## SCHEME OF INSTRUCTION AND EXAMINATIONS FOR M.E. COURSE (WEF 2016-17)

### UNDER CBCS

#### M.E. / M.TECH FIRST YEAR I SEMESTER

<table>
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#### LABS

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**Total** 20 | 3 | 5 | - | 245 | 505 | 750 | 22 |

**Grand Total** 28

#### M.E. / M.TECH FIRST YEAR II SEMESTER

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**Total** 20 | 3 | 5 | - | 245 | 505 | 750 | 22 |

**Grand Total** 28

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### M.E. / M.TECH FIRST YEAR III SEMESTER

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### M.E. / M.TECH FIRST YEAR IV SEMESTER

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Grand Total: 30

Total Credits: 69
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Power Systems
EE5020  Advanced Synchronous Machine Theory

Instruction: 3 Periods / Week
Duration of Univ. Examination: 3 Hours
Univ. Examination: 70 Marks
Sessional: 30 Marks

UNIT I
The Synchronous machine - Park’s transformation — Flux linkage equations — Voltage equations — Current formulation of state space equations — Per-unit conversion — Normalizing Voltage and torque equations — Torque and power — Equivalent circuits of synchronous machine — Flux linkage state space model — Treatment of saturation Synchronous machine connected to infinite bus — Current, Voltage and flux linkage models.

UNIT II
Sub-transient and transient reactances and time constants — Simplified models of the synchronous machine — Steady state equations and phasor diagrams — Machine connected to infinite bus with local load at machine terminals - Determining steady state conditions.

UNIT III
Linear models of the synchronous machine - Linearization of the generator state space current, voltage and flux linkage models.

UNIT IV
Linearization of the load equation for the one machine problem -- Simplified linear models — Effect of loading — State space representation of simplified model.

UNIT V
Representation of excitation systems, Different models of excitation systems — IEEE, 1, 2 & 3 systems — Representation of loads.

Suggested Reading:
Distribution System Planning and Automation

Instruction : 3 Periods / Week
Duration of Univ. Examination : 3 Hours
Univ. Examination : 70 Marks
Sessional : 30 Marks

UNIT I
Distribution System Planning: Introduction, Distribution system Planning: Factors effecting planning, present techniques, planning models, planning in the future, future nature of distribution planning, Role of computer in Distribution planning. Load characteristics and Load models – Wye connected loads, Delta connected loads.

UNIT II
Sub Transmission lines & Substations: Types of sub-transmission, Distribution substation, bus schemes, substation location, rating of substation, calculation of voltage drops with primary feeders, Derivation of the K constant, Application curves, Interpretation of the Percentage Voltage drop formula.

UNIT III
Primary Feeders: Types of primary feeders, Primary feeder loading, Tie-lines, Distribution feeder exit – rectangular and radial type development, Design of radial primary feeders – Voltage drop calculations by A,B,C,D constants, Uniformly distributed load, Non uniformly distributed load. Distribution Feeder Analysis – the ladder Iterative technique.

UNIT IV
Secondary Feeders: Secondary voltage levels, Present design practice, Secondary Banking, Economic design of secondaries, Total annual cost equation, Voltage drop and Power loss calculations. Distribution system voltage regulation: Quality of services, voltage control, Application of capacitors in Distribution system.

UNIT V
Distribution Automation: Distribution Automation, project planning, Definitions, communication, sensors, Supervisory Control and Data Acquisition Systems (SCADA), Consumer Information Service(CIS), Geographical Information System (GIS), Automatic Meter Reading (AMR), Automation system.

Suggested Reading:
UNIT I
Steady state stability: Basic concept of stability-Types of stability- Stability criteria for single and multi-machine systems - Concept of voltage stability - Characteristics of network, generator and load, for voltage stability.

UNIT II
Transient stability: The swing equation for single and multi-machine system - Basic assumptions - Different methods of solution of swing equation - Solution by indirect methods - Runge- gutta method Swing curve - Determination of critical time and critical angle.

UNIT III
Hydraulic power and governor models - IEEE standard models - Models for steam turbine. Improvement of Transient stability- potential energy function for SVC, SSSC & UPFC.

UNIT IV
Low frequency oscillation and supply controls: Transfer function of low frequency oscillation studies - Improving system damping with supplementary excitation - Design of supplementary excitation system - State equation for single machine system - Improving system model with governor control.

UNIT V

Suggested Reading:
Advanced Computer Methods in Power Systems

Instruction: 3 Periods / Week
Duration of Univ. Examination: 3 Hours
Univ. Examination: 70 Marks
Sessional: 30 Marks

UNIT I

UNIT II
Matrix representation of power systems, Triangularization, Gaussian elimination method, LU, LOU factorization, Table of factors, optimal ordering. Algorithm for formation of ZBus matrix. Concept of branch and link addition - modification of bus impedance matrix for changes in the network, Z bus - sparse vector method.

UNIT III

UNIT IV

UNIT V
Basic assumption in short circuit studies - System representation - General equations for short circuit study in phase variables and Symmetrical components for fault current and node voltage - Short circuit calculations for balanced three phase network using ZBUS - Fault impedance and admittance matrices - Analysis of 3 phase, line to ground and double line to ground faults - Flow chart for short circuit study.

Suggested Reading:
UNIT I
**Static relays** - Comparators and static relay characteristics: Relays as comparators – Amplitude and Phase comparison schemes – General equation for comparators for different types of relays – Static comparators – Coincidence circuits – Phase splitting methods–Hall effect comparators – Operating principles – Use of level detectors – Time delay circuits – Filters – Thyristors – Triggering circuits and DC power supplies.

UNIT II
**Static relay hardware: Operating principles:** Static time current relays directional units based on phase and amplitude comparison– Differential relays – Distance relays – Quadrilateral relay – Elliptical relay – Relay response – Principle of R-X diagram – Convention for superposing relay and system characteristics – Power swings, Loss of synchronism and its effect on distance relays.

UNIT III
**Generator, motor and transformer protection:** Generator protection against short circuits using differential relays against inter-phase fault – Combined split-phase and overall differential relays – Protection against stator open circuits – Rotor and Stator overheating, Loss of excitation protection and field & ground fault protection. Digital protection scheme based upon second harmonic current induced in the rotor field circuit.

UNIT IV

UNIT V

**Suggested Reading:**
Real Time Applications in Power Systems

Instruction : 3 Periods / Week
Duration of Univ. Examination : 3 Hours
Univ. Examination : 70 Marks
Sessional : 30 Marks

UNIT I
Power Flow Studies: Introduction, power flow problem, formulation of power flow equation, computational aspects of power flow problem, Gauss-Seidel iterative technique, Gauss elimination (Triangular factorization) method, Power flow solution using Zbus matrix, power flow solution by Newton-Raphson method, decoupled load flow, fast decoupled load flow, power flow control by regulating the operating conditions.

UNIT II
Contingency Analysis Techniques: Security in a power system, approximations in contingency analysis, simulation of addition and removal of multiple lines in a power system, simulation of tie lines in interconnected power systems, network reduction for contingency analysis, contingency analysis, approximate power flow method for simulating contingencies.

UNIT III
State Estimation Techniques: Data acquisition, role of a state estimator, rationale of state estimation, method of least squares for state estimation, estimation of power system state variables by the weighted least square estimation (WLSE) technique, statistical errors and bad data recognition, power system state estimator in noisy environment, composition of the Jacobian matrix H and the measurement vector Z.

UNIT IV

UNIT V

Suggested Reading:
1. T.K.Nagsarkar, M.S.Sukhija, Power system analysis, Oxford publications
**High Voltage D.C. Transmission**

**Instruction** : 3 Periods / Week  
**Duration of Univ. Examination** : 3 Hours  
**Univ. Examination** : 70 Marks  
**Sessional** : 30 Marks

**UNIT I**  

**UNIT II**  
Harmonic elimination - Design of ac. Filters- D.C. side filters - Alternative methods of harmonic elimination - Control of H.V.D.C. converters and systems - Individual phase control - Equidistant firing control - D.C. system control - Characteristics and direction of D.C power flow.

**UNIT III**  
Fault development and protection - Converter disturbances -A.C system faults -Over current protection - Transient over-voltages - Harmonic over voltages excited by A.C disturbances - Fast transients generated on the D.C system - Surges generated on the a system insulation co-ordination. DC Circuit breakers.

**UNIT IV**  
AC – DC system interactions: System models, Torsional, harmonic interactions with HVDC systems. Reactive power control: Requirements in steady state, Sources of reactive power and control during transients.

**UNIT V**  
Study of MTDC systems, Multi-infeed DC systems, Types of MTDC systems, Existing a.c.transmission facilities converted for use with d.c. - Generator rectifier units- Forced commutation - Compact converter stations - Microprocessor based digital control.

**Suggested Reading:**  
UNIT I

UNIT II

UNIT III
Wind energy- Principles of wind energy conversion systems - Nature of wind - Power in the Wind-Basic components of WECS -Classification of WECS -Site selection considerations - Advantages and disadvantages of WECS -Wind energy collectors -Wind electric generating and control systems - Applications of Wind energy -Environmental aspects.

UNIT IV

UNIT V
Energy from Biomass - Biomass conversion technologies / processes - Photosynthesis - Photosynthetic efficiency - Biogas generation - Selection of site for Biogas plant - Classification of Biogas plants - Details of commonly used Biogas plants in India - Advantages and disadvantages of Biogas generation -Thermal gasification of biomass - Biomass gasifies.

Suggested Reading:
Reliability Modeling in Power Systems

Instruction : 3 Periods / Week
Duration of Univ. Examination : 3 Hours
Univ. Examination : 70 Marks
Sessional : 30 Marks

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V

Suggest Reading:
3. E.Balaguruswamy, Reliability Engineering.
EE 5170

Energy Management

Instruction : 3 Periods / Week
Duration of Univ. Examination : 3 Hours
Univ. Examination : 70 Marks
Sessional : 30 Marks

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V

Suggested Reading:
1. KV Sharma,P.Venkataseshaiah: Energy management and conservation IK International publishing house Pvt. Ltd.
2. Guide book for national certification examination for energy managers and energy auditors, Books1,2,3 &4-Bureau of Energy Efficiency, Ministry of power, Govt. of India
UNIT I
**Fundamentals of Genetic Algorithms:** Introduction to GAs, Encoding, Fitness Function, Premature Convergence, Basic Operators, Selection, Tournament Selection, Truncation Selection, Linear Ranking Selection, Exponential Ranking Selection, Elitist Selection, Proportional Selection, Crossover, Mutation

UNIT II
**Fundamentals of Particle Swarm Optimization Techniques:** Introduction, Basic Particle Swarm Optimization, Background of Particle Swarm Optimization, Original PSO, Variations of Particle Swarm Optimization, Discrete PSO, PSO for MINLPs, Constriction Factor Approach (CFA), Hybrid PSO (HPSO), Lbest Model,

UNIT III

UNIT IV

UNIT V

**Suggested Reading:**

2. Soliman, Soliman Abdel-Hady, Mantawy, Abdel-Aal Hassan, “Modern Optimization Techniques with Applications in Electric Power Systems” Springer publications
3. S.N.Sivanandam, S.N.Deepa, “Introduction to Genetic algorithms” Springer publications
High Voltage Engineering

Instruction: 3 Periods/Week
Duration of Univ. Examination: 3 Hours
Univ. Examination: 70 Marks
Sessional: 30 Marks

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V

Suggested Reading:
EE5260 - SMART GRID TECHNOLOGIES

Instruction : 3 Periods/Week
Duration of Univ. Examination : 3 Hours
Univ. Examination : 70 Marks
Sessional : 30 Marks

UNIT I
Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Concept of Resilient & Self Healing Grid, Present development & International policies in Smart Grid, Diverse perspectives from experts and global Smart Grid initiatives.

UNIT II
Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV).

UNIT III
Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit (PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection.

UNIT IV

UNIT V
Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid.

Suggested Reading:


EE5270 - DISTRIBUTED GENERATION AND MICRO-GRIDS

Instruction : 3 Periods/Week
Duration of Univ. Examination : 3 Hours
Univ. Examination : 70 Marks
Sessional : 30 Marks

UNIT I
Need for Distributed generation, renewable sources in distributed generation, current scenario in Distributed Generation, Planning of DGs – Siting and sizing of DGs – optimal placement of DG sources in distribution systems.

UNIT II

UNIT III

UNIT IV

UNIT V

Suggested Reading:
Power Electronics
EE5010  Power Semi-Conductor Devices & Circuits

Instruction : 3 Periods / Week
Duration of Univ. Examination : 3 Hours
Univ. Examination : 70 Marks
Sessional : 30 Marks

UNIT I
Switching characteristics: Power MOSFETs and IGBTs, limitations and Safe Operating Areas (SOAs), —Latching in IGBTs. Thyristors-Converter & Inverter grade, GTO, RCT, MCT.

UNIT II
Switch Mode D.C-D.C Converters: Step-down converter (Buck)—Step-up converter (Boost) — Buck-Boost converter Control of D.C-D.C converters — Cuk converter.

UNIT III
Switch Mode D.C-A.C Inverters: Pulse width modulated switching schemes — sinusoidal PWM and Square wave PWM of Single phase Inverters and Three phase Voltage source Inverters — Effect of Blanking time on output voltage in PWM Inverters.

UNIT IV
Resonant Converters: Classification — Basic resonant circuit concepts, Load resonant! Resonant switch converters — Resonant D.C Link Inverters with Zero-voltage switching — High frequency Link Integral half-Cycle converters.

UNIT V
Power supply Applications: overview of switching power supplies – DC-AC converters with electrical isolation, electrical isolation in the feedback loop, fly-back converters forward converters, push pull converters – full bridge converters, power supply protection, applications

Suggested Reading:

UNIT 1
**General System considerations and FACTS:** Transmission Interconnections, Flow of Power in an AC System, Power Flow and Dynamic Stability Considerations of a Transmission Interconnection, principles of series and shunt compensation, Basic Types of FACTS Controllers, Benefits from FACTS, Application of FACTS.

UNIT II
**Shunt Compensators:** Objectives of Shunt Compensation, Midpoint Voltage Regulation for Line Segmentation, End of Line Voltage Support to Prevent Voltage Instability, improvement of Transient Stability, Power Oscillation Damping, Static Var Compensators, SVC and STATCOM, The Regulation Slope, Transfer Function and dynamic Performance, Transient Stability Enhancement and Power Oscillation Damping

UNIT III
**Series Compensators:** Objectives of Series Compensation, concept of series capacitive compensation, voltage stability, improvement of transient stability, power oscillation damping, GTO thyristor controlled series capacitor, thyristor controlled series capacitor, SSSC.

UNIT IV
**Combined Compensators:** Introduction, unified power flow controller, basic operating principles, independent real and reactive power flow control, control structure, basic control system for P and Q control.

UNIT V
**Mitigation of Harmonics:** Power quality problems, harmonics, harmonic creating loads, harmonic power flow, and mitigation of harmonics, filters, passive filters, active filters, shunt, series and hybrid filters.

**Suggested Reading:**
1. Narain G. Hingorani, Laszlo Gyugyi, Understanding FACTS, IEEE press
Power Electronics Controlled Electric Drives

Instruction : 3 Periods / Week
Duration of Univ. Examination : 3 Hours
Univ. Examination : 70 Marks
Sessional : 30 Marks

UNIT I

UNIT II

UNIT III

UNIT IV
Microprocessors in the Control of Electrical Drives: Applications of microprocessors in variable speed drives (Block Diagram and Flowchart Approach only) – DC motor speed control using microprocessor – Microprocessor based firing scheme for a dual converter – Induction motor speed control – Synchronous motor speed control – Stepper Motor Control.

UNIT V

Suggested Reading:
IE5250 - POWER ELECTRONIC CONVERTERS

Instruction : 3 Periods / Week
Duration of Univ. Examination : 3 Hours
Univ. Examination : 70 Marks
Sessional : 30 Marks

UNIT I
Analysis of power semiconductor switched circuits with R, L, RL, RC loads, d.c.motor load, battery charging circuit.

UNIT II
Single-Phase and Three-Phase AC to DC converters- half controlled configurations operating domains of three phase full converters and semi-converters – Reactive power considerations.

UNIT III
Analysis and design of DC to DC converters- Control of DC-DC converters, Buck converters, Boost converters, Buck-Boost converters, Cuk converters

UNIT IV
Single phase and Three phase inverters, Voltage source and Current source inverters, Voltage control and harmonic minimization in inverters.

UNIT V
AC to AC power conversion using voltage regulators, choppers and cyclo-converters, consideration of harmonics, introduction to Matrix converters.

Suggested Reading:
Machine Modeling and Analysis

Instruction : 3 Periods / Week
Duration of Univ. Examination : 3 Hours
Univ. Examination : 70 Marks
Sessional : 30 Marks

UNIT I

UNIT II

UNIT III
Reference Frame Theory: Equations of transformation - Change of variables, Stationary circuit variables Transformed to the Arbitrary Reference Frame, Commonly used reference frames, Transformation between reference frames, Transformation of a balanced set, Balanced steady state phasor Relationships, Balanced steady state equations, Variables observed from various frames.

UNIT IV

UNIT V

Suggested Reading:
UNIT I

UNIT II
Voltage Sag Analysis: Voltage sag characteristics - Methodology for computation of voltage sag magnitude and occurrence — Accuracy of sag analysis — Duration & frequency of sags — Faults behind transformers — Effect of pre-fault voltage — Simple examples — Voltage dip problems, fast assessment methods for voltage sags in distribution systems.

UNIT III
PQ Consideration in Industrial Power Systems: Adjustable speed drive (ASD) systems and applications — Sources of power system harmonics — Mitigation of harmonics — Characterization of voltage sags experienced by three-phase ASD systems — Types of sags and phase angle jumps — Effects of momentary voltage dips on the operation of induction and synchronous motors.

UNIT IV
Harmonics: Harmonic distortion, Voltage versus current distortion, Harmonics versus Transients, Harmonic Indices, Harmonic sources from commercial loads, Harmonic sources from industrial loads, Locating Harmonic sources, System response characteristics, Effects of Harmonic distortion, Inter harmonics, Devices for controlling harmonic distortion.

UNIT V
Transient Overvoltages – Sources of Transient Overvoltages. Wiring and Grounding: Resources, Definitions, Reasons for Grounding, Typical wiring and grounding problems, Solutions to wiring and grounding problems.

Suggested Reading:
EE5280 - ADVANCED TOPICS IN POWER ELECTRONICS

Instruction : 3 Periods / Week
Duration of Univ. Examination : 3 Hours
Univ. Examination : 70 Marks
Sessional : 30 Marks

UNIT I
Introduction to switches - Advanced Silicon devices - Silicon HV thyristors, MCT, BRT & EST. SiC devices - diodes, thyristors, JFETs & IGBTs. Gallium nitrate devices - Diodes, MoSFETs.

UNIT II
Advance converter topologies for PEE - Interleaved converters, Z-Source converters, Multi level converters (Cascaded H-Bridge, Diode clamped, NPC, Flying capacitor) Multi pulse PWM current source converters, Advanced drive control schemes.

UNIT III
Advances in reactive elements - Advanced magnetic material, technology and design (Powder ferrite, Amorphous, Planar designs) Advance capacitive designs (Multilayer chip capacitors, double layers for storage, Aluminum electrolytic)

UNIT IV
Advance storage systems - Developments in battery systems, Ultra capacitors, Fly wheel energy storage, Hybrid storage systems for EV/HEV, Power management in hybrid systems, Energy storage in renewables.

UNIT V
Thermal engineering with EMI/EMC techniques - Advanced thermal solutions (fan cooled, liquid cooled, heat pipes, hybrid techniques) EMC techniques (Conducted, Radiated emissions & Susceptibility), System design for EMC

Suggested Reading:
2. R D MiddleBrook & Slobodan CUK, 'Advances in Switched Mode Power Conversion', Vol I, II, & III, Tesla Co (optimum power conversion)
UNIT I

UNIT II
Basic concepts and steady state analysis of second and higher order Switched Mode power converters: PWM DC - DC Converters (CCM and DCM) - Operating principles, constituent elements, characteristics, comparisons and selection criteria.

UNIT III
Dynamic modeling and control of second and higher order switched mode power converters: Analysis of converter transfer functions, design of feedback compensators, current programmed, frequency programmed and critical conduction mode control.

UNIT IV

UNIT V
Pulse Width Modulated Rectifiers: Properties of ideal rectifier, realization of near ideal rectifier, control of the current waveform, single phase and three phase converter systems incorporating ideal rectifiers and design examples - Non-linear phenomena in switched mode power converters: Bifurcation and Chaos.

Suggested Reading:
EE5300 - PWM CONVERTERS AND APPLICATIONS

Instruction : 3 Periods / Week
Duration of Univ. Examination : 3 Hours
Univ. Examination : 70 Marks
Sessional : 30 Marks

UNIT I
AC/DC and DC/AC power conversion - Overview of applications of voltage source converters - Pulse modulation techniques for bridge converters.

UNIT II
Bus clamping PWM - Space vector based PWM - Advanced PWM techniques - Practical devices in converter - Calculation of switching and conduction losses.

UNIT III
Compensation for dead time and DC voltage regulation - Dynamic model of a PWM converter - Multilevel converters - Constant V/F induction motor drives.

UNIT IV
Estimation of current ripple and torque ripple in inverter fed drives - Line–side converters with power factor compensation.

UNIT V
Active power filtering - Reactive power compensation - Harmonic current compensation.

Suggested Reading:
UNIT I
Introduction to the C2xx DSP core and code generation - The components of the C2xx DSP core - Mapping external devices to the C2xx core - Peripherals and Peripheral Interface - System configuration registers - Memory - Types of Physical Memory - Memory addressing Modes - Assembly Programming using C2xx DSP - Instruction Set - Software Tools.

UNIT II
Pin Multiplexing (MUX) and General Purpose I/O Overview - Multiplexing and General Purpose I/O Control Registers - Introduction to Interrupts - Interrupt Hierarchy - Interrupt Control Registers - Initializing and Servicing Interrupts in Software.

UNIT III
ADC Overview - Operation of the ADC in the DSP - Overview of the Event manager (EV) - Event Manager Interrupts - General Purpose (GP) Timers - Compare Units - Capture Units And Quadrature Enclosed Pulse (QEP) Circuitry - General Event Manager Information.

UNIT IV
Introduction to Field Programmable Gate Arrays – CPLD Vs FPGA – Types of FPGA - Xilinx XC3000 series - Configurable logic Blocks (CLB) - Input/Output Block (IOB) – Programmable Interconnect Point (PIP) – Xilinx 4000 series – HDL programming –overview of Spartan 3E and Virtex II pro FPGA boards-case study.

UNIT V
Controlled Rectifier - Switched Mode Power Converters - PWM Inverters - DC motor control - Induction Motor Control.

Suggested Reading:
EE5320 – STATIC CONTROL OF ELECTRIC DRIVES

Instruction : 3 Periods / Week
Duration of Univ. Examination : 3 Hours
Univ. Examination : 70 Marks
Sessional : 30 Marks

UNIT I
DC Motor Control: Operation of Single phase and Three phase Full converter and Semi converter fed dc motors, Speed torque characteristics, Performance characteristics, Dual converter drives, Analysis of four quadrant chopper fed dc drive, Dynamic & Regenerative braking, Closed loop control of phase control and chopper dc drive.

UNIT II
Scalar Control: Stator voltage control, Static rotor resistance control, Slip power recovery schemes, Closed loop control, VSI & CSI fed Induction motor drives, Analysis of stepped and PWM waveform, Harmonic equivalent circuit and motor performance.

UNIT III
Vector Control: DC drive analogy, Equivalent circuit and Principle of Vector control, Direct vector control – Flux & Torque processor using Terminal voltages and Induced emf, Indirect vector control – Flow chart and Implementation.

UNIT IV
Principle of Sensor less vector control: Principle of Space vector Pulse width modulation & control, Direct torque and Flux control - Torque expression with Stator and Rotor fluxes - Control strategy of DTC.

UNIT V

Suggested Reading:
EE5330 – MICRO CONTROLLER APPLICATIONS IN POWER CONVERTERS

Instruction: 3 Periods / Week
Duration of Univ. Examination: 3 Hours
Univ. Examination: 70 Marks
Sessional: 30 Marks

UNIT – I

UNIT – II

UNIT – III

UNIT – IV

UNIT – V
Introduction to MPLAB IDE and PICSTART plus – Device Programming using MPLAB and PICSTART plus – Generation of firing / gating pulses for typical power converters.

Suggested Reading:
UNIT–I: SINGLE-PHASE CONTROLLED RECTIFIERS FED DC MOTOR
Separately excited DC motors with rectified single phase supply – single-phase semi converter and single phase full converter for continuous and discontinuous modes of operation – power and power factor.

UNIT–II: THREE-PHASE CONTROLLED RECTIFIERS FED DC MOTOR
Three-phase semi converter and Three phase full converter for continuous and discontinuous modes of operations – power and power factor - Addition of Free wheeling diode – Three phase double converter.

UNIT–III: PHASE, CURRENT & SPEED CONTROLLED DC DRIVE

UNIT–IV: CHOPPER CONTROLLED DC MOTOR DRIVES


UNIT–V: SIMULATION OF DC MOTOR DRIVES
Dynamic simulations of the speed controlled DC motor drives – Speed feedback speed controller – command current generator – current controller.

Suggested Reading:
UNIT-I: INTRODUCTION
Introduction to motor drives – Torque production – Equivalent circuit analysis – Speed – Torque Characteristics with variable voltage operation Variable frequency operation constant v/t operation – Variable stator current operation – Induction motor characteristics in constant torque and field weakening regions.

UNIT-II: STATOR SIDE CONTROL OF INDUCTION DRIVES

UNIT-III: ROTOR SIDE CONTROL OF INDUCTION DRIVES


UNIT-IV: CONTROL OF SYNCHRONOUS MOTOR DRIVES
Synchronous motor and its characteristics – Control strategies – Constant torque angle control – Unity power factor control – Constant mutual flux linkage control.


UNIT-V: VARIABLE RELUCTANCE MOTOR DRIVE
Variable Reluctance motor drive – Torque production in the variable reluctance motor Drive characteristics and control principles – Current control variable reluctance motor service drive.

BRUSHLESS DC MOTOR DRIVES: Three phase full wave Brushless dc motor – Sinusoidal type of Brushless dc motor- current controlled Brushless dc motor Servo drive.
Suggested Reading:

3. Power Electronics and Control of AC Motors – MD Murthy and FG Turn Bull pergman Press (For Chapters II, III, V ) 1st edition
Common to Power Systems and Power Electronics
Advanced Microprocessor Systems

Instruction : 3 Periods / Week
Duration of Univ. Examination : 3 Hours
Univ. Examination : 70 Marks
Sessional : 30 Marks

UNIT I

UNIT II
Architectural details of 80386 Microprocessor - Special registers - Memory management - Operation in protected mode and virtual 80386 mode - Memory paging mechanism - Special instructions of 80386 - Architectural details of 80486 - Special registers - Additional instructions - Comparison of 80386 and 80486 processors.

UNIT III
Introduction to Pentium Processor - Architectural features - Comparison with the workstations - Branch prediction logic - cache structure - Special Pentium Registers. Memory management - virtual mode of operation - Comparison with the previous processors. Features of Pentium-II, Pentium-III and Pentium Pro-processors.

UNIT IV

UNIT V

Suggested Reading
Instruction : 3 Periods / Week
Duration of Univ. Examination : 3 Hours
Univ. Examination : 70 Marks
Sessional : 30 Marks

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V
State Feedback Controllers and Observers(Discrete): Design of state feedback controller through pole placement - Necessary and sufficient conditions - Ackerman’s formula - State Observers - Full order and Reduced order observers - Min/Max principle, Linear Quadratic Regulators - Kalman filters - State estimation through Kalman filters - Introduction to adaptive controls.

Suggested Reading:
2. Digital Control and State Variable Methods by M. Gopal, TMH
4. Digital Control Engineering, M. Gopal
EE5220  Programmable Logic Controllers And Their Applications

Instruction : 3 Periods/Week
Duration of Univ. Examination : 3 Hours
Univ. Examination : 70 Marks
Sessional : 30 Marks

UNIT-I:
PLC Basics PLC system, I/O modules and interfacing CPU processor programming equipment programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

UNIT-II:
PLC Programming input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill-press operation. Digital logic gates programming in the Boolean algebra system, conversion examples Ladder diagrams for process control Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system.

UNIT-III:
PLC Registers: Characteristics of Registers module addressing holding registers input registers, output registers. PLC Functions Timer functions and industrial applications counters counter function industrial applications, Architecture functions, Number comparison functions, number conversion functions.

UNIT-IV:
Data handling functions: SKIP, Master control Relay Jump Move FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two axes and three axis Robots with PLC, Matrix functions.

UNIT-V:
Analog PLC operation: Analog modules and systems Analog signal processing multi bit data processing, analog output application examples, PID principles position indicator with PID control, PID modules, PID tuning, PID functions.

Suggested Reading:
1. Programmable Logic Controllers – Principle and Applications by John W Webb and Ronald A Reiss Fifth edition, PHI
UNIT - I
Introduction and 8051 Architecture: Introduction to microcontrollers, comparing microprocessors and microcontrollers, 4, 8, 16 and 32 bit microcontrollers, Development systems for Microcontrollers, Architecture, Architecture of 8051, pin configuration of 8051 microcontroller, hardware input pins, output pins ports and external memory, counters and timers, serial data input and output and interrupts.

UNIT - II

Unit - III
Arithmetic Operations, Jump and Call Op-codes: Introduction, Flags, Incrementing and Decrementing, Addition, Subtraction, Multiplication and Division, Decimal Arithmetic, Jump and Call op-codes, introduction, The jump and call program range, Jumps, Calls and Subroutines, call and returns, Interrupts and Returns.

Unit - IV

Unit - V

Suggested Reading:
Modern Control Theory

Instruction : 3 Periods / Week
Duration of Univ. Examination : 3 Hours
Univ. Examination : 70 Marks
Sessional : 30 Marks

UNIT I
Review of state variable representation of systems - Controllability and Observability — Model control of single input — single output systems (SISO), Controllable and Observable companion forms — Effect of state feedback on Controllability and Observability, Pole placement by State feed back.

UNIT II

UNIT III

UNIT IV

UNIT V
Introduction to adaptive control, types of adaptive control systems. Design of model reference adaptive control systems using M/T rule and Lyapunov stability theory.

Suggested Reading:
3. Donald E Kirk, optimal control thery An introduction
Instruction : 3 Periods / Week
Internal Marks : 50 Marks

1. Load flow studies
2. Short circuit studies
3. Transient stability studies
4. Simulation of IGBT inverters
5. Distribution load flow studies
6. Simulation of Facts controllers
7. Simulation of thyristor converters
8. Simulation of Resonant converters
9. Load forecasting and unit commitment
10. Simulation of reactive power compensation
11. Simulation of Buck, Buck-Boost converters
12. Simulation of single -area and Two -area Systems
13. Economic Load Dispatch with thermal power plants
14. Simulation of V/F controller for 3-phase induction motor
15. Economic Load Dispatch with Hydro thermal power plants
Instruction : 3 Periods / Week
Internal Marks : 50 Marks

Part-A (Power Systems)

1. Measurement of positive, negative and zero sequence reactances of synchronous machine
2. Measurement of Direct axis and quadrature axis reactances of synchronous machine
3. Fault analysis of Single Line To Ground Fault
4. Fault analysis of Line To Line Fault
5. Fault analysis of Three-phase fault
6. Microcontroller based Over current relay
7. Percentage biased Differential Relay
8. Microcontroller based Over Voltage Relay
9. Microcontroller based Under Voltage Relay
10. Measurement of positive, negative and zero sequence reactances of three-phase transformer

Part-B (Power Electronics)

1. Three phase step down cyclo-converter
2. Three phase controlled rectifier with R and RL loads
3. Three phase half controlled rectifier with R and RL loads
4. Three phase IGBT inverter
5. Single phase dual converter
6. Speed control of dc motor using chopper

Note: At least five experiments should be conducted in each part