Outcomes

On successful completion of the course, the students will be able to:

1. Discuss the utilization of electrical power for Heating welding and illumination applications.
2. Explain the principle of electrolytic process.
3. Discuss the operation of Electrical traction and Electric Hybrid vehicles.

UNIT 1: Electric Heating: Introduction, Advantages, Modes of heat transfer, Methods of Electric heating, Resistance heating, Arc heating-Arc furnaces, Induction heating, Dielectric heating, choice of frequency.

06 Hours

SLE: Infrared or radiant heating.

UNIT 2: Electric Welding: Welding processes, Resistance electric welding, Electric Arc welding, Submerged arc welding, Electron-beam welding, Ultrasonic welding, Plasma arc welding, Laser beam welding, Welding transformers and Generators.

07 Hours

SLE: Welding of various metals

UNIT 3: Electrolytic processes: Introduction, Electro-deposition, manufacture of chemicals, Anodizing, electro-polishing, Electro-cleaning, Electro-parting, electro-metallurgy

06 Hours

SLE: Power Supply for Electrolytic processes

UNIT 4: Illumination: Introduction, Laws of Illumination, Photometry, Artificial Sources of lights, Incandescent lamps, Arc lamps, Discharge lamps, Lighting Schemes, Street lighting, Factory lighting.

07 Hours

SLE: Flood lighting.

UNIT 5: Electric Traction: Introduction, Requirements, Different types, Comparison, power supply, AC locomotive, Tramways, Trolley-bus, Diesel electric Traction, overhead equipment.

06 Hours

SLE: Power factor and harmonics.

UNIT 6: Introduction to Electric and Hybrid vehicles: Configuration, Performance and Energy consumption of electric vehicles, Concept and Architecture of Hybrid electric vehicles, economic aspects of EV.

08 Hours

SLE: Tractive effort during normal driving of electrical vehicles.

Text Books:

1. R. K. Rajput**, "Utilization of Electrical Power" (including drives and traction),** Laxmi Publications (P) Ltd. 113, Goden House, Daryaganj, New Delhi.
2. MehrdadEhsani, YiminGao and Ali Emadi**, "Modern Electric, Hybrid Electric & Fuel Cell Vehicles – Fundamental Theory and Design",** CRC Press, 2009.

Reference Books:

1. **E.** Openshaw Taylor, **"Utilization of Electrical Energy",** revised by V.V.L. Rao, Orient Longman.

Electrical Energy Management (3-0-0)

Sub Code : EE0344 **CIE : 50% Marks**
Hrs/week : 3 Hrs **SEE : 50% Marks**
SEE Hrs : 3 Hrs **Max marks : 100**

Course Outcomes

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

1. Discuss the energy scenario and fundamentals of energy and financial management.
2. Apply energy efficiency measures to save power.
3. Analyse the energy efficiency of electric motor and lighting loads.
4. Describe the DSM techniques.

UNIT 1: Energy Scenario: Introduction, primary and secondary energy, commercial and non-commercial energy, non-renewable and renewable energy, global primary energy resource, Indian energy scenario, long term energy scenario for India, energy conservation and its importance, energy and environment.

6 Hours

SLE: Indian Energy Scenario.

UNIT 2: Energy Management and Audit: energy audit definitions, need for energy audit, types of energy audit and approach, preliminary, detailed and post audit phases, bench marking, plant energy performance, instruments and metering for energy audit.
Financial Management: Introduction, financial analysis techniques-payback period, return on investment (ROI), time value of money: net present valued method, internal rate of return method, electricity tariff and billing, numerical.

7 Hours

SLE: Responsibilities and Duties of energy manager.

UNIT 3: Energy Efficiency in Electrical Utilities: Introduction, electrical load management and maximum demand control, power factor improvement, Economics of power factor improvement , automatic power factor controllers, selection and location of capacitors, performance assessment of power factor capacitors, energy efficient transformers, standards and labeling programme for distribution transformer, distribution losses in industrial system, assessment of T&D losses in power systems, estimation of technical losses in distribution system, causes for technical losses in distribution system, measures to reduce technical losses, commercial losses, A T & C losses.

9 Hours

SLE: Measures to reduce commercial losses.

UNIT 4: Electric Motors: Energy performance assessment of motors and variable speed drives: Introduction, determining motor loading, concept of variable frequency drive, need for VFD, principles of VFD, soft starters, star labeling of energy efficient induction motors.

Selection of Motors, Energy efficient motor, factors affecting energy efficiency and minimizing motor losses in operation.

6 Hours

SLE: Rewinding effects on energy efficiency.

UNIT 5: Lighting System: Introduction, basic parameters and terms in lighting system, light source and types of lamps, recommended illumination levels for various tasks, activities locations. Methods of calculating illuminance -lighting design for interiors, energy saving opportunities, energy efficient lighting controls. DG set as a system, energy performance assessment of DG sets.

6 Hours

SLE: Energy saving measures for DG sets.

UNIT 6: Demand Side Management and Demand Response: Introduction to DSM, Concept of DSM and Demand Response, Classification of DSM programs, Objectives & importance of DSM, DSM techniques, Load shaping objectives, time of day pricing, Benefits from DSM. Promoting energy conservation: Scope and potential in India.

6 Hours

SLE: India's efforts DSM applications.

TEXT BOOKS:

1. "Energy Manager Training Programme (2012)", Bureau of Energy Efficiency

2. "Demand-side management from a sustainable development perspective", TERI and IREDA, 2003.

3. "Engineering Economics and Management", N Narasimhaswamy, Dynaram Publications

Nokia offered Elective

- Theory :26 Hrs
- Project session/discussion : 10 Hrs (approx.)

Module	Topic	Duration Hrs
Wireless Connectivity Technology Options	OneM2M and IoT World Forum standardized architecture and LTE - 1(LTE Network Architecture)	2
	LTE-2(LTE Radio Protocols)	1
	LTE-3(LTE Radio Basic Procedures)	1
	WiFi	2
	5G : General introduction and IoT specific features	1
Software Engineering	Software Development Life Cycle,Software Testing and Security	2
IoT : Introduction and end to end architecture	LoRA&SigFox	2
	Sensors & Actuators layer	2
	Communication Network Layer	2
	Applications & Analytics layer,Key Design Considerations	1
Cellular IoT	Cellular IOT#1	2
	Cellular IOT#2	2
	Cellular IOT#3	2
Cloud and IoT Platforms (Cloud, Virtualization, Analytics)	Cloud and Virtualization	2
	Analytics	2

VLSI circuits (3-0-0)

Sub code: EE0305 **CIE: 50% Marks**

Hrs/Week: 3+0+0 **SEE: 50% Marks**

SEE Hrs : 3 **Max. Marks: 100**

Course Outcomes

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

1. Describe the fundamental process of IC fabrication, basic components, design flow, scaling trends and limitations.
2. Analyze the electrical characteristics of MOSFET and DC characteristics of CMOS logic gates.
3. Develop simple delay models to analyze the high-speed VLSI system performance
4. Analyze advanced design techniques of CMOS circuits.

UNIT1: An overview of VLSI and logic design with MOSFETs: Complexity and Design, Basic concepts,Ideal switches and Boolean operations, MOSFETs as switches, Basic logic gates in CMOS, Complex logic gates in CMOS, Transmission gate circuits.

06 hours

SLE: Clocking and Dataflow control.

UNIT2: Physical structure of CMOS Integrated circuits: Integrated circuit layers, MOSFETs, CMOS layers, Designing FET arrays.
Fabrication of CMOS integrated circuits: Overview of silicon processing, Material growth and deposition, Lithography, CMOS process flow, Latchup, Design rules, Gate layout.

07 hours

SLE: stick diagrams.

UNIT 3: Elements of Physical Design: Basic concepts, Layout of Basic structures, cell concepts, FET sizing and unit transistor, Physical design of logic gates, Design hierarchies.
Electrical characteristics of MOSFETs: MOS physics, nFET I-V equations, FET RC model, pFET characteristics.

07 hours

SLE: modelling of small MOSFETs.

UNIT 4: Electronic analysis of CMOS logic gates: DC characteristics of CMOS inverter, Inverter switching characteristics, Power dissipation, DC Characteristics and transient response of NAND and NOR gates, Analysis of complex logic gates, Gate design for transient performance, transmission.

07 hours

SLE: gates and pass transistors.

UNIT 5: Designing high-speed CMOS logic networks: Introduction, Transient response, Gate delays, RC delay model, Driving large capacitive loads, Logical effort, Parasitic delay, BiCMOS drivers.

07 hours

SLE: Overview of interconnects.

Unit 6: Advanced techniques in CMOS logic circuits: Mirror circuits, Pseudo nMOS, Tristate circuits, Clocked CMOS, Dynamic CMOS logic circuits.

06 hours

SLE: Dual-rail logic networks.

Text Book:

1. John P.Uyemura, John Wiley, **" Introduction to VLSI Circuits and Systems",**

Reference Books:

1. Sung-Mo Kang and Yusuf Leblebici, **"CMOS Digital Integrated Circuits-Analysis and Design",** TMH
2. Niel H.E Weste, **"Principles of CMOS VLSI Design",** Pearson Education

Fuzzy Logic and Soft Computing (3-0-0)

Sub Code	**: EE0309**	**CIE:**	**50%Marks**
Hrs/week	**: 3+0+0**	**SEE:**	**50%Marks**
SEE Hrs	**: 3**	**Max. Marks :100**	

Course Outcomes

On successful completion of the course, the students will be able to:

1. Understand soft computing concepts technologies, and applications
2. Understand the underlying principle of artificial neural network and its learning techniques.
3. Understand the underlying principle of fuzzy logic and its applications
4. Understand the underlying principle of genetic algorithm and its applications

UNIT 1: Introduction: Difference between Soft and Hard computing, Brief descriptions of different components of soft computing and its application, Artificial neural networks Vs Biological neural networks, ANN architecture, Basic building block of an artificial neuron, Activation functions, Introduction to Early ANN architectures (basics only)-McCulloch & Pitts model, Perceptron, ADALINE, MADALINE

7 Hours

SLE: Application of soft computing techniques

UNIT 2: Artificial Neural Networks: Supervised Learning: Neuron as a simple computing element, The perceptron, Backpropagation networks: architecture, multilayer perceptron, backpropagation learning-input layer, accelerated learning in multilayer perceptron, The Hopfield network, Bidirectional associative memories (BAM), RBF Neural Network.

7 Hours

SLE: Biological neuron signal transmission

UNIT 3: Artificial Neural Networks: Unsupervised Learning: Hebbian Learning, Generalized Hebbian learning algorithm, Competitive learning, Self- Organizing Computational Maps: Kohonen Network.

7 Hours

SLE: Advantages of learning algorithms

UNIT 4: Fuzzy Logic: Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, properties, fuzzy relations, cardinalities, membership functions.,

Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods,

7 Hours

SLE: Computer based simulation of fuzzy logic

UNIT5: Fuzzy Inference Systems and applications: Fuzzy Inference Systems, Mamdani Fuzzy Models, Sugeno Fuzzy Models, Adaptive Neuro-Fuzzy Inference Systems, Applications, function Approximation, control and process, Monitoring, fault diagnosis and load forecasting, other engineering applications

6 Hours

SLE: Advantages of Neuro-Fuzzy system

UNIT6: Genetic algorithms: Introduction, encoding, fitness function, reproduction- Roulette wheel, Boltzmann, tournament, rank, and steady state selections, Convergence of GA, Applications of GA case studies. Introduction to genetic programming- basic concepts.

6 Hours

SLE: Limitations of Genetic Algorithm

Textbooks:

1. Simon Haykin, ***"Neural Networks and Learning Machines",*** 3rd ed., Pearson Education, 2016
2. Timothy J. Ross, ***"Fuzzy logic with engineering applications",*** Wiley India Pvt. Ltd, student edition.
3. D. E. Goldberg, "***Genetic Algorithms in Search, Optimisation, and Machine Learning"***, Addison-Wesley Longman Publishing Co., Inc., USA

Reference Books:

1. S. N. Sivanandam and S.N.Deepa, "***Principles of Soft Computing"***, 3rd ed., Wiley India Pvt. Ltd.
2. James A. Freeman, David M. Skapura, "***Neural Networks Algorithms, Applications, and Programming Techniques"***, Pearson Education India.
3. R. Rajasekaran and G. A and Vijayalakshmi Pa, "***Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications"***, Prentice Hall of India

Microcontroller Based System Design (3-0-0)

Sub Code : EE0334 **CIE : 50% Marks**

Hrs/week : 3+0+0 **SEE : 50% Marks**

SEE Hrs : 3 **Max marks : 100**

Course Outcomes:

On successful completion of the course, the students will be able to:

1. Describe the architecture of PIC microcontroller
2. Explain the working of peripheral devices and Interfacing concepts
3. Explain microcontroller applications along with examples
4. Explain the Real time operating systems in embedded systems

UNIT 1: INTRODUCTION TO PIC MICROCONTROLLER : Introduction to PIC Microcontroller–PIC 16C6x and PIC16C7x Architecture–PIC16cxx–-Register File Structure - Instruction Set - Addressing modes –Simple Operations.

07 Hours

SLE: Pipelining - Program Memory considerations

UNIT 2 : INTERRUPTS AND TIMER :PIC micro controller Interrupts- External Interrupts-Interrupt Programming–Loop time subroutine – Timers. Timer Programming–Front panel I/O-Soft Keys– State machines

06 Hours

SLE: Key switches, Display of Constant and Variable strings.

UNIT 3: PERIPHERALS AND INTERFACING :I 2 C Bus for Peripherals Chip Access–Bus operation-Bus subroutines– Serial EEPROM—Analog to Digital Converter–UART-Baud rate selection–Data handling circuit–Initialization - LCD and keyboard Interfacing - ADC, DAC.

08Hours

SLE: Sensor Interfacing.

UNIT-4: PIC Microcontroller Application design and Hardware Interfacing: Requirements definition, PIC microcontroller resource allocation, Effective user interfacing, Project management, Power management, Reset

06 Hours

SLE: Interfacing to external devices

UNIT5 : Sensors, Actuators and Examples of Embedded Systems: Sensors, actuators, Mobile phones, Automotive electronics, RFID, Wireless sensor networks, Robotics, biomedical applications.

07 Hours

SLE: Brain machine interface

UNIT 6: RTOS: Real time tasks, Real time systems, Types of real time tasks, real time operating systems, Real time scheduling algorithms, Rate monotonic algorithm, The earliest dealine first algorithm.

06 Hours

SLE: Basic design using RTOS

Text Books:

1. Peatman, J. B, "***Design with Microcntrollers***", Pearson Education, 3rd edition, 2004.

2. Lyla. B. Das, "***Embedded Systems- An Integrated approach***", Pearson Education.

Reference Books:

1**.** Raj Kamal, "***Embedded Systems***" 13th reprint 2007, Tata-McGraw Hill Publications.

2. Myke Predko, "***Programming and customizing the PIC Microcontroller***", McGraw Hill Education, 3rd edition.

Advanced Nano-Science & Technology (2-0-2)

Sub Code: ME0325 **CIE :50 % Marks**

Hrs / Week: 04 **SEE : 50 % Marks**

SEE Hrs: 3 Hrs **Max. Marks: 100**

Course Prerequisites: Introduction to Nano-Science and Technology (ME0438)

Course Outcomes:

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

1. Define the basics of miniaturization at nanoscale.
2. Classify the Semiconducting materials and devices at nanoscale
3. Summarize the basics of Nanoscale heat transfer and fluid dynamics
4. Experiments will provide broad prospect of advance research techniques involved in nanotechnology research field.

Unit 1: Introduction to Miniaturization: scaling laws and accuracy, scaling in mechanics, scaling in electricity and electromagnetism, scaling in optics, scaling in heat transfer, scaling in fluids.

4hours

Self Learning Exercise: accuracy of the scaling laws

Unit 2:Nano Electronics :tuning the band gap of nanoscale semiconductors, Quantum Confinement, The density of States for Solids, Single Electron transistor, Molecular Electronics, the colors and uses of quantum dots, lasers based on quantum confinement, Semiconductor nanowires- Fabrication strategies, quantum conductance effects in semiconductor nanowires, fabrication of porous Silicon, nanobelts and nanosprings.

5 hours

Unit 3: Nano Electronic devices: Single Electronic Transistor, Spintronic Transitor, Single Photonic Transistor, Tandem Solar cell, Spintronic LED Perovskites thin film Photovoltaic, Quantum Dot thin film Photovoltaic,

5 hours

Self Learning Exercise: current research trends on thin film Photovoltaics

Unit4: Nanoscale heat transfer and Fluid dynamics

Introduction, All heat is Nanoscale Heat: Boltzman constant, The Thermal Conductivity of Nanoscale Structures, Convection, Radiation.

4 hours

Unit 5: Nanoscale fluid dynamics:
Introduction, Low Reynolds Numbers, Surface Charges and The Electrical Double Layer, Pressure-Driven Flow, Gravity-Driven Flow, Electro osmosis, Superposition Of Flows, Stokes Flow Around A Particle,

4 hours

Self Learning Exercise: Applications of Nano fluidics

Unit 6: Nano Biotechnology: Introduction, The Machinery of the cell, Biomimetic Nanostructures, Molecular motors, Bio Sensors

4 hours

Self Learning Exercise: Applications of Bio Technology

Lab Experiments: (26 hrs)

1. Thin film preparation by DC sputtering
2. Thin film preparation by Thermal Evaporation
3. Thin film preparation by Sol-Gel Method (Spin and Dip)
4. Characterization studies of thin films by AFM
5. Phase studies of thin films by XRD
6. Optical properties of thin films by UV-Visible

Text Book:

1. Nanotechnology understanding small systems, 2nd Edition, by Ben rogers, CRC press

Reference Books:

1. Micro- And Nanoscale Fluid Mechanics-transport in microfluidic device By Brian J. Kirby, Cambridge University Press
2. Micro- And Nanoscale Heat Transfer by Sebastain- Volz, Springer

Bio-Medical Instrumentation (3-0-0)

Sub Code : EE0351 **CIE : 50% Marks**

Hrs/week : 3+0+0 **SEE : 50% Marks**

SEE Hrs : 3 **Max marks : 100**

Course Outcomes

On successful completion of the course, the students will be able to:

1. Describe the physiology of the human body and origin of biomedical signals.
2. Explain the working of different diagnostic instruments, Clinical Lab Equipments and different imaging modalities
3. Emphasize the knowledge on Telemedicine and Patient safety

UNIT-1: Fundamentals of Medical Instrumentation: Anatomy, Physiology, Physiology systems of the body, sources of bio-medical signals, basics of medical instrumentation, Performance requirements, Origin of biomedical signals.

06 Hours

SLE: action potential, general constraints in design of medical instrumentation systems

UNIT-2: Diagnostics and Monitoring: General concepts, ECG, Measurement of pulse rate, blood pressure measurement, Cardiac output measurement, measurement of respiration rate, EEG, oxymeter

08 Hours

SLE : Capnography(CO_2 method of respiration rate)

UNIT-3:Medical Image Processing: X-ray: Basics of diagnostic radiology, Nature Production of X-ray, Computed tomography & system components. **MRI**: Principles and Image reconstruction techniques

07 Hours

SLE: Radiation hazard reduction and biological impact

UNIT-4: Surgical and Therapeutic: Defibrillator: Need and DC defibrillators, Lithotriptors: First and Modern Lithotriptor, Anaesthesia: Anesthesia machine, Ventilators: Mechanics of respiration, artificial ventilation, ventilators, types of ventilators

Drug Delivery systems: Infusion pumps and components, Implantable infusion systems,

07Hours

SLE: ESU

Unit-5: Clinical Lab Equipment: Equipments: Spectrophotometery, Spectrophotometer, Colorimerter, Blood gas analyzers – Acid-base balance, Ph, PCO2 pO2 measurement (Intra-arterial blood gas monitoring), Types of blood cell, Method of blood cell counting.

06 Hours

SLE: Automated biochemical analysis system

Unit-6 Telemedicine and patient safety: Shock hazard, leakage current, safety code for medical devices, safety analyzers, Radiation safety, Regulations of medical device, Telemedicine.

06 Hours

SLE: Testing of biomedical equipment.

Text Book:

1. R S Khandpur, ***" Handbook of Biomedical instrumentation",*** 2nd Edn., TMH,

Reference Books:

1. Nandini K Jog, ***"Electronics in medicine and biomedical Instrumentation",*** PHI, New Delhi, 2013
2. AnandNatarajan, ***"Biomedical instrumentation and measurement",*** 2nd Edn. PHI New Delhi,
3. Raja Rao and Guha, ***"Principles of medical electronics and biomedical instrumentation"***, Universities press, Hydeabad, 2013
4. Mandeep Singh, ***"Introduction to bio-medical instrumentation"***, 2nd Edn, PHI New Delhi, 2014
5. Shakti Chatterjee , ***"Biomedical Instrumentation system",*** Delmer Cengage, 2010

Electric vehicles and Battery Management systems (3-0-0)

Sub Code: EEXXX **CIE: 50%Marks**
Hrs/week: 3 **SEE: 50%Marks**
SEE Hrs: 3 **Max marks :100**

Course Outcomes

On successful completion of the course, students will be able to:

1. Efficiency comparison, Development of Vehicle model, Various characteristic parameters of vehicle load.
2. Fuel economy of drives and Architecture of hybrid electric drive train
3. Configuration and performance of Electric vehicles
4. Describe the basic functions, topology and requirements of a battery-management system
5. Analyze the Equivalent-Circuit Models of lithium-ion cells and its applications to simulate the response of a battery pack to an input stimulus
6. Discuss theory basis and implementation details of state of charge and state of health estimation algorithms.

UNIT 1: History of hybrid electric and electric vehicles, EV advantage, Efficiency comparison with conventional vehicles, Roadway fundamentals, Laws of motion and vehicle kinetics. Dynamic equations for the vehicle, Force velocity characteristics, maximum gradability, velocity and acceleration, Velocity profile, Energy required.

07 Hours

SLE: EV Market and Infrastructure and propulsion system design basics

UNIT 2: Fuel economy characteristics of internal combustion engine, Basic techniques to improve fuel economy, Braking performance, Hybrid electric vehicles-Concept, Architecture, Series hybrid electric drive train, parallel hybrid electric drive train

07 Hours

SLE: Torque-Coupling and Speed-Coupling Parallel Hybrid Electric Drive Trains

UNIT 3: Configuration of Electric Vehicles, Performance of Electric vehicles-Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance

06 Hours

SLE: Tractive effort in normal driving and Energy consumption

UNIT 4: Overview of Battery and Its Management: Introduction -Application Requirements for Batteries and BMS, Development Background of the Battery, Principles and Classification of the Lithium-Ion Battery. Battery-pack topology, Battery Management System (BMS) - basic functions, topology and development process of the BMS. BMS design requirements.

7 Hours

SLE: Communication via Control Area Network bus

Unit 5: Equivalent-Circuit Models : Introduction, Model construction, Parameters Identification, Open-circuit voltage, SOC dependence, Equivalent series resistance, Diffusion voltages , Rough parameter values, Warburg impedance ,Hysteresis voltages , Enhanced self-correcting (ESC) cell model, OCV-relationship lab tests Dynamic-relationship tests , overall process of Creating the ESC model.

7 Hours

SLE: Laboratory equipment for cell-data collection

Units 6: Battery SOC and SOH Estimation: SOC estimation, classification, Model based SOC estimation, Battery SOC Estimation Based on AEKF Algorithm, SOC Estimation Based on HIF Algorithm, SOH Estimation , Classification of SOH Estimation Methods, Capacity Estimation Based on SOC Estimation , Available Capacity Estimation Method Based on Response Surface.

SLE : Advantages and disadvantages of various SOH estimation methods and their application scope **6 Hours**

Text Books:

1. Iqbal Hussein, ***Electric and Hybrid Vehicles: Design Fundamentals***, CRC Press, 2003
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, ***Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals***, Theory and Design, CRC Press, 2004
3. Rui Xiong "***Battery Management Algorithm for Electric Vehicles",*** Springer Publisher, 2020
4. Gregory L. Plett , ***Battery Management Systems Volume II-Equivalent Circuit Methods ,*** ARTECH house,2016

Reference Books

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

Power System Simulation Lab (0-0-3)

Sub Code : EE0109 **CIE: 25 Marks**
Hrs/Week : 0+0+3 **SET: 25 Marks**

Course Outcomes

On successful completion of the course, the students will be able to:

1. Formulate Y-Bus and Z-Bus and determine bus currents and line currents
2. Determine the transmission line parameters and efficiency
3. Perform the transient stability analysis
4. Perform load flow studies using numerical methods
5. Perform short circuit analysis
6. Solve unit commitment problem

List of experiments:

1. ABCD parameters: Formation for symmetric Π and T- configuration. Verification of AD-BC=1, determination of efficiency and regulation.
2. Obtaining power angle characteristics for salient and non-salient pole synchronous machines and determination of reluctance power and voltage regulation.
3. Y-Bus formation and determination of bus currents, bus power and line flow for a system with a given bus voltage Profile.
   a) Y Bus formation by inspection method.
   b) Y-Bus formation by singular transformation method
   c) Determination of bus currents, bus power and line flows for a given system.
4. Formation of Z Bus (without mutual coupling) using Z-Bus Building Algorithm.
5. To obtain swing curve and critical clearing time for a single machine connected to infinite bus.
6. Formation of Jacobian for a system not exceeding 4 buses (with no PV buses) in polar coordinates.
7. Program to perform load flow using Gauss- Seidel method (only PQ bus).
8. To determine fault currents and voltages in a single transmission line systems with star-delta transformers at a specified location for SLGF, DLGF.
9. Load flow analysis using Gauss Siedel method, NR method and Fast decoupled load flow method.
10. Optimal Generator Scheduling for Thermal power plants.
11. Determine the transmission losses and efficiency by using hardware simulator.

Relay and High Voltage Lab (0-0-3)

Sub Code : EE0110 **CIE:25 Marks**

Hrs/Week : 0+0+3 **SET:25 Marks**

Course Outcomes

On successful completion of the course, the students will be able to:

1. Demonstrate the performance characteristics of Relays and Fuse
2. Demonstrate the Spark over characteristics of air insulation with uniform and non-uniform field configurations
3. Construct Field mapping for coaxial cable /capacitor/ transmission conductor model by electrolytic tank method
4. Conduct and verify the method of High voltage measurement.

List of experiments:

1. DMT characteristics of over voltage or under voltage relay. (solid state or Electromechanical type)
2. Operation of negative sequence relay.
3. Current-time characteristics of fuse.
4. Operating characteristics of microprocessor based over-current relay.
5. Operating characteristics of microprocessor based over/under voltage relay
6. Operating Characteristics microprocessor based Distance Relay.
7. Operating Characteristics Numerical based Differential Relay.
8. Spark over characteristics of air insulation subjected to high voltage DC with spark over voltage corrected to STP.
9. Measurement of HVAC using standard spheres.
10. Breakdown strength of transformer oil using oil-testing unit.
11. Field mapping using electrolytic tank for co axial cable /capacitor/transmission Line conductors models.
12. Generation and measurement of Lightning Impulse Voltage.

Mini Project (2 credits)

Sub code: EE0204 **CIE: 50 Marks**

Course Outcomes

On successful completion of the course, students will be able to:

1. Identify the topic of relevance within the discipline.

2. Formulate the problem, develop and implement solution methodology.

3. Analyze and interpret the results.

4. Inculcate ethical practices.

5. Document and present reports.

Evaluation

- Students in consultation with the guide identify the topic which will be approved by DPC (Department Program Committee).
- Evaluation shall be based on two presentations by appropriate rubrics.

VIII Semester

Professional Engineering Practice (3-0-0)

Sub Code : EE0335 **CIE: 50% Marks**
Hrs/week : 3+0+0 **SEE: 50% Marks**
SEE Hrs : 3 **Max marks : 100**

Course Outcomes

On successful completion of the course, students will be able to:

1. Explain and Discuss Characteristics of Engineering Profession, Professional responsibility, Reporting and Rules of Practice.
2. Discuss and analyze conflicts of interest, Confidentiality and certification aspects.
3. Discuss about Professional Standards, Practice Guidelines, Professional misconduct and Code of Ethics.
4. Analyze feasibility of projects, Coordinate and control execution of Projects.
5. Describe Concepts of Project Management and apply project management tools and techniques.

UNIT 1: Introduction, Characteristics of a Profession, The Engineering Profession, Licence. Professional Responsibility, The Engineer's Duty to Report. Rules of Practice; Use of the Professional Engineers Seal, Relations with Client or Employer, Due Diligence.

07 Hours

SLE: Professional Engineering Bodies in India

UNIT 2: Report Writing, Giving Options, Communications, Retaining Documents, Confidential Information, Volunteering, Data Gathering at the Beginning of a Project. Conflicts of Interest, Certificate of Authorization

07 Hours

SLE: Software available for report writing.

UNIT 3: Professional Standards, Practice Guidelines. Professional Misconduct, Code of Ethics for the Profession.

06 hours

SLE: Professional code set forth by The Institution of Engineers, India

UNIT 4: Concepts of Project Management: Concepts of a project, Categories of projects, Phases of project life cycle, Tools and techniques for project management.

06 Hours

SLE: Roles and responsibility of project leader

UNIT 5: Project Planning and Estimating: Technical Feasibility, Estimating Financial Feasibility, NPV, IRR, Comparison of alternatives with unequal lives.

07 Hours

SLE: Objectives and goals of a project

UNIT 6: Tools & Techniques of Project Management: Bar (GANTT) chart, bar chart for combined activities, logic diagrams and networks, Project Evaluation and Review Technique (PERT) & Critical Path Method (CPM).

07 Hours

SLE: Role of computers in project management

Text Books:

1. Caroline Whitbeck *"**Ethics in Engineering Practice and Research**"*, Cambridge University Press, 2nd Edition, 2011.

Reference Books & Materials

1. Professional Engineering Practice: Professional Engineers Ontario, 101-40 Sheppard Avenue West Toronto ON M2N 6K9
2. Harold Kerzner, ***"Project Management,* A System approach to planning Scheduling & Controlling",** 10th edition 2012, John Wiley & Sons.

Smart Grid (3-0-0)

Sub Code	**: EE0346**	**CIE**	**: 50%Marks**
Hrs/week	**: 3+0+0**	**SEE**	**: 50%Marks**
SEE Hrs	**: 3**	**Max. Marks**	**: 100**

Course Outcomes

On successful completion of the course, the students will be able to:

1. Identify the need of smart grid and differentiate between smart grid and Intelligrid
2. Implement the knowledge of smart grid to power system.
3. Compare the use of AC and DC sources in Smart grid.
4. Discuss various concepts of Dynamic Energy Systems.
5. Acquire the knowledge of market implementation and demand side planning

Unit 1: Introduction: Introduction to smart grid, electricity network, local energy networks, electric transportation, low carbon central generation, attributes of the smart grid, alternate views of a smart grid.

06 Hours

SLE: Benefits of Smart Grid.

Unit 2: The Intelligrid Architecture For The Smart Grid : Introduction, Launching the IntelliGrid, The IntelliGrid Today- Visualizing the Power System in Real Time, Increasing System Capacity, Relieving Bottlenecks, Enabling a Self-Healing Grid and Enabling (Enhanced) Connectivity to Consumers, A Smart Grid Vision Based on the IntelliGrid Architecture, Barriers to achieving this vision, Communication Architecture- The Foundation of the IntelliGrid, Fast Simulation and Modeling and Open Communication Architecture for Distributed Energy Resources in Advanced Automation, Enabling Technologies- Automation : The Heart of the IntelliGrid, Distributed Energy Resources and Storage, Development & Integration, Power Electronics-Based Controllers, Power Market Tools.

08 Hours

SLE: Technology Innovation in Electricity use and the Consumer Portal.

Unit 3: Smart Grid to Evolve a Perfect Power System: Introduction, overview of the perfect power system configurations, device level power system, building integrated power systems, distributed power systems.

06 Hours

SLE: Fully integrated power system.

Unit 4: DC Distribution and Smart Grid: AC Vs. DC sources, benefits of and drives of dc power delivery systems, powering equipment and appliances with DC, data centers and information technology loads, future neighbourhood.

06 Hours

SLE: Potential future work and research.

Unit 5: The Smart Grid –Enabling Demand Response The Dynamic Energy Systems Concept: Smart energy efficient end use devices, smart distributed energy resources, advanced whole building control systems, integrated communications architecture, energy management, role of technology in demand response, current limitations to dynamic energy management, distributed energy resources, overview of a dynamic energy management, key characteristics of smart devices.

08 Hours

SLE: Key characteristics of advanced whole building control systems

Unit 6: Market Implementation and Demand Side Planning: The Market Planning Framework, Factors Influencing Customer Acceptance and Response- Customer Satisfaction, Direct Customer Contact, Trade Ally Cooperation, Advertising and Promotion, Alternative Pricing and Direct Incentives, Program Planning- Program Management, Program Logistics and The Implementation Process, Monitoring and Evaluation- Monitoring Program Validity and Data and Information Requirements, Management Concerns, Introduction to Demand Side Planning, Issues Critical to the Demand Side, Issues Critical to Demand Side, Demand Side Activities and its Objectives, Utility Planning Process, Demand Response and Energy Efficiency.

06 Hours

SLE: Type of Demand Side Activities.

TEXT BOOKS:

1. Clark W Gellings, **"The Smart Grid, Enabling Energy Efficiency and Demand Side Response",** CRC Press, 2009.

Power System Operation and Control (3-0-0)

Sub Code: EE0304 **CIE : 50%Marks**
Hrs/week : 3+0+0 **SEE : 50%Marks**
SEE Hrs : 3 **Max. Marks : 100**

Course Outcomes

On successful completion of the course, the students will be able to:

1. Describe various basic aspects of electrical power system operation and system control strategies
2. Discuss load frequency control techniques and the methods of voltage and reactive Power control.
3. Describe optimum operation of power system units and Solve power system security analysis problems
4. Explain the recent trends in handling the practical issues with respect to power system operation and control.

UNIT-1: INTRODUCTION : Basic concepts of operation and control of power system, Operational objectives of a power system, Major Threats to System Security, Hierarchy of controls in a power system, Load forecasting, Purpose of load foresting, Classification of load forecasting, Forecasting procedure.

7 hours

SLE: Reliable operation of power system and forecasting accuracy

UNIT-2: AUTOMATIC GENERATION CONTROL: Introduction, basic generator control loops, functions of AGC, speed governors, governor model, generator model, load model, turbine model, complete ALF model, proportional integral controller, Tie-line control with primary speed control.

7 hours

SLE: Load frequency control and issues in AGC implementation

UNIT-3: CONTROL OF VOLTAGE AND REACTIVE POWER CONTROL

Introduction, generation and absorption of reactive power, methods of voltage control, dependence of voltage on reactive power, sensitivity of voltage to changes in P and Q, cost saving, methods of voltage control by reactive power injection, voltage control using transformers.

7 hours

SLE: Flexible AC transmission controllers - SVC, STATCOM and TCSC

UNIT-4: OPTIMAL OPERATION: Introduction, Simple enumeration, Constraints in unit commitment, priority list method, dynamic programming method for unit commitment, DP algorithm, forward DP approach.

6 hours

SLE: Alternative approaches to unit commitment.

UNIT-5: Power System Reliabilty and Security: Introduction, reliability cost, adequacy indices, security levels of system, constrained optimal power flow, contingency analysis, Linear sensitivity factors.

6 hours

SLE: Concentric Relaxation and Bounding.

UNIT-6: SCADA AND WAMS: Introduction, components of SCADA system, standard SCADA configurations, functionality, users of power system SCADA, data for a supervisory power system, transducers for data acquisition, RTUs for power system SCADA, common communication channels for SCADA in power systems, power system operator's requirements, introduction to wide area measurement systems, synchronized phasor measurement system, Functions and opportunities of application of WAMS systems.

7 hours

SLE: Constraints on the design and implementation of SCADA systems and security of power system SCADA.

Text Books:

1. Dr.K.Uma Rao , *"**Power System- Operation and Control"***, Wiley India
2. I J Nagarath and D P Kothari ,*"**Modern Power System Analysis**"*- TMH, 3rd Edition, 2003

Reference Books:

1. Allen J Wood and Woollenberg, *"**Power generation, operation and control**"*, John Wiley and Sons, Second Edition, 2009.
2. S. Sivaganaraju, *"P**ower System Analysis, Operation and Control**"*.

Insulation of High Voltage Equipment (3-0-0)

Sub Code	**: EE0337**	**CIE : 50%Marks**
Hrs/week	**: 3+0+0**	**SEE : 50%Marks**
SEE Hrs	**: 3**	**Max. Marks : 100**

Course Outcomes

On successful completion of the course, the students will be able to:

1. Explain the requirements of Insulation and Methods of Determining the Electric Strength
2. Discuss the Short- and Long-Term Electric Strength of Insulating Materials
3. Describe the methods for Increasing the Working Field Strength of Insulation and design of insulation.

UNIT-1: Insulating Materials and System Design Selection & Test Techniques: Operational Conditions and Requirements on Insulation, Typical Design of Electrophysical Systems Insulation, Testing Electric Strength, Lifetime. **06 Hours**

SLE: Treeing Tests

UNIT-2: Influence of Dielectric Properties, State, and Electrodes on Electric Strength: Pressure, Density, and Mechanical Stresses, Temperature, Molecular and Super molecular Structure, Electrode Material .**Influence of Contamination and Structural Defects:** Solid Particles, Structural Defects and Impurities in Solid Dielectrics, Moisture

08 Hours

SLE: State of the Electrode Surface

UNIT-3: Dependence of Electric Strength on the Parameters of Applied Voltage: Voltage Duration, Shape of a Voltage Pulse, Frequency and Periodicity, **Influence of Insulation Gap Geometry on Electric Strength:** Field Configuration in an Insulation Gap, Interelectrode Gap Length, Electrode Surface Area, Dielectric Volume in an Electric Field

07 Hours

SLE: Voltage Polarity

UNIT-4: Flashover Voltage at the Interface between Two Dielectric Media: Orientation and Dimensions of an Insulator in an Electric Field , Geometry of the Electrodes and the Character of Their Contact with the Insulator , Properties and State of the Insulator Surface and Ambient Medium, Parameters of the Applied Voltage. **Methods for Improving the Dielectric Properties of Electric Insulating Materials and Media:** Mixing and Injection of Additives and Fillers, Conditioning of the Electrodes and Dielectric Medium

07 Hours

SLE: Radiation Modification

UNIT-5 : Methods for Increasing the Working Field Strength of Insulation: Electric Field Control, Combination Insulating Materials. **Calculation of Insulation :** Calculations of

Short-Term Electric Strength (Static and Voltage-Time Characteristics), Statistical Characteristics of the Electric Strength and Coordination of Insulation, Calculation of Insulation Reliability and Operating Lifetime, Choice of the Working Field Strength.

06 Hours

SLE: Electrode Coating

UNIT -6: Electric Strength of Dielectric Materials in a Hostile Environment: Ionizing Radiation, Electron and Ion Beams, Laser and UV Radiation, Magnetic Field, Electric Strength of Insulation and Inter contact Medium in Explosive Commutators, Electric Strength of Gases and Liquids in a Flow. **06 Hours**

SLE: Recovery of Electric Strength after Spark and Arc Discharge

Text Books:

1. V.Y.Ushakov **"Insulation of High-Voltage Equipment", 1ST**edition**,** Springer New York 2004.
2. Ravindra Arora, Wolfgang Mosch **"High Voltage and Electrical Insulation Engineering"**, 1st edition Wiley publications, 2008

HVDC Transmission (3-0-0)

Sub code : EE0313 **CIE : 50% Marks**
Hrs/Week : 3+0+0 **SEE : 50% Marks**
SEE Hrs : 3 **Max. Marks : 100**

Course Outcomes

On successful completion of the course, the students will be able to:

1. Discuss the state-of-art technology in HVDC transmission
2. Analyse HVDC converter performance and describing the techniques of converter control.
3. Discuss the HVDC converter faults and protection schemes
4. Describe concept of Reactive power control and design of harmonic filters.

UNIT 1: DC POWER TRANSMISSION TECHNOLOGY: Introduction, Comparison of AC and DC transmission, Applications of Dc transmission, description of DC transmission system, Types of DC links, planning for HVDC transmission.

06 Hours

SLE: Modern trends in DC transmission.

UNIT 2: ANALYSIS OF HVDC CONVERTERS: Pulse Number, Choice of Converter configuration, Simplified analysis of Gratez circuit without and with overlap, Characteristics of Twelve Pulse Converter.

06 Hours

SLE: Converter Bridge Characteristics

UNIT 3: CONVERTER and HVDC SYSTEMS: Principles of DC link control, Converter control characteristics and its modifications, system control hierarchy, firing angle control, current and extinction angle control, starting and stopping of DC link, Power control,

08 Hours

SLE: Higher level controller.

UNIT 4 : SMOOTHNING REACTOR AND DC LINE: Introduction, smoothing reactor, DC line corona effects , DC line insulators, Transient over voltage in a DC line , Protection of DC line, DC breakers –basic concept of current interruption,

06 Hours

SLE: Monopolar operation

UNIT 5: CONVERTER FAULTS AND PROTECTION: Introduction, Converter Faults, Protection against over currents, over voltages in converter stations, protection against over voltages

06 Hours

SLE: Surge arresters

UNIT 6: REACTIVE POWER CONTROL AND FILTERS: Reactive power requirements in steady state, sources of reactive power, Static Var Systems, Types of filters, Design criteria for DC filters

08 Hours

SLE: Generation of harmonics

Text Book:

1. K R Padiyar, **"HVDC POWER TRANSMISSION SYSTEMS Techno-logy and System Interactions",** 5th edition, New age international limited ,2005

Reference Book:

1. S.Rao **"EHV-AC, HVDC Transmission & Distribution Engineering"** 3rd edition**,** Khanna publishers New Delhi**,** 2008

Finite Element Analysis of Electrical Machines (3-0-0)

Sub Code : EE0338	**CIE : 50% Marks**
Hrs/week : 3+0+0	**SEE : 50% Marks**
SEE Hrs : 3	**Max marks : 100**

Course Outcomes

On successful completion of the course, the students will be able to:

1. Understand the basics of Finite element and nonlinear problems.
2. Model the permanent magnets and analyze the eddy current in a non-linear material.
3. Compute the losses, resistance inductance force and torque using machine model.
4. Analysis of synchronous machine and induction motors in steady state conditions
5. Modeling of induction machine in time domain.

UNIT 1: INTRODUCTION TO FINITE ELEMENT: Introduction, The Galerkin Finite Element Method, Boundary Conditions, Magnetostatic Example. **NON-LINEAR PROBLEMS:** Introduction, Representation of the B-H Curve, The Basic Newton Raphson Method for a Single Equation, Application of the Newton Raphson Method to a First Order Element.

06hours

SLE: Cubic Splines.

UNIT 2: PERMANENT MAGNETS: Introduction, Magnetisation Model of Permanent Magnet, Current Sheet Equivalents, Example With Permanent Magnet, Intrinsic and Normal Hysteresis Characteristics. **EDDY CURRENT ANALYSIS:** Introduction, Eddy current and Skin effect, Finite element example, Elliptical description of Flux Density, Eddy current in Nonlinear material, Nonlinear permeability model, Coupling Finite elements to External circuits, Numerical Example

06hours

SLE: Modelling Consideration.

UNIT 3: COMPUTATION OF LOSSES, RESISTANCE AND INDUCTANCE: Introduction, Computation of Eddy current loss, Losses in a series winding, Inductance and Reactance, Poynting vector, Nonlinear Problem. **CALCULATION OF FORCE AND TORQUE:** Introduction, Amperes force law, The Maxwell stress method, The Virtual work method, Using Machine models to find torque, Error in Force Computation.

08hours

SLE: Convergence of Force.

UNIT 4: SYNCHRONOUS MACHINES IN THE STEADY STATE: Introduction, The basic configuration of a synchronous machine, steady state operation –excitation calculation, Modeling Consideration, Excitation calculation, Computation of Steady State Reactance, Direct Axis Transient Reactance , Direct Axis Subtransient Reactance, Frequency Response Curves, Time Constant.

08hours

SLE: Poynting Vector Method.

UNIT 5: THE INDUCTION MOTOR IN STEADY STATE: Introduction, Obtaining Reactance from the frequency response, Results, Using Frequency Domain Data with time domain solution.

06hours

SLE: Obtaining Steady State Parameters

UNIT 6: TIME DOMAIN MODELING OF INDUCTION MACHINES: Introduction, Electromagnetic and Mechanical Theory, Galerkin Formulation, Time Discretization, Linerization, Global System of Equation, Example **AIR GAP ELEMENTS FOR ELECTRICAL MACHINES:** Introduction, Description of the Method: Finite element discretization, Application.

06hours

Text Book:

1. Finite Element Analysis of Electrical Machines By Sheppard J. Salon, Springer Science &Business Media, 06-Dec-2012

AI Application to Power Systems (3-0-0)

Sub Code : EE0342	**CIE : 50% Marks**
Hrs/week : 3 Hrs	**SEE : 50% Marks**
SEE Hrs : 3 Hrs	**Max Marks : 100**

Course Outcomes

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

1. Discuss the fundamental concepts of AI techniques.
2. Analyse the different AI framework.
3. Apply AI techniques to solve power system problems.

UNIT 1: Artificial Neural Networks:

Introduction Models of Neuron Network – Architectures – Knowledge representation – Artificial Intelligence and Neural networks–Learning process – Error correction learning – Hebbian learning – Competitive learning – Boltzman learning –Supervised learning – Unsupervised learning – Reinforcement learning.

7 Hours

SLE: Learning Tasks.

UNIT 2: ANN Paradigms:

Multi – layer perceptron using Back propagation Algorithm (BPA) – Self – Organizing Map (SOM)– Radial Basis Function Network – Functional Link Network (FLN).

7 Hours

SLE: Hopfield Network.

UNIT 3: Fuzzy Logic:

Introduction – Fuzzy versus crisp – Fuzzy sets – Membership function – Basic Fuzzy set operations – Properties of Fuzzy sets – Fuzzy Cartesian Product – operations on Fuzzy relations –Fuzzy-logic – Fuzzy Quantifiers–Fuzzy Inference – Fuzzy Rule based system.

7 Hours

SLE: Defuzzification methods

UNIT 4: Genetic Algorithms:

Introduction–Encoding – Fitness Function–Reproduction operators–Genetic Modeling – Genetic operators–Cross over – Single site cross over – Two point cross over.

5 Hours

SLE: convergence of Genetic Algorithm

UNIT 5: Genetic Algorithms:

Multi point cross over – Uniform cross over – Matrix cross over–Cross over Rate –Inversion & Deletion – Mutation operator –Mutation – Mutation Rate–Bit–wise operators.

7 Hours

SLE: Generational cycle

UNIT 6:

Applications of AI Techniques:

Load forecasting – Load flow studies – Economic load dispatch – Load frequency control – Single area system and two area system – Small Signal Stability (Dynamic stability) Reactive power control.

7 Hours

SLE: speed control of DC and AC Motors

Text Books

1. S.Rajasekaran and G.A.V.Pai Neural Networks, Fuzzy Logic & Genetic Algorithms, PHI, New Delhi, 2003.
2. Rober J. Schalkoff, Artificial Neural Networks, Tata McGraw Hill Edition, 2011.

Design of Control Systems (3-0-0)

Sub Code : EE0326 **CIE : 50% Marks**
Hrs/week : 3+0+0 **SEE : 50% Marks**
SEE Hrs : 3 **Max marks : 100**

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

1. Recall the time domain and frequency domain response specifications and the Stability concepts.

2. Design lead, lag and lag-lead compensators in time domain.

3. Design lead, lag and lag-lead compensators in frequency domain.

4. Describe the realization of PID controllers by passive and active elements.

5. Design proportional, integral and derivative controllers in time domain.

6. Discuss various tuning rules of PID controller.

UNIT 1: Review of time response analysis, Performance indices, Approximation of high-order systems by lower-order systems, Time domain and frequency domain specifications, Stability from Rootlocus and Bode plots.

06 Hours

SLE: Relationship between phase margin and damping ratio

UNIT 2: Approaches to design problem, Preliminary considerations of classical design, Design of lead, Lag, Lag-lead compensator using Rootlocus.

07 Hours

SLE: Design of compensators using MATLAB in time domain

UNIT 3: Cascade compensation in frequency domain, Design of Lead, Lag and Lag-Lead compensators using Bode diagrams, Realization of compensators by passive and active elements, Comparison of characteristics of phase lead and lag networks.

07 Hours

SLE: Design of compensators using MATLAB in frequency domain

UNIT 4: Design of P, PI and PD controllers using the Root-locus diagrams, Rate feedback compensator design, Minor loop feedback compensation.

07 Hours

SLE: Design of PID controllers using the Root-locus diagrams

UNIT 5: Design of P, PI, PD and PID controllers using the Bode diagrams

07 Hours

SLE: Design of controllers using MATLAB in frequency domain

UNIT 6: Tuning rules forPID controllers, Ziegler-Nichols rules fortuning PID controllers-First method, second method, Design considerations for robust control.

06 Hours

SLE: Modifications of PID control schemes

Text Books:

1. Katsuhiko Ogata, "**Modern Control Engineering**", 3rd edition, Prentice Hall of India.
2. J. Nagrathand M. Gopal,"**Control Systems Engineering**", 5th edition, New Age International (P) Ltd.
3. A.K.Tripathi & Dinesh Chandra, "**Control System Analysis and Design**", New Age International Publishers.

Reference Book:

1. Richard C. Dorf and Robert H, **"Modern Control Systems**", 8th Bishop, Addison-Wesley.

Philips Elective on Machine Learning

1 Methods of classification and prediction

Exercise: Identify solved and unsolved repetitive problems

2 Intro to ML

Exercise: Cosine distance; Discover bias in embedding

3 Intro to python, numpy and pytorch

Exercise: Algo try-outs using pytorch

4 Getting used to pytorch

Exercise: Algo try-outs using pytorch

5 Learning principles, estimation

Exercise: Estimate travel time / real-estate prices

6 Linear methods - Part 1

Exercise: Work out binary and math with ML

(E.g., XOR)

7 Linear methods - Part 2

Exercise: Work out on a simple logistic regression

8 Non-linear methods

Exercise: A simple example in decision trees

9 Neural Networks

Exercise: A simple logistic regression implementation using NN

10 Introduction to NLP

Exercise: Sentiment analysis

11 Instance based learning, Unsupervised learning

Exercise: KNN on word embeddings

12 Intro to deep learning

Exercise: Explore limitations of YOLO implementations

13 Deployment aspects of ML

Exercise: Part-failure prediction

Major Project (6 credits)

Sub code : EE0602 **CIE:50 Marks**

Hrs/Week: 12 **SEE : 100 Marks**

SEE Hr : 1.5 hrs

Course Outcomes:

On successful completion of the course, students will be able to:

1. Identify the topic of relevance within the discipline and carry out literature survey.
2. Formulate the problem, develop and implement solution methodology.
3. Analyze and interpret the results.
4. Identify and execute economically feasible projects of social relevance.
5. Document and present reports.

Evaluation

- Students in consultation with the guide identify the topic which will be approved by DPC (Department Program Committee).
- Internal evaluation shall be based on two presentations by appropriate rubrics.
- External evaluation for 100 marks at the end of eighth semester by a panel of examiners consisting of internal and external members.