Syllabus for the Academic Year – 2020 - 2021

Department: Electrical & Electronics Engineering

Semester: VIII

Subject Name: POWER SYSTEM OPERATION AND CONTROL

Subject Code: EE8T01 **L-T-P-C: 4-0-0-4**

Course Objectives:

1. To provide students with a solid foundation in formation in power systems operation & control of equipments with SCADA system
2. To understand needs of control of speed governing system & area load frequency control.
3. To understand economic operation of power plants for hydel & thermal plants & unit commitment in substation.
4. To understand the security, analysis, states of power system & contingency analysis.

UNIT	Description	Hours
I	**CONTROL CENTER OPERATION OF POWER SYSTEMS:** Introduction to SCADA, control center, digital computer configuration, automatic generation control, area control error, operation without central computers, expression for tie-line flow and frequency deviation, parallel operation of generators, area lumped dynamic model.	**10**
II	**AUTOMATIC GENERATION AND CONTROL:** Automatic voltage regulator, automatic load frequency control, AVR control loops of generators, performance of AVR, ALFC of single area systems, concept of control area, multi-area systems, POOL operation-two area systems, tie-line bias control.	**10**
III	**CONTROL OF VOLTAGE AND REACTIVE POWER:** Introduction, generation and absorption of reactive power, relation between voltage, power and reactive power at a node, single machine infinite bus systems, methods of voltage control, sub synchronous resonance, voltage stability, voltage collapse.	**10**
IV	**POWER SYSTEM OPTIMIZATION:** Optimal system operation with thermal plants, incremental production cost for steam power plants, analytical form of generating cost of thermal plants, constraints in economic operation, flow chart, transmission loss as a function of plant generation, the B-coefficients, examples. **UNIT COMMITMENT:** Statement of the problem, need and importance of	**12**

	unit commitment, methods-priority lists method, dynamic programming method, constraints, spinning reserve, and examples.	
V	**POWER SYSTEM SECURITY:** Introduction, factors affecting power system security, power system contingency analysis, detection of network problems, network sensitivity methods, calculation of network sensitivity factor and contingency ranking.	**10**

Course Outcomes:

After completion of course, student will be able to

1. Knowledge about SCADA and parallel operation of algorithms load sharing.
2. Able to understand needs of control of speed governing system & area load frequency control.
3. Understand economic operation of power plants for hydel & thermal plants & unit commitment in substation.
4. Understand the security, analysis, states of power system & contingency analysis.

Text Books:

1. Computer Aided Power System Analysis, G.L. Kusic, Prentice Hall India
2. Modern Power System Analysis, I J Nagarath and D P Kothari, TMH, 1993

Reference Books:

1. Power generation, operation and control, John Wiley and Sons, Wood & B A J F Woollenberg, 1984
2. Electric Power Systems, B. M. Weedy

Syllabus for the Academic Year – 2020 - 2021

Department: Electrical & Electronics Engineering

Semester: VIII

Subject Name: INDUSTRIAL MANAGEMENT, ELECTRICAL ESTIMATION & ECONOMICS

Subject Code: EE8T02 **L-T-P-C: 3-0-1-4**

Course Objectives:

1. Management, Evolution, Functions and Organization
2. Various behavioral approaches
3. Personnel and Production management
4. Tariffs and interior wiring system

UNIT	Description	Hours
I	INTRODUCTION: Historical prospective, contribution of Taylor, Henry Fayol, Gilberth and H L Gantt to the evolution of management as a scientific discipline, concept of scientific management and it relevance in the Indian Context. MANAGEMENT FUNCTIONS: Planning, organizing, staffing, directing, controlling. ORGANIZATION: Types of organization; their merits and demerits	10
II	MANAGEMENT AND BEHAVIORAL APPROACH: Contribution of Elton mayo and skinner and others to behavioral science. Skills of a manager at various levels in an organization and inter related systems, understanding past behavior, predicting future behavior, directing, changing and controlling behavior; Maslow's hierarchy of needs and satisfaction, goal oriented behavior, integration of organizational goals and needs of employees, Hawthorn's studies and its finding, theory X and Y.	10
III	**PERSONNEL MANAGEMENT:** Recruitment and selection, training of personnel employer and employee relationship, causes and settlement of disputes. **PRODUCTION MANAGEMENT:** Plant location, plant lay-out, CPM and PERT, line balancing, automation, statistical quality control, control chart & motion study.	10

IV	TARIFFS: Aim and objectives of Tariffs, factors governing the Tariffs, components of Tariffs, Choice of electrical power supply, Worked examples. **INTERIOR WIRING SYSTEM:** Wiring system, earthing, and estimation of wiring installation.	10
V	**POWER INSTALLATION:** Load calculation, wire size selection, wiring materials for power circuits, and the estimate for motor installation, pump set, workshop, theater etc., depreciation and valuation of machinery, inventory, economic order quantity, break-even analysis	12

Course Outcomes:

After completion of course, student will be able to

1. Define management, evolution, functions and types of organizations
2. Discuss the various behavioral approaches
3. Identifies different HR aspects and tools for decision making purpose
4. Describe various types of tariff and apply the knowledge of electrical wiring system

Text Book:

Introduction to Management (1993),S. S. Chatterjee, The World Press, 1993

Reference Books:

1. Engineering Economics and Management, N. Narasimhaswamy, Dynaram Publications
2. Electrical Estimation and Electrical Wiring Systems, Raghavendra Rao., Sapna Book House
3. Industrial Organization and Engineering Economics, T. R. Banga & S. C. Sharma

   Khanna Publishers, 2003
4. Industrial Management, Electrical Estimation & Economics, Prof. P.M. Chandrashekaraiah, Rajeshwari Publications

Syllabus for the Academic Year – 2020 - 2021

Department: Electrical & Electronics Engineering

Semester: VIII

Subject Name: ADVANCED POWER SYSTEM PROTECTION

Subject Code: EE8T03 **L-T-P-C: 4-0-0-4**

Course Objectives:

1. To understand concepts of different types of comparators.
2. To explicate the function of various types of static relays.
3. To express the concept of static distance protection and pilot relaying schemes.
4. To elucidate the concepts of microprocessor based protective relays and digital relaying

UNIT	Description	Hours
I	**STATIC RELAYS:** Introduction, Basic construction, Classification, Basic Circuits, Smoothing Circuits, Voltage regulation, square wave Generator, Time delay Circuits, Level Detectors, Summation device, Sampling Circuits, Zero crossing detector, output devices.	**10**
II	**COMPARATORS:** Replica impedance, Mixing Transformers, General equation of phase and Amplitude, Comparators, Realization of ohm, mho, Impedance and offset impedance characteristics, Duality principle, Static amplifier comparator – Rectifier bridge circulations current type, sampling comparator, static phase comparator coincidence circuits type Rectifier phase comparator, Block split comparator, Zener diode phase comparator,	**12**
III	**PRINCIPLES OF DIGITAL/ NUMERICAL RELAYS:** Definition of Numerical Protection System, Advantages of Numerical relays, Block diagram of Numerical Relays, Processing Unit, non machines Interface, communication in protective relays, Information handling with sub station monitoring system.	**10**
IV	**STATIC OVER CURRENT, TIMER AND VOLTAGE RELAYS:** Instantanense over current Relay, Definite time lag relay, inverse time over current relay, static timer relay, Basic relay circuits, monostable delay circuits Single phase Instantaneous over voltage and under voltage relays, instantaneous over voltage relay using Op-amp.	**08**
V	**DISTANCE RELAY:** general Principle of operation, Zone discrimination, Fault area on impedance diagram, Basic measuring elements, Different characteristics used in distance relaying- Impedance, Reactance, Admittance. Ohm, Distance relay settings, Distance measurement Problems. **DIGITAL RELAYS:** Block Schematic approach of microprocessor based	**12**

	relays, over current relay Protection, Transformer differential protection, Directional relay scheme, Impedance relay scheme.	

Course Outcomes:

After completion of course, student will be able to

1. Understand concepts of different types of comparators.
2. Explicate the function of various types of static relays.
3. Express the concept of static distance protection and pilot relaying schemes.
4. Elucidate the concepts of microprocessor based protective relays and digital relaying

Text Books:

1. Power System Protection, Static Relays with Microprocessor applications, T.S. Madhava Rao, TMH, Second editon, 2004
2. Protective Relays and Protection, Van Warrington A. R. and Van C, Vol, I & II Chapman and Hall, 1968

Reference Books:

1. Power System Protection, Patra. S.P. Basu. S.K. Choudhari.S., Oxford, and IBH Publications Co., 1983.
2. Power System Protection and switchgear, Ravindranath. B and Chanda M. New age International

Syllabus for the Academic Year – 2020 - 2021

Department: Electrical & Electronics Engineering

Semester: VIII

Subject Name: ELECTRICAL DISTRIBUTION SYSTEM

Subject Code: EE8PE312 **L-T-P-C: 3-0-0-3**

Course Objectives:

1. To understand the distribution system planning and automation
2. To explain the design considerations of sub transmission lines
3. To explain the design considerations of primary and secondary systems
4. To apply various protective devices and its coordination techniques to distribution system

UNIT	Description	Hours
I	**INTRODUCTION TO POWER SYSTEM PLANNING AND AUTOMATION:** Factors affecting system planning, present planning techniques, planning models, future trends in planning, systems approach, distribution automation	**08**
II	**LOAD CHARACTERISTIC:** Basic definition, relation between load and load factor, load growth.	**08**
III	**SYSTEM PLANNING:** Planning process, planning criteria, system developers, dispersed generation, distribution systems, economics and finance, mapping.	**08**
IV	**DESIGN AND OPERATION:** Engineering design, operation criteria, substation and feeder, voltage control, harmonics, load variations, system losses, energy management.	**08**
V	**DISTRIBUTION AUTOMATION:** Definitions, communication, sensors, SCADA. **OPTIMIZATION:** Introduction, costing of schemes, typical network configurations, planning terms, network cost modeling, synthesis of optimum line network.	**08**

Course Outcomes:

After completion of course, student will be able to

1. Understand the distribution system planning and automation
2. Explain the design considerations of sub transmission lines
3. Explain the design considerations of primary and secondary systems
4. Apply various protective devices and its coordination techniques to distribution system

Text Book:

Electric power distribution system engineering, Turan Gonen, Mc GrawHill, 1986

Reference Books:

1. Electric power distribution**,** A S. Pabla, TMH, 5th edition, 2004
2. Electrical Distribution Systems, Dale R. Patrick, Stephen W. Fardo

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(A constituent College of Siddhartha Academy of Higher Education, Tumakuru)

Syllabus for the Academic Year – 2020 - 2021

Department: Electrical & Electronics Engineering

Semester: VIII

Subject Name: HVDC POWER TRANSMISSION

Subject Code: EE8PE313 **L-T-P-C: 3-0-0-3**

Course Objectives:

1. To demonstrate complete knowledge of HVDC technology.
2. To understand various Power Electronics devices.
3. To understand and analyze converters, associated controllers, harmonics and filters of HVDC systems.
4. To apply the knowledge to design and develop HVDC systems and associated controls.

UNIT	Description	Hours
I	**General Aspects of DC Transmission and Comparison of it with AC Transmission**: Historical sketch, Types of DC links, Comparison of AC and DC transmission, Applications of DC links, Comparison of AC and DC transmission, Description of DC transmission systems.	**08**
II	**Converter Circuits**: Valve characteristics, properties of converter circuits, Assumptions, single phase and three phase converters.	**08**
III	**Analysis of The Bridge Converter**: Analysis with Grid control without overlap, Analysis with Grid control and overlap less than 60^0. Complete characteristics of rectifier & inversion.	**08**
IV	**Control Strategies**: Basic means of control, power reversal, limitations of manual control, constant voltage versus constant current control, desired features of control, constant current control, stability of control, Tap change control, power control and current limits & MTDC systems.	**08**
V	**Protection:** General, DC reactors, prevention of consequent commutation failures, converter faults, DC circuit breakers, clearing line faults and re-energizing the line. HARMONICS AND FILTER: Characteristics and uncharacteristic harmonic, telephone interference, troubles caused by harmonics, means of reducing harmonics and harmonic filters.	**08**

Course Outcomes:

Department of Electrical & Electronics Engineering.

After completion of course, student will be able to

1. Demonstrate complete knowledge of HVDC technology.
2. Able to understand various Power Electronics devices.
3. Understand and analyze converters, associated controllers, harmonics and filters of HVDC systems.
4. Apply the knowledge to design and develop HVDC systems and associated controls.

Text Book:

Power System Stability and Control, Prabha Kundur, TMH, 9th reprint, 2007.

Reference Books:

1. HVDC Power Transmission Systems, K.R. Padiyar, Technology and system interactions, Wiley Eastern Limited, 1992.
2. Direct Current Transmission, E.W. Kimbark, Wiley Futerscience, 1971

Syllabus for the Academic Year – 2020 - 2021

Department: Electrical & Electronics Engineering

Semester: VIII

Subject Name: ENERGY AUDITING & DEMAND SIDE MANAGEMENT

Subject Code: EE8PE314 **L-T-P-C: 3-0-0-3**

Course Objectives :

1. Basic knowledge of energy situation in the world.
2. Understand the need of energy auditing and its type.
3. Study the need of system optimization and power factor.
4. Understand and design demand side management models.

UNIT	Description	Hours
I	**INTRODUCTION**: Energy situation – world and India, energy consumption, conservation, Codes, standards and Legislation. **ENERGY ECONOMIC ANALYSIS:** The time value of money concept, developing cash flow models, payback analysis, depreciation, taxes and tax credit – numerical problems.	**08**
II	**ENERGY AUDITING:** Introduction, Elements of energy audits, energy use profiles, measurements in energy audits, presentation of energy audit results. **ELECTRICAL SYSTEM OPTIMIZATION:** The power triangle, motor horsepower, power flow concept.	**08**
III	**ELECTRICAL EQUIPMENT AND POWER FACTOR** –correction & location of capacitors, energy efficient motors, lighting basics, electrical tariff, Concept of ABT.	**08**
IV	**DEMAND SIDE MANAGEMENT:** Introduction to DSM, concept of DSM, benefits of DSM, different techniques of DSM – time of day pricing, multi-utility power exchange model, time of day models for planning,	**08**
V	Load management, load priority technique, peak clipping, peak shifting, valley filling, strategic conservation, energy efficient equipment. Management and Organization of Energy Conservation awareness Programs.	**08**

Course Outcomes:

After completion of course, student will be able to

1. To get the basic knowledge of energy situation in the world.
2. To understand the need of energy auditing and its type.
3. To study the need of system optimization and power factor.
4. To understand and design demand side management models.

Text Book:

Industrial Energy Management Systems, arry C. White, Philip S. Schmidt, David R. Brown Hemisphere Publishing Corporation, New York.

Reference Books:

1. Recent Advances in Control and Management of Energy Systems, D.P.Sen, K.R.Padiyar, Indrane Sen, M.A.Pai, Interline Publisher, Bangalore.

2. Energy Demand – Analysis, Management and Conservation, Ashok V. Desai, Wiley Eastern.

Syllabus for the Academic Year – 2020 - 2021

Department: Electrical & Electronics Engineering

Semester: VIII

Subject Name: POWER SYSTEM DYNAMICS AND STABILITY

Subject Code: EE8PE411 **L-T-P-C: 3-0-0-3**

Course Objectives :

1. To study the concept of system modeling and dynamics of synchronous generator.
2. To analyze excitation and prime mover controllers.
3. Design of prime mover models.
4. Analyze concept of load modeling. Familiarize with the concept of transient stability analysis.

UNIT	Description	Hours
I	**INTRODUCTION:** Basic concepts, Review of classical methods. **SYSTEM MODELING AND DYNAMICS OF SYNCHRONOUS GENERATOR:** Modeling of synchronous machine, Swing equation, Park's transformation – Park's voltage equation, Park's mechanical equation (torque). Applications – (a) Voltage build up in synchronous machine, and (b) Symmetrical short circuit of generator. Solution for transient analysis, Operational impedance, Relationship between Tdo/ and Tdo//, Algebraic constraints.	**08**
II	**EXCITATION AND PRIME MOVER CONTROLLERS:** Introduction, Types of excitation, AVR with and without ESS, TGR, Amplifier PSS, Static exciters.	**08**
III	**MODELING OF PRIME MOVERS:** Introduction, Three major components, Block diagram, Hydraulic turbine, Steam turbine.	**08**
IV	**LOAD MODELING:** Introduction, Two approaches – Polynomial model and Exponential model. Small Signal Angle Stability: Small signal angle stability with SMIB system, detailed model of SMIB.	**08**
V	**TRANSIENT STABILITY ANALYSIS:** Simulation for Transient stability Evaluation, Transient stability controllers.	**08**

Course Outcomes:

After completion of course, student will be able to

1. To study the concept of system modeling and dynamics of synchronous generator
2. To analyze excitation and prime mover controllers.
3. Design of prime mover models.
4. Analyze concept of load modeling. Familiarize with the concept of transient stability analysis.

Text Book:

Power System Dynamics, Stability and Control, Padiyar K.R, Interline Publications

Reference Books:

1. Dynamics and Control of Large Electric Power Systems, Marija Ilic; John Zaborszky IEEE Press and John Wiley & Sons, Inc

2. Power System Control and Stability Revised Printing, Paul M. Anderson and A. A. Fouad, IEEE Press and John Wiley & Sons, Inc.

Syllabus for the Academic Year – 2020 - 2021

Department: Electrical & Electronics Engineering

Semester: VIII

Subject Name: ELECTRO MAGNETIC COMPATIBILITY

Subject Code: EE8PE412 **L-T-P-C: 3-0-0-3**

Course Objectives:

1. To concept of electromagnetic compatibility and use of network theory.
2. To analyze the inductive and capacitive coupling
3. To knowledge about grounding
4. Understand the concept of Suppressing the noise, Shielding against magnetic and electric fields.

UNIT	Description	Hours
I	**INTRODUCTION:** Designing of electromagnetic compatibility, EMC regulation, typical noise path, use of network theory, method of noise coupling, miscellaneous noise sources, and methods of eliminating interference.	**08**
II	**CABLING:** Capacitive coupling, effect of shield on magnetic coupling, mutual inductance calculations, magnetic coupling between shield and inner conductor, shielding to prevent magnetic radiation, shielding a receptor against magnetic fields, shield transfer impedance, experimental data, example of selective shielding, co-axial cable versus shielded twisted pair braided shields, effect of pig tails, ribbon cable, electrically long cables.	**08**
III	**GROUNDING:** Safety grounds, signal grounds, single point ground systems, hybrid grounds, multipoint ground systems, functional ground layout, practical low frequency grounding, hardware grounds, single ground reference for a circuit amplifier shields, grounding of cable shields, ground loops, low frequency analysis of common mode choke, high frequency analysis of common mode choke, differential amplifiers, shields grounding at high frequencies, guard shields guarded meters.	**08**
IV	**BALANCING AND FILTERING:** Balancing, power supply decoupling, decoupling filters, amplifier decoupling driving capacitive loads, high frequency filtering, system bandwidth, modulation and coding.	**08**
V	**SHIELDING:** Near field and far fields, characteristic and wave impedance's shielding effectiveness, absorption loss, reflection loss, composite adsorption and reflection loss, summary of shielding equation, shielding with magnetic	**08**

	material, experimental data, apertures, wave guide below cutoff, conductive gaskets, conductive windows, conductive coatings, cavity resonance & grounding of shields. **ELECTROSTATIC DISCHARGE:** Static generation, human body model, static discharge, ESD protection in equipment design, software and ESD protection & ESD versus EMC.	

Course Outcomes:

After completion of course, student will be able to

1. Concept of electromagnetic compatibility and use of network theory
2. Analyze the inductive and capacitive coupling
3. Knowledge about grounding
4. Concept of Suppressing the noise

Text Book:

Noise reduction techniques in electronic systems, Henry W. Ott, John Wiley, 2nd edition, 1988

Reference Books:

1. Handbook of Electromagnetic Compatibility, *Reinaldo Perez,* Science Direct Publications, ISBN: 978-0-12-550710-3
2. Applied Electromagnetics and Electromagnetic Compatibility, Dipak L. Sengupta, Valdis V. Liepa, Wiley India Pvt Ltd.

Syllabus for the Academic Year – 2020 - 2021

Department: Electrical & Electronics Engineering

Semester: VIII

Subject Name: ELECTRICAL POWER QUALITY

Subject Code: EE8PE413 **L-T-P-C: 3-0-0-3**

Course Objectives :

1. To understand the basic power quality issues in power systems.
2. To analyze the voltage sag and interruption in power system apparatus.
3. To analyze the transient over voltage in power systems.
4. To able to study the harmonics in power systems. To study the power quality monitoring.

UNIT	Description	Hours
I	**INTRODUCTION:** Power Quality-Voltage Quality, Power Quality Evaluation Procedures Term And Definitions general classes of power quality problems, Transients, long duration voltage variation, short duration voltage variations, voltage imbalance, waveform distortion & power quality terms.	**08**
II	**VOLTAGE SAGS AND INTERRUPTIONS:** Sources of sags and interruptions, estimating voltage sag performance, fundamental principles of protection & monitoring sags.	**08**
III	**TRANSIENTS OVER VOLTAGES:** Sources of transient over voltages, principles of over voltages protection, utility capacitor switching transients, Fundamentals of harmonics: Harmonic distortion, voltage versus transients, harmonic indexes, harmonic sources from commercial loads, harmonic sources from Industrial loads, effects of harmonic distortion & intraharmonics	**08**
IV	**APPLIED HARMONICS:** Harmonic distortion evaluations, principles for controlling harmonics, harmonic studies, devices for controlling harmonic distortion, harmonic filters, standards of harmonics **POWER QUALITY BENCHMARK:** introduction, benchmark process, power quality contract, power quality state estimation, including power quality in distribution planning, Interface to utility system, power quality issues & interconnection standards	**08**
V	**POWER QUALITY MONITORING:** Monitoring considerations, power quality measurement equipments, assessment of power quality measurement data, application of intelligent systems & power quality monitoring standards.	**08**

Course Outcomes:

After completion of course, student will be able to

1. Able to understand the basic power quality issues in power systems.
2. Analyze the voltage sag and interruption in power system apparatus.
3. Analyze the transient over voltage in power systems.
4. Able to study the harmonics in power systems. To study the power quality monitoring.

Text Book:

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

Reference Books:

1. **Electric Power Quality,** G.T.Heydt, stars in a circle publications, 1991.
2. **Modern Power Electronics,** M.H.Rashid, TATA McGraw Hill, 2002.

Syllabus for the Academic Year – 2020 - 2021

Department: Electrical & Electronics Engineering

Semester: VIII

Subject Name: COMPUTER CONTROL OF ELECTRIC DRIVES

Subject Code: EE8PE414 **L-T-P-C: 3-0-0-3**

Course Objectives:

1. To study the basics of Microcontrollers used in drives.
2. To study the basics and classification of AC machine drives
3. To study the basics and classification of Synchronous machine drives
4. To design phase controlled converters. To study the Vector control methods in AC drives.

UNIT	Description	Hours
I	**REVIEW OF MICRO CONTROLLERS IN INDUSTRIAL DRIVES SYSTEM:** Typical Micro controller's 8 bit 16 bit (only block diagram) Digital Data Acquisition system, voltage sensors, current sensors, frequency sensors and speed sensors. **EVOLUTION OF POWER ELECTRONICS IN DRIVES:** Power semiconductors devices used for drives control, GTO, BJT, power MOSFET, IGBT, MCT and IGCT structures, Ratings, comparison and their applications. Block diagram of power integrated circuit for D C motor drives.	**08**
II	**A C MACHINE DRIVES:** general classification and National Electrical Manufacturer Association (NEMA) classification, Speed control of Induction motors with variable voltage constant frequency, constant voltage variable frequency, (v/f) constant operation, drive operating regions. Variable stator current operation. Effect of Harmonics.	**08**
III	**SYNCHRONOUS MACHINE DRIVES:** Wound field machine, comparison of Induction and wound field synchronous machines, Torque angle characteristics of salient pole synchronous machines, synchronous reluctance permanent magnet synchronous machines (SPM) & variable reluctance machines (VRM).	**08**
IV	**PHASE CONTROLLED CONVERTERS:** Converter controls, Linear firing angle control, cosine wave crossing control, phase locked Oscillator principle, Electrro magnetic Interference (EMI) and line power quality problems, cyclo converters, voltage fed converters, Rectifiers & Current fed converters. **PRINCIPALS OF SLIP POWER RECOVERY SCHEMES**: Static Kramer's drive system, block schematic diagram, phasor diagram and limitations, Static Scherbins scheme system using D.C link converters with	**08**

	cyclo converter modes of operation, modified Scherbins Drive for variable source & constant frequency (VSCF) generation	
V	**PRINCIPLE OF VECTOR CONTROL OF A C DRIVES:** Phasor diagram, digital Implementation block diagram, Flux vector estimation, indirect vector control block diagram with open loop flux control & synchronous motor control with compensation. **EXPERT SYSTEM APPLICATION TO DRIVES (ONLY BLOCK DIAGRAM):** Expert system shell, Design methodology, ES based P-I tuning of vector controlled drives system, Fuzzy logic control for speed controller in vector control drives & structure of fuzzy control in feedback system.	**08**

Course Outcomes:

After completion of course, student will be able to

1. To study the basics of Microcontrollers used in drives.
2. To study the basics and classification of AC machine drives
3. To study the basics and classification of Synchronous machine drives
4. To design phase controlled converters. To study the Vector control methods in AC drives.

Text Book:

Power Electronics & Motor Drives, Bimal Bose, Elsevier, 2006.

Reference Books:

1. Advanced Microprocessor and Interfacing, Badri Ram, TMH
2. Control of Electrical Drives Hardcover, Werner Leonhard, Springer Publications, 2001