R.K.D.F. UNIVERSITY, BHOPAL

Master of Technology

Branch- Electrical Power System

Department Of Electrical Engineering

Semester – I

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EPS	Advanced Mathematics	MTEPS-1001	3L-1T-0P	4

Course Outcomes:

CO 1 **Find** Laplace Transform of periodic functions, Dirac delta function and solve differential equations, integral equations and integro- differential equations and can analyze the solution.

CO 2 **Analyse** solutions of partial differential equations and solve the initial value and boundary value problems. Extremis the functional and also solve Isoperimetric problems.

CO 3 **Understand** Principle of operation and characteristics, biasing arrangements of Field effect transistors and MOSFETs and types of oscillator.

CO 4 **Evaluate** conversion of numbers from one code to other code, logic gates and truth table of digital circuits.

Course Contents:

UNIT – I

Solution of Partial Differential Equation (PDE) by separation of variable method, numerical Solution of PDE (Laplace, Poisson's, Parabola) using finite difference methods, Elementary Properties of FT, DFT, WFT, Wavelet transform, Haar transform.

UNIT – II

Probability, compound probability and discrete random variable. Binomial, Normal, Poisson's distribution. Sampling distribution, elementary concept of estimation and theory of hypothesis, recurred relations.

UNIT – III

Stochastic process, Markov process transition probability transition probability matrix, just and higher order Markov process, Markov chain. Queuing system, transient and steady state, traffic intensity, distribution queuing system, concepts of queuing models (M/M/1: Infinity/ Infinity/ FC FS), (M/M/1: N/ Infinity/ FC FS), (M/M/S: Infinity/ Infinity/ FC FS).

UNIT – IV

Operations of fuzzy sets, fuzzy arithmetic & relations, fuzzy relation equations, fuzzy logics.MATLAB

introduction, programming in MATLAB scripts, functions and their application.

UNIT – V

Introduction and definition of reliability, derivation of reliability functions, Failure rate, Hazard Rate, mean time t future & their relations, concepts of fault tolerant analysis, Elementary idea About decision theory and goal programming.

Reference Books:

1. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Hill.
2. Advance Engineering Mathematics by Ervin Kreszig, Wiley Easten Edd.
3. Applied Numerical Methods with MATLAB by Steven C chapra, Tata Mc Graw Hill.
4. Introductory Methods of Numerical Analysis by S.S. Shastry,
5. Introduction of Numerical Analysis by Forberg
6. Numerical Solution of Differential Equation by M. K. Jain
7. Numerical Mathematical Analysis By James B. Scarborogh
8. Fourier Transforms by J. N. Sheddon
9. Fuzzy Logic in Engineering by T. J. Ross
10. Fuzzy Sets Theory & its Applications by H. J. Zimmersoms

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Course Content

anch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EPS	Advance power system protection relays	MTEPS-1002	3L-1T-0P	4

Course Outcomes:

CO 1 **Ability** to design and analyze the real time electrical transmission system with respect to various electrical parameters considering environmental and economic obligations.

CO 2 **Develop** the ability to implement the appropriate safety equipments for design of electrical power system with enhancing the efficiency of the transmission and distribution system with environment friendly technology.

CO 3 **Ability** to implement the knowledge of basic mathematical.

CO 4 **Judge** the suitability of installing overhead and underground power transmission strategies considering electrical, mechanical, environmental, performance, safety and economic constraints

Course Contents:

UNIT – I

Protective Relays: Relaying review, characteristics and operating equations of relays. CT's and PT's differential relay, over-current relay, reverse power relay, distance relays, applications of relays.

UNIT – II

STATIC RELAYS: Introduction, advantages and disadvantages, classification logic ckts, smoothing circuits,
voltage regulator square wave generator, time delay ckts level detectors, summation device, sampling circuit,
zero crossing detector, output devices. COMPARATORS: Replica Impedance, mixing transformers, general
equation of phase and amplitude comparator, realization of ohm, impedance and off set impedance characteristics, duality principle, static amplitude comparators, coincidence circuit, Hall effect devices, Magneto receptivity, zener diode phase comparator multi input comparators.

UNIT – III

Generator and transformer protection: Protective devices for system. Protective devices for stator, rotor, and prime mover of generator, percentage differential relays protection, three winding transformer protection, earth fault protection, generator transformer unit protection.

UNIT – IV

Bus bar and transmission line protection: Distance protective schemes, directional wave detection relay. Phase
compensation carrier protection. High impedance differential scheme, supervisory and check relay, Some features of500 KV relaying protection.

UNIT – V

Modern trends in power system protection: Different types of digital and computer aided relays, Microprocessor based relays, auto-reclosing, frequency relays, under and over frequency relays, di/dt relays.
Algorithms for transmission line, transformer & bus bar protection; out-of-step relaying Introduction to adaptive relaying & wide area measurements.

Reference Books:

1. Power System Protection and Switchgear, B.Ram – Tata Mc-Graw Hill Pub.
2. Switchgear and Protection, M.V.Deshpande - Tata Mc-Graw Hill Pub.
3. Power System Protection & Switchgear, Ravindra Nath, M.Chander, Willy P
4. Computer Relaying for power system, Arun Phadke, James Thorp, Johns W P

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Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EPS	Advance Course In Electrical Machines	MTEPS-1003	3L-1T-0P	4

Course Outcomes:

CO1 Students are able to understand modeling of power system .

CO2 Able to know the various types of DC drive.

CO3 Able to analyze and implementation of power electronics to different drives

CO4 Able to analyze operation and control of induction motor and synchronous motor drives

Course Contents:

UNIT – I

Review: Primitive machine, voltage and torque equation. Concept of transformation, change of variables, m/cvariables and transform variables. Application to D.C. machine for steady state and transient analysis, equation of cross field commutator machine.

UNIT – II

Induction Machine: Voltage, torque equation for steady state operation, Equivalent circuit, Dynamic performance during sudden changes in load torque and three phase fault at the machine terminals. Voltage & torque equation for steady state Operation of 1-ö induction motor & scharge motor.

UNIT – III

Synchronous Machine: Transformation equations for rotating three phase windings, Voltage and power equation for salient and non salient alternator, their phasordiagrams, Simplified equations of a synchronous machine with two damper coils.

UNIT – IV

Operational Impedances and Time Constants of Synchronous Machines : Park's equations in operational form, operational impedances and G(P) for a synchronous machine with four Rotor Windings, Standard synchronous
machine Reactances, time constants, Derived synchronous machine time constants, parameters from short circuit characteristic.

UNIT – V

Approximate Methods for Generator & System Analysis: The problem of power system analysis, Equivalent circuit & vector diagrams for approximate calculations, Analysis of line to line short circuit, Application of approximate method to power system analysis.

Reference Books:

1. Analysis of Electric Machinery - P.C.Krause
2. The General theory of Electrical Machines - B.Adkins
3. The General theory of AC Machines - B.Adkins & R.G.Harley
4. Generalised theory of Electrical m/c - P.S.Bhimbra

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Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EPS	Power Electronics Applications in Power System	MTEPS-1004	3L-1T-0P	4

Course Outcomes:

CO1 Familiarize the power semiconductor switching devices for power conversion .

CO2 Understand the principle of working of resonant converter and resonant switch converter.

CO3 Understand different modulation techniques .

CO4 Understand power electronic applications in FACTS.

Course Contents:

UNIT – I

Power System components models formation of bus admittance matrix, algorithm for formation of bus impedance matrix. Reactive power capability of an alternator, transmission line model & load ability, Reactive power transmission & associated difficulties, Regulated shunt compensation, Models of OLTC & Phase shifting transformer, load flow study.

UNIT – II

Sensitivity analysis: Generation shift distribution factors, line outage distribution factors, Compensated shift factors. Power systems security levels, contingency selection & evaluation, security constrained economic dispatch. Pre-contingency corrective rescheduling.

UNIT – III

Voltage stability: Proximity indicators e.g. slope of PV curve, Minimum Eigen value of reduced load flow Jacobian participation factors based on modal analysis and application.

UNIT – IV

Flexible ac transmission system, reactive power control, brief description and definition of FACT's controllers, shunt compensators, configuration and operating characteristics of TCR, FC-TCR, TSC, Comparisons of

SVCs

UNIT – V

Thy thyristor controlled series capacitor (TCSC) Advantages of the TCSC, Basic principle and different mode of operation, analysis variable reactance model and transient stability model of TCSC. Static condenser (STATCON), Static synchronous series compensator (SSSC) and Unified power flow controller (UPFC).

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Reference Books:

1. Modern power system analysis D.P. Kothari, I.J. Nagrath, TMH, 2003
2. Power generation operation and control, A.J. Wood, B.F Woolenberg, John W
3. Understanding facts: Concepts and technologies of flexible AC transmission system IEEE Press, 2001 N.G. Hingorani, L. Gyugyi
4. Power system stability and control IEEE press P. Kundur, 1994
5. Thyristor Based FACTS controllers for electrical Transmission systems- R.M. Mathur, R.K. Verma, Wieldy inter science, 2002

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Semester – I
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EPS	Power System Dynamics Analysis and Control	MEPS-1005	3L-1T-2P	6

Course Outcomes:

CO1 Proficiency in voltage & frequency control of modern power system

CO2 Understand power system security concepts and study the methods to rank the contingencies.

CO3 Capability to contrive Load Dispatch functions

CO4 Understand how to analyze various types of faults in power system

Course Contents:

UNIT – I

INTRODUCTION TO POWER SYSTEM STABILITY PROBLEM: Basic concepts and definitions: Rotor angle stability, voltage stability and voltage collapse, Midterm and long-term stability, Classification of stability, states of operation and system security system dynamic problems.

UNIT – II

REVIEW OF CLASSICAL METHOD: System model, some mathematical analysis of steady state stability, analysis of transient stability, simplified representation of excitation control.

UNIT – III

MODELING OF SYNCHRONOUS MACHINE: Introduction, synchronous machine, parks transformation, analysis of steady state performance per unit equivalent circuits of synchronous machine, determination of parameters of equivalent circuits, measurements for obtaining data, saturation models, transient analysis of a synchronous machine.

UNIT – IV

EXCITATION AND PRIME MOVER CONTROLLERS: Excitation system Modeling, system representation by state evasions, prime move control systems.

UNIT – V

TRNMISSION LINE, SVC AND LOADS: D-Q transformation using L-B variables, static var compensators, loads Dynamics of a synchronous generator connected to estimate bus: system model, synchronous machine model, calculation of initial conditions, inclusion of SVC Model, Analysis of single machine system, Small signal analysis with block diagram representation, synchronizing and damping torque analysis, small signal model, nonlinear oscillators.

UNIT – VI

APPLICATION OF POWER SYSTEM STABILIZERS: Basic concepts, control signals, structure and tuning of PSS, field implementation and operating experience 8 Hours.

Reference Books:

1. K.R. Padiyar, Power system dynamics, stability and control, BS Pub. Hydbd
2. P Kunder, Power system stability and control, TMH.
3. P. W. Sauer & M A Pai: Power system dynamics and stability: Pearson.

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Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EPS	Reactive Power Control & Facts	MTEPS-2001	3L-1T-0P	4

Course Outcomes:

CO1 Analyze the power system data for load-flow and fault studies.

CO2 An ability to apply knowledge of FACTS Controllers.

CO3 A knowledge of recent trend in FACTS controllers and application of FACTS controllers.

CO4 An ability to design a Compensators within realistic constraints.

Course Contents:

UNIT – I

Description and definition of Introduction to FACTS: Basic Types of controllers – Benefits from FACTS technology- Static Var Compensator (SVC):Principle of operation, configuration and control. Thyristor Controlled Series compensator (TCSC): Principle of operation, configuration and control, Application for damping electromechanical Oscillations, Application for mitigation of SSR. Static Compensator (STATCOM): Principle of operation, configuration and control. Static Synchronous Series Compensator (SSSC): Principle of operation, configuration and control. Thyristor Controlled Phase Angle
Regulator (TCPAR): Principle of operation, configuration and control, Unified Power Flow Controller (UPFC): Principle of operation, configuration and control, Simulation of UPFC, Steady state model of UPFC. Interline Power Flow Controller (IPFC):Principle of operation, configuration and control.

UNIT – II

Oscillation Stability Analysis and Control: Introduction – Linearised model of power systems installed with FACTS based Stabilisers – Heffron-Phillips model of a SMIB system installed with SVC, TCSC and TCPS – Heffron-Phillips modulo a SMIB system with UPFC – Heffron-Phillips model of a Multi-machine system installed with SVC, TCSC and TCPS.

UNIT – III

Analysis and Design of FACTS based stabilizers: Analysis of damping torque contribution by FACTS based stabilisers installed in SMIB systems, Design of robust FACTS based stabilizers installed in SMIB systems by phase compensation method. Selection of installing locations and feedback signal for FACTS based stabilizers

UNIT – IV

Transient Stability control with FACTS: Introduction – Analysis of Power systems installed with FACTS devices: Power transmission control using Controllable Series Compensation(CSC), Power Transmission Control using SSSC, Power Transmission Control using UPFC, Power Transmission Control using Phase Shifting Transformer(PST), Power Transmission Control using UPFC, Control of FACTS devices for transient stability improvement – General considerations of FACTS control strategy: CSC,SSSC, SVC, STATCOM and UPFC control strategy – General Structure of the FACTS devices control.

References:

1. Reactive Power Control in Power Systems, T J E Miller John Wiley.
2. Computer modeling of Electrical Power Systems, J Arriliga, N R Watson, Wiley
3. Understanding FACTS' N G Hingorani and L Gyugyi, IEEE Press.
4. Flexible ac Transmission Systems (FACTS), Y.H. Song, A.T.Johns,IEEE P.

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Semester – II
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EPS	Restructed Power Systems	MTEPS-2002	3L-1T-0P	4

Course Outcomes:

CO1 To provide in-depth understanding of operation of deregulated electricity market systems.

CO2 To examine topical issues in electricity markets and how these are handled world-wide in various markets.

CO3 To train the students to analyze various types of electricity market operational and control issues under congestion management.

CO4 To learn different pricing mechanism and power trading in restructured power system.

Course Contents:

Fundamentals of restructured system, Market Architecture, Load Elasticity, Social welfare maximization, OPF: Role in vertically integrated systems and in restructured markets, Congestion Management, Optimal Bidding, Risk assessment and Hedging, Transmission Pricing and Tracing of power, Ancillary Services, Standard Market Design, Distributed Generation in restructured markets, Developments in India, IT applications in restructured markets, Working of restructured power systems :PJM.

Reference Books:

1. Understanding electric utilities and de-regulation, Lorrin Philipson, H. Lee Willis, Marcel DekkerPub., 1998.
2. Power system economics: designing markets for electricity Steven Stoft, John Wiley & Sons, 2002.
3. Operation of restructured power systems. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, Kluwer Academic Pub., 2001.
4. Restructured electrical power systems: operation, trading and volatility Mohammad Shahidehpour,Muwaffaq Alomoush, Marcel Dekker Pub., 2001

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Semester – II
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EPS	Power System Transients	MTEPS-2003	3L-1T-0P	4

Course Outcomes:

CO1 To understand the concepts of switching transients and damping, transients in DC and three phase circuits

CO2 To learn the origin and nature and type of power system transients

CO3 To learn about the travelling surges, lighting phenomena and fast transients in transmission lines

CO4 To understand the insulation coordination procedures for high voltages systems

Course Contents:

UNIT – I

Origin and nature of transients and surges. Equivalent circuit representations. Lumped and distributed circuit transients. Line energisation and de-energisation transients. Earth and earth wire effects.

UNIT – II

Current chopping in circuit breakers. Short line fault condition and its relation to circuit breaker duty. Trapped charge effects. Effect of source and source representation in short line fault studies. Control of transients.

UNIT – III

Lightning phenomena. Influence of tower footing resistance and earth resistance Traveling waves in distributed parameter multi-conductor lines, parameters as function of frequency.

UNIT – IV

Simulation of surge diverters in transient analysis. Influence of pole opening and pole closing. Fourier integral and Z transform methods in power system transients. Bergeron methods of analysis and use of EMTP and EMTDC/PSCAD package.

UNIT – V

Insulation Coordination: overvoltage limiting devices, dielectric properties, breakdown of gaseous insulation, tracking and erosion of insulation, high current arcs.

Reference Books:

1. Power System Transients by Vanikov
2. Power System Transients by C. S. Indulkar and D.P. Kothari
3. Power Circuit breaker theory and design by Flurscheim C.H.
4. EMTP Rulebook
5. EMTDC/PSCAD Rulebook

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Department Of Electrical Engineering

Semester – II

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EPS	Power Quality and Conditioning	MTEPS-2004	3L-1T-0P	4

Course Outcomes:

CO1 Reliably identify the sources of various power quality problems.

CO2 Explain about causes of harmonic and its distortion effect.

CO3 Educate the harmful effects of poor power quality and harmonics.

CO4 Decide the compensators and filters to keep the power quality indices within the standards.

Course Contents:

UNIT – I

Understanding Power quality, types of power quality disturbances, power quality indices,Causes and effects of power quality disturbances.

UNIT – II

Causes and effects of harmonics, converter configuration and their contribution to supply harmonics, other sources of harmonics, Difference between harmonics and transients, voltage and current distortion, harmonic indexes, sources of harmonic distortion .

UNIT – III

Radio interference, supply standards, elimination/suppression of harmonics, classical solutions& their drawbacks, passive input filters, design of harmonic filters, Improved power quality converter topologies,(single and three phase), transformer connections, Elimination/suppression of harmonics using active power filters – topologies, and their control methods, PWM converter as a voltage source active filter, current source active filter.

UNIT – IV

Active wave shaping of input line current, constant frequency control, constant tolerance band control, variable tolerance band control, discontinuous current control, Electromagnetic interference(EMI), EMI generation ,EMI standards, and elimination.

Reference Books:

1. Power Quality – by R.C. Duggan
2. Power system harmonics – by A.J. Arrillga

3. Power electronic converter harmonics – by Derek A. Paice
4. Power Electronics –Mohan,Undeland,Robbins

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EPS	Energy Conservation and Management	MTEPS-2005	3L-1T-2P	6

Course Outcomes:

CO1 Acquaintance with conservation of energy and its management, energy planning, and energy economics.

CO2 Know-How of energy efficient machinery systems, energy losses and their management.

CO3 Competency in Energy analysis techniques and methods & Energy conservation planning and practices.

CO4 Know-How of Energy forecasting, Energy economics, Energy pricing and incentives for energy conservation.

Course Contents:

UNIT – I

General energy problem: Energy use patterns and scope for conservation. Energy audit: Energy monitoring, Energy accounting and analysis, Auditing and targeting. Energy conservation policy, Energy management & audit, Energy audit, Types of energy audit, energy management (audit), qualities and function of energy managers, language of an energy manager, Questionnaire, Check list for top management, Loss of energy in material flow, energy performance, Maximizing system efficiency, Optimizing, input energy requirements, Energy auditing instruments, Material load energy balance diagram.

UNIT – II

Thermodynamics of Energy Conservation, Basic principle, Irreversibility and second law, efficiency analysis of systems, Primary energy sources, optimum use of prime-movers, energy efficient housekeeping, energy recovery in thermal systems, waste heat recovery techniques, thermal insulation, Thermal energy audit in heating, ventilation and air conditioning. Maintenance and Energy audit, friction, lubrication and tribological innovations. Predictive and preventive maintenance.

UNIT – III

Load curve analysis & load management DSM, Energy storage for power systems (Mechanical, Thermal, Electrical & Magnetic) Restructuring of electric tariff from energy conservation consideration, Economic analysis depreciation method, time value of money, Evaluation method of

projects, replacement analysis, special problems inflation risk analysis. Payback period, Energy economics, Cost Benefit Risk analysis, Payback period.

UNIT – IV

Energy efficient electric drives, Energy efficient motors V.S.D. power factor improvement in power system, Energy Conservation in transportation system especially in electric vehicle. Energy flow networks,

Simulation & modeling, formulation & Objective & constraints, alternative option, Matrix chart.

UNIT – V

Energy conservation task before industry, Energy conservation equipments, Co-Generation, Energy conservation in Sugar, Textiles, Cement, process industry, Electrical Energy Conservation in building, heating, lighting, domestic gadgets.

Reference Books:

1. Energy Management – W.R. Murphy & G. Mckey Butler worths.
2. Energy Management Head Book- W.C. Turner, John Wiley
3. Energy Management Principles- Craig B. Smith, Pergamon Press
4. Energy Conservation- Paul O Callagan- Pergamon Press
5. Design & Management of energy conservation. Callaghan,
6. Elect, Energy Utilization & Conservation. Dr. Tripathi S.C.

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Semester – III
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EPS	Power System Instrumentation	MTEPS-3001 (1)	3L-1T-0P	4

Course Outcomes:

CO1 To understand the concepts of Power System Instrumentation.

CO2 To enable design an selection of Power System Instrumentation sub-systems.

Course Contents:

UNIT – I

Introduction to instrumentation and control of energy systems, display instruments, recorders.

UNIT – II

Transducers, sensors, actuators such as pressure, temperature, velocity, speed, volume, torque and solar flux measuring devices, current, voltage and power factor.

UNIT – III

Gas analysers, power plants and industrial instrumentation and pollution monitoring devices.

UNIT – IV

Signal conditioning of inputs, single channel and multichannel data acquisition system/A and A/D converters, data loggers, supervisory control.

UNIT – V

Data transmission systems, Advantage and disadvantage of digital transmission overanolog. Time division
multiplexing, pulse modulation, digital modulation.

Reference Books:

1. Transducers & Instrumentation by D.V.S. Murty – PHI Prentice Hall
2. Electronic Instrumentation by H.S.Kalsi – Tata McGraw Hill
3. Electrical and Electronics Measurement and Instr., A.K.Sawhney, Dhanpat Rai
4. Instrumentation devices and systems by C.S.Rangan and G.R.

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Semester – III
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EPS	DSP & its Application	MTEPS-3001 (2)	3L-1T-0P	4

Course Outcomes:

CO1 Thorough understanding of frequency domain analysis of discrete time signals.

CO2 Ability to design & analyze DSP systems like FIR and IIR Filter etc

CO3 Practical implementation issues such as computational complexity, hardware resource limitations as well as cost of DSP systems or DSP Processors.

CO4 Understanding of spectral analysis of the signals.

Course Contents:

UNIT – I

Introduction to DSP - Classification of signals, Multichannel and multi dimensional continuous v/s discrete time signals, continuous v/s discrete valued signals, continuous time sinusoidal signal, discrete time sinusoidal signals, sampling of analog signal, sampling theorem, quantification and coding of D/A conversion.

UNIT – II

Discrete Time Signal and Systems - Discrete time signal, systems, Z-transform & Inverse Z-transform, analysis of discrete time, linear time invariant systems, co-relation of discrete time systems.

UNIT – III

Frequency Analysis Of Signals - Frequency analysis of analog signals, frequency analysis of discrete time signals. Properties of Fourier Transform, Frequency Domain Characteristics, Time Frequency Dualities, Sampling of signals in time and frequency domain, DFT & FFT.

UNIT – IV

Design Of Digital Filter - Design of linear phase FIR filter using window & frequency sampling method. Design of equiripple linear phase filters. Comparison of design methods for linear phase FIR filters. Design of IIR filters from analog filters. Direct Design Technique for digital IIR filters.

UNIT – V

DSP Application - Introduction to digital signal processors chips, case study of differentDSP applications. Application of filters to analog & digital signal processor, FET spectrum analyzer.

Reference Books :

1. Digital Signal Processing - W.D.Stanley
2. Analog & Digital Signal Processing – Ashok Ambardar

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Semester – III

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EPS	Power Controller	MTEPS-3001 (3)	3L-1T-0P	4

Course Outcomes:

CO1 Competency in function of various power electronics devices.

CO2 Skill of analyzing power electronic devices.

CO3 Capability in testing & harnessing typical characteristics of power semiconductor devices
CO4 Competency in Triggering & Protective mechanism of semiconductor devices.

Course Contents:

UNIT – I

Various power semiconductor devices i.e. SCR, GTO, MOSFET, BJT, IGBT & MCT's & their protection,
series-parallel operation, Heat sink calculations, Design of firing circuit for converters, choppers & inverters.

UNIT - II

Analysis & design of 1-f bridge converter, 3-f bridge converter with and without freewheeling diode, effect of source impedance, power factor improvement techniques, pulse width modulated converters, Dual converters, converter for HVDC application & DC drives.

UNIT - III

Analysis & design of voltage commutated, current commutated and load commutated choppers, multi quadrant choppers, chopper for traction application. Resonant choppers, SMPS.

UNIT - IV

Detailed analysis of 1-f VSI, 3-f VSI (180° mode, 150° mode & 120° mode of conduction),various inverter
commutation circuits, harmonic reduction techniques, PWM inverters, Inverters for HVDC application & AC drives. Advantages & limitation of current source inverters over VSI, 1-ö and 3-ö CSI. Resonant inverters.

UNIT - V

1-f to 1-f, 3-f to 3-f cycloconverter circuits, circulating current scheme, non-circulating current operation, Mean output voltage, harmonics in supply current waveform & input-power factor. Concept of power quality.

Reference Books :

1. Thyristorised Power Controllers - G.K.Dubey, Doradla, Joshi, Sinha
2. Power Electronics - C.W.Lander
3. Power Electronics - Rashid
4. Thyristorised power controlled converters & cycloconverters - B.R.Pelly
5. Power Electronics - N.Mohan

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Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EPS	Special Machines	MTEPS-3002 (1)	3L-1T-0P	4

Course Outcomes:

CO1 To provide knowledge about the fundamentals of electrical machines by using transformation theory based mathematical modelling.

CO2 To impart knowledge about principle of operation and performance of DC, Synchronous, Induction machines and transformers.

CO3 Ability to analyze steady state & dynamic operation of induction machine

CO4 Capability in contriving drive operation as per the industry requirements.

Course Contents:

UNIT - I

Square wave permanent magnet brushless dc motor, magnetic circuit analysis on open circuit torque & emf
equations, torque speed characteristics, efficiency, commutation, winding inductances, armature reaction and
controllers.

UNIT - II

Sine wave permanent magnet brushless dc motor, torque & emf equation, Inductance of phase winding, synchronous reactance, phasor diagram, torque-speed characteristics.

UNIT - III

Switched reluctance motor, static torque production, partition of energy and the effects of saturation, Dynamic torque production, torque speed characteristics, shaft position sensing, solid rotors.

UNIT - IV

Linear Induction Motors, construction, performance, thrust-speed characteristic, application, end effect.

UNIT - V

Stepper motor – variable reluctance stepper motor, single stack stepper motor multistackstepper motor, permanent magnet stepper motor, Important features of stepper motor, torque v/s stepping rate characteristics, Drive circuits, unipolar drive circuits, Bipolar drive circuits.

Reference Books:

1. Brushless Permanent Magnet & Reluctance Motor Drives – T.J.E.Miller
2. Principles of Electric Machines & Power Electronics – P.C.Sen
3. Electric Drives – G.K.Dubey

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Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EPS	Advanced Electrical Drives	MTEPS-3002 (2)	3L-1T-0P	4

Course Outcomes:

CO1 Competency in developing Dynamic model of drive system.

CO2 Fitness' in solving typical drive issues.

CO3 Ability in control strategy of cycloconverter based Drives.

CO4 Skill in Transient analysis of drive system.

Course Contents:

UNIT - I

Electrical Drives Introduction, Choice of Electrical Drives, Dynamics of Electrical Drives, Concept of Multiquadrant operation, Components of load torques. Selection of motor power rating.

UNIT - II

D.C.Drive, speed torque, speed control. Starting, Breaking. Controlled rectified fed DC drive, chopper controlled dc drives. Close loop control of d.c. drive. Introduction of transient analysis.

UNIT - III

Induction motor drives : three phase i.m., analysis and performance. operation with unbalanced source voltages and single phasing, analysis of i.m. fed from non-sinusoidal voltage supply. starting, breaking, introduction of transient analysis. speed control methods, single-phase i.m. close loop control of i.m. drives.

UNIT - IV

Synchronous Motor Drives, cylindrical rotor wound field motor, salient pole wound field motor, synchronous reluctance motor, Hysteresis synchronous motor, operation from fixed frequency supply, starting, breaking, synchronous motor variable speed drives, starting large synchronous machines.

UNIT - V

Introduction of Brushless dc motor, stepper motor and switch reluctance motor drives, solar and battery powered drives, Traction Drives, Energy conservation in Electrical Drives.

Reference Books:

1. Power semi conductor controlled drives by G.K.Dubey
2. Fundamentals of Electrical Drives by G.K.Dubey
3. Electrical Machine & Power Electronics by P.C.Sen

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Semester – III

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EPS	Dissertation Part- I (Literature Review/Problem Formulation/ Synopsis	MTEPS-3003	0L-0T-2P	2

Course Outcomes: After studying this course, students will be able to,

CO1- To define and limit of the research.

CO2- To place your study in an historical perspective.

CO3- To avoid unnecessary duplication.

CO4- To evaluate promising research methods.

Course Content

The objective of Dissertation Part-I is to promote a systematic understanding of the knowledge, critical awareness of current problems, originality in the application of knowledge and the quality of work. The ideal work may be characterized by a new result in design, development and implementation. It should have the potential of industrial/scientific acceptance. The first part of the Dissertation should be to determine the interest of students and broadly identify the area of work, finalize the research problem based on literature survey. Also, by now the students should have familiarity with the concepts, tools, techniques required to carry out the Dissertation work. Student is expected to start the research work. Outcome of Dissertation Part-I should be to conclude the work on the identified problem its importance, its justification, literature survey, field work, research work etc. Minor variation may be accepted depending upon nature of title.

Department Of Electrical Engineering

Semester – IV

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
EPS	Dissertation Part- I I	MTEPS-4001	0L-0T-2P	2

Course Outcomes: After studying this course, students will be able to,

CO1- The programme of instruction will consist of advanced subjects of the respective specialization. The complete programme is distributed over four semesters with two semesters per academic year. Course work is offered in the first two semesters (except for PG programme in Mechanical engineering where it is extended up to third semester) and the dissertation work will be carried out during third and fourth semesters. Every branch of M.E/ M. Tech programme will have a curriculum and syllabi for the courses recommended by the board of studies and approved by the academic council. The academic programmes of the Institute follow the credit system.

CO2- Every candidate shall be required to submit the record of dissertation work at the end of fourth semester.

Course Content

The objective of Dissertation Part-I is to promote a systematic understanding of the knowledge, critical awareness of current problems, originality in the application of knowledge and the quality of work. The ideal work may be characterized by a new result in design, development and implementation. It should have the potential of industrial/scientific acceptance. Dissertation Part-II should be seen in continuation with Dissertation Part-I. The researcher should continue the research work in the two parts.