AISECT UNIVERSITY

A STATUTORY UNIVERSITY UNDER SECTION 2(f) OF THE UGC ACT

SCHEME OF EXAMINATION
&
DETAILED SYLLABUS

MASTER OF TECHNOLOGY
M.Tech

Power System Engineering

2017

Bhopal-Chiklod Road, Near Bangrasia Chouraha,
Vill-Mendua, Distt-Raisen(Madhya Pradesh), Ph:07480-295707
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PROGRAM OBJECTIVES

The objectives of the undergraduate program are to provide students an excellent academic experience and to equip graduates with the ability to solve a broad range of problems in our rapidly changing technological, economic and social environment. To this end, the Faculty is committed to educate graduates who have:

1. a strong foundation and knowledge in engineering fundamentals with a capacity to know how, when and where to use the knowledge in specific ways;
2. an ability to identify, formulate, analyze and solve engineering problems and a capacity to integrate material from more than one subject and to apply appropriate engineering principles to arrive at correct and effective solutions;
3. a comprehensive knowledge in the fundamentals of engineering practice, including an ability to use analytical techniques, experimental and laboratory skills and modern engineering simulation and design software tools;
4. a broad knowledge of the principles and skills in engineering design, development and management in global, cultural and business contexts;
5. a multidisciplinary view with an ability to work effectively as members of teams, composed of individuals from different disciplines and different professional cultures;
6. strong oral and written communication skills with a capacity to produce effective technical documents and to use current communication techniques and tools;
7. a culture of life-long learning with a capacity to engage in continuous self-improvement, personal enrichment and professional development; and
8. a broad sense of social, ethical and professional responsibility with a capacity to demonstrate an understanding and appreciation of the human dimension of technology and its impact on mankind.

PROGRAM OUTCOMES:

1. Prepare students for careers in industry, academia, and government organizations by fostering in them the technical capabilities pertinent to Electrical & Electronics and allied engineering and interpersonal skills necessary to succeeding in their fields, as well as the foundation for lifelong learning.
2. Lead the way in Electrical & Electronics engineering based research and other scholarly activities.
3. Provide technical knowledge, leadership, guidance, and support to industry, the government establishments, and the general public

PROGRAM SPECIFIC OBJECTIVES:

1. To provide students with the knowledge of Basic Sciences in general and Electrical and electronics Engineering in particular so as to acquire the necessary skills for analysis and synthesis of problems in generation, transmission and distribution.
2. To provide technical knowledge and skills to identify, comprehend and solve complex tasks in industry and research and inspire the students to become future researchers / scientists with innovative ideas
3. Work in a team using technical knowhow, common tools and environments to achieve project objectives
4. Engage in lifelong learning, career enhancement and adapt to changing professional and societal needs.
5. To train the students in basic human and technical communication skills so that they may be both good team-members, leaders and responsible citizen.

PROGRAM SPECIFIC OUTCOMES:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
5. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
6. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
7. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
8. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
9. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
10. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

AISECT University, Bhopal (M.P.)
Scheme of Examination

Department: Electrical & Electronics Engineering

Subject Code	Subject Name	Credits	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			Major	Minor	Sessional.	End Sem	Lab Work			
TMPS 101	Advance Mathematics	4(3+1+0)	50	20	30	-	-	100	3 hr	-

COURSE OBJECTIVE-
The primary objective of the course is to introduce operation principles ofAdvance Mathematicsrelated toSolution of Partial Differential Equationand to have an adequate knowledge in Mathematicstechniques forFT, DFT, WFTStochastic process, Introduction and definition of reliability.

UNIT 1
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 2
Probability, compound probability and discrete random variable. Binomial, Normal and Poisson's distributions, Sampling distribution, elementary concept of estimation and theory of hypothesis, recurred relations.

UNIT 3
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 4
Operations of fuzzy sets, fuzzy arithmetic & relations, fuzzy relation equations, fuzzy logics. MATLAB introduction, programming in MATLAB scripts, functions and their application.

UNIT 5
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.

COURSE OUTCOME –
After successful completion of course, Students are expected to possess an in-depth

understanding and Knowledge of the concepts and principles of concepts of fault tolerant analysisof electrical and non electrical viz. physical quantities anddecision 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 EastenEdd.
3. Applied Numerical Methods with MATLAB by Steven C Chapra, TMH.
4. Introductory Methods of Numerical Analysis by S.S. Shastry,
5. Numerical Solution of Differential Equation by M. K. Jain
6. Numerical Mathematical Analysis By James B. Scarborogh
7. Fourier Transforms by J. N. Sheddon
8. Fuzzy Logic in Engineering by T. J. Ross
9. Fuzzy Sets Theory & its Applications by H. J. Zimmersoms

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AISECT University, Bhopal (M.P.)
Scheme of Examination

Department: Electrical & Electronics Engineering

Subject Code	Subject Name	Credits	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			Major	Minor	Sessional.	End Sem	Lab Work			
TMPS 102	Power system dynamics analysis & control	4(3+1+0)	50	20	30	-	-	100	3 hr	-

COURSE OBJECTIVE-
The primary objective of the course is to introduce operation principles ofPower system dynamics analysis & controlrelated toPower System Stability Problemand to have an adequate knowledge in Review Of Classical Method techniques forModelling Of Synchronous MachineTransmission Line, Svc And Loads.

UNIT 1
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 2
REVIEW OF CLASSICAL METHOD: System model, some mathematicalanalysis of steady state stability, analysis of transient stability, simplifiedrepresentation of excitation control.

UNIT 3
MODELING OF SYNCHRONOUS MACHINE: Introduction, synchronousmachine, parks transformation, analysis of steady state performance per unitequivalent circuits of synchronous machine, determination of parameters ofequivalent circuits, measurements for obtaining data, saturation models, and transientanalysis of a synchronous machine.

UNIT 4
EXCITATION AND PRIME MOVER CONTROLLERS: Excitation systemModelling, system representation by state evasions, prime move control systems.
TRNMISSION LINE, SVC AND LOADS: D-Q transformation using L-B variables, static var compensators, loads Dynamics of a synchronous generator connectedto estimate bus: system model, synchronous machine model, calculation of initialconditions, inclusion of SVC Model, Analysis of single machine system, Smallsignal analysis with block diagram representation, synchronizing and dampingtorque analysis, small signal model, nonlinear oscillators.
UNIT 5

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

COURSE OUTCOME –

After successful completion of course, Students are expected to possess an in-depth understanding and Knowledge of the concepts and principles ofPower system dynamics analysis & control related toPower System Stability Problem and to have an adequate knowledge in Review Of Classical Method techniques forModeling Of Synchronous MachineTrnmission Line, Svc And Loads.

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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AISECT University, Bhopal (M.P.)
Scheme of Examination

Department: Electrical & Electronics Engineering

Subject Code	Subject Name	Credits	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			Major	Minor	Sessional.	End Sem	Lab Work			
TMPS 103	Advance Power System Protection Relays	4(3+1+0)	50	20	30	-	-	100	3 hr	-

COURSE OBJECTIVE-
The Primary Objective Of The Course Is To Introduce Operation Principles OfProtective Relays,Static Relays,ComparatorsRelated ToGenerator And Transformer Protection,Modern Trends In Power System Protection.

Unit 1
Protective Relays: Relaying review, characteristics and operating equations ofrelays. CT's and PT's differential relay, over-current relay, reverse power relay,distance relays, applications of relays.

Unit 2
STATIC RELAYS: Introduction, advantages and disadvantages, classificationlogic ckts, smoothing circuits, voltage regulator square wave generator, timedelay ckts level detectors, summation device, sampling circuit, zero crossingdetector, output devices. COMPARATORS: Replica Impedance, mixingtransformers, general equation of phase and amplitude comparator, realization ofohm, impedance and off set impedance characteristics, duality principle, staticamplitude comparators, coincidence circuit, Hall effect devices, Magnetoreceptivity, zener diode phase comparator multi input comparators.

Unit 3
Generator and transformer protection: Protective devices for system. Protectivedevices for stator, rotor, and prime mover of generator, percentage differentialrelays protection, three winding transformer protection, earth fault protection,generator transformer unit protection.

UNIT 4
Bus bar and transmission line protection: Distance protective schemes,directional wave detection relay. Phase compensation carrier protection. Highimpedance differential scheme, supervisory and check relay, Some features of500 KV relaying protection.

Unit 5
Modern trends in power system protection: Different types of digital andcomputer aided relays; Microprocessor based relays, auto-reclosing, frequencyrelays, under and over

frequency relays, di/dt relays. Algorithms for transmissionline, transformer & bus bar protection; out-of-step relaying Introduction toadaptive relaying & wide area measurements

COURSE OUTCOME –

After successful completion of course, Students are expected to possess an in-depth understanding and Knowledge of the concepts and principles ofProtective Relays,Static Relays,electrical and non-electricalComparatorsRelated ToGenerator And Transformer Protection,Modern Trends In Power System Protection.

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, RavindraNath, M.Chander, Willy P
4. Computer Relaying for power system, ArunPhadke, James Thorp, Johns W P
5. Power System Protection, M.A.Date, Bharti Prakashan, VallabhVidya N,(Guj).

AISECT University, Bhopal (M.P.)
Scheme of Examination

Department: Electrical & Electronics Engineering

Subject Code	Subject Name	Credits	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			Major	Minor	Sessional.	End Sem	Lab Work			
TMPS 104	Power Electronics Applications in Power System	4(3+1+0)	50	20	30	-	-	100	3 hr	-

COURSE OBJECTIVE-
The primary objective of the course is to introduce operation principles ofSensitivity analysis,Voltage stability,Flexible ac transmission systemThy thyristor controlled series capacitor (TCSC) Advantages of the TCSC.

UNIT 1
Power System components models formation of bus admittance matrix, algorithmfor formation of bus impedance matrix. Reactive power capability of an alternator,transmission line model &loadability, Reactive power transmission & associateddifficulties, Regulated shunt compensation, Models of OLTC & Phase shiftingtransformer, load flow study.

UNIT 2
Sensitivity analysis: Generation shift distribution factors, line outage distributionfactors, Compensated shift factors. Power systems security levels, contingencyselection & evaluation, security constrained economic dispatch. Pre-contingencycorrective rescheduling.

UNIT-3
Voltage stability: Proximity indicators e.g. slope of PV curve, Minimum Eigenvalue of reduced load flow Jacobian participation factors based on modalanalysis and application.

UNIT-4
Flexible ac transmission system, reactive power control, brief description anddefinition of FACT's controllers, shunt compensators, configuration and operating characteristics of TCR, FC-TCR, TSC, Comparisons of SVCs.

UNIT-5
Thy thyristor controlled series capacitor (TCSC) Advantages of the TCSC, Basicprinciple and different mode of operation, analysis variable reactance model andtransient stability model of TCSC.

COURSE OUTCOME –
After successful completion of course, Students are expected to possess an in-depth understanding

and Knowledge of the concepts and principles ofSensitivity analysis,Voltage stability,Flexible ac transmission systemThy thyristor controlled series capacitor (TCSC) Advantages of the TCSC.

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

AISECT University, Bhopal (M.P.)
Scheme of Examination

Department: Electrical & Electronics Engineering

Subject Code	Subject Name	Credits	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			Major	Minor	Sessional.	End Sem	Lab Work			
TMPS 105	Advance Course In Electrical Machines	4(3+1+0)	50	20	30	-	-	100	3 hr	-

COURSE OBJECTIVE-
The primary objective of the course is to introduce operation principles ofReviewterminology related toInduction Machine, Synchronous Machineand to have an adequate knowledge in Operational Impedances and Time Constants of Synchronous Machinestechniques for Approximate Methods for Generator & System Analysis.

UNIT 1
Review: Primitive machine, voltage and torque equation. Concept oftransformation, change of variables, m/c variables and transform variables.Application to D.C. machine for steady state and transient analysis, equation ofcross field commutator machine.

UNIT 2
Induction Machine: Voltage, torque equation for steady state operation, Equivalentcircuit, Dynamic performance during sudden changes in load torque and threephase fault at the machine terminals. Voltage & torque equation for steady stateoperation of 1-ö induction motor &scharge motor.

UNIT 3
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 4
Operational Impedances and Time Constants of Synchronous Machines : Park'sequations in operational form, operational impedances and G(P) for a synchronousmachine with four Rotor Windings, Standard synchronous machine Reactance,time constants, Derived synchronous machine time constants, parameters fromshort circuit characteristics.

UNIT 5

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

COURSE OUTCOME –

After successful completion of course, Students are expected to possess an in-depth understanding and Knowledge of the concepts and principles ofReviewterminology related toInduction Machine, Synchronous Machineand to have an adequate knowledge in Operational Impedances and Time Constants of Synchronous Machines techniques forApproximate Methods for Generator & 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
5. Electro Mechanical Energy Conversion - White & Woodson

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AISECT University, Bhopal (M.P.)
Scheme of Examination

Department: Electrical & Electronics Engineering

Subject Code	Subject Name	Credits	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			Major	Minor	Sessional.	End Sem	Lab Work			
TMPS 106	Power Electronics Laboratory	1(0+0+1)	-	-	-	25	25	50	-	2 hr.

List of Experiments-

1 Study of characteristics of various power electronics devices.
2. Study of characteristics of various power electronic converters.
3. Application of power electronics in speed control of various electricalmachines.

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AISECT University, Bhopal (M.P.)
Scheme of Examination

Department: Electrical & Electronics Engineering

Subject Code	Subject Name	Credits	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			Major	Minor	Sessional.	End Sem	Lab Work			
TMPS 107	Power System Laboratory	1(0+0+1)	-	-	-	25	25	50	-	2 hr.

List of Experiments

1. Study of Bucholz relay.
2. To determine the characteristics of inverse time current relay.
3. To determine the dielectric strength of transformer oil.
4. Separation of eddy current & iron losses of single phase transformer.
5. To perform slip test on synchronous machine and to determine d-axis & q-axisreactances.
6. To measure the direct axis subtransient reactance of synchronous machine.
7. To measure the quadrature axis subtransient reactance of synchronous machine.

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AISECT University, Bhopal (M.P.)
Scheme of Examination

Department: Electrical & Electronics Engineering

Subject Code	Subject Name	Credits	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			Major	Minor	Sessional.	End Sem	Lab Work			
TMPS 201	Reactive Power Control & Facts	4(3+1+0)	50	20	30	-	-	100	3 hr	-

COURSE OBJECTIVE-
The primary objective of the course is to introduce operation principles ofReactive Power Control & Factsterminology related toDescription and definition of Introduction to FACTS,Oscillation Stability Analysis and Controland to have an adequate knowledge in Transient Stability control with FACTS techniques forControl of FACTS devices for transient stability improvement,Transient Stability control with FACTS.

UNIT 1
Description and definition of Introduction to FACTS: Basic Types of ccontrollers – 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 2
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 model of a SMIB system with UPFC – Heffron-Phillips model of a Multi-machine system installed with SVC, TCSC and TCPS.

UNIT 3
Analysis and Design of FACTS based stabilisers: Analysis of damping torque contribution by FACTS based stabilisers installed in SMIB systems, Design of robust FACTS based stabilisers installed in SMIB systems by phase compensation method. Selection of installing locations and feedback signal for FACTS based stabilizers.

UNIT 4

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.

UNIT 5

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.

COURSE OUTCOME –

After successful completion of course, Students are expected to possess an in-depth understanding and Knowledge of the concepts and principles ofReactive Power Control & Facts terminology related toDescription and definition of Introduction to FACTS,Oscillation Stability Analysis and Control and to have an adequate knowledge in Transient Stability control with FACTS techniques forControl of FACTS devices for transient stability improvement,Transient Stability control with FACTS:.

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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AISECT University, Bhopal (M.P.)
Scheme of Examination

Department: Electrical & Electronics Engineering

Subject Code	Subject Name	Credits	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			Major	Minor	Sessional.	End Sem	Lab Work			
TMPS 202	Energy Conservation and Management	4(3+1+0)	50	20	30	-	-	100	3 hr	-

COURSE OBJECTIVE-

The primary objective of the course is to introduce operation principles ofEnergy Conservationterminology related toManagementand to have an adequate knowledge in General energy problemtechniques forEnergy efficient electric drives,Thermodynamics of Energy Conservation.

Unit 1

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 2

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 tribo-logical innovations. Predictive and preventive maintenance

Unit 3

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. Pay back period, Energy economics, Cost Benefit Risk analysis, Pay back period.

Unit 4

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 &modelling, formulation & Objective & constraints, alternative option, Matrix chart.

Unit 5

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

COURSE OUTCOME –

After successful completion of course, Students are expected to possess an in-depth understanding and Knowledge of the concepts and principles ofEnergy Conservation terminology related toManagement and to have an adequate knowledge in General energy problem techniques forEnergy efficient electric drives,Thermodynamics of Energy Conservation.

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.,

AISECT University, Bhopal (M.P.)
Scheme of Examination

Department: Electrical & Electronics Engineering

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			Theory			Practical		Total	Theory	Practical
			Major	Minor	Sessional.	End Sem	Lab Work			
TMPS 203	Power Quality and Conditioning	4(3+1+0)	50	20	30	-	-	100	3 hr	-

COURSE OBJECTIVE-

The primary objective of the course is to introduce operation principles ofPower Qualityterminology related toConditioningUnderstanding Power qualityand to have an adequate knowledge inRadio interferencetechniques forRadio interference, supply standardsActive waveshaping of input line current.

UNIT 1
Understanding Power quality, types of power quality disturbances, power quality indices, Causes and effects of power quality disturbances.

UNIT 2
Causes and effects of harmonics, converter configuration and their contribution to supply harmonics, other sources of harmonics.

UNIT 3
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 4
Active waveshaping of input line current, constant frequency control, constant tolerance band control.

UNIT 5
Variable tolerance band control, discontinuous current control,Electromagnetic interference(EMI), EMI generation ,EMI standards,and elimination.

COURSE OUTCOME –

After successful completion of course, Students are expected to possess an in-depth understanding and Knowledge of the concepts and principles ofPower Quality terminology related toConditioning Understanding Power quality and to have an adequate knowledge inRadio interference techniques forRadio interference, supply standards Active waveshaping

of input line current.

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

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AISECT University, Bhopal (M.P.)
Scheme of Examination

Department: Electrical & Electronics Engineering

Subject Code	Subject Name	Credits	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			Major	Minor	Sessional.	End Sem	Lab Work			
TMPS 204	Restructured Power Systems	4(3+1+0)	50	20	30	-	-	100	3 hr	-

COURSE OBJECTIVE-
The primary objective of the course is to introduce operation principles ofRestructured Power Systemsterminology related toFundamentals of restructured systemand to have an adequate knowledge in Social welfare maximization techniques for Congestion Management, Distributed Generation in restructured markets.

UNIT 1
Fundamentals of restructured system, Market Architecture, Load Elasticity.

UNIT 2
Social welfare maximization, OPF: Role in vertically integrated systems and in restructured markets.

UNIT 3
Congestion Management, Optimal Bidding, Risk assessment and Hedging.

UNIT 4
Transmission Pricing and Tracing of power, Ancillary Services, Standard Market Design.

UNIT 5
Distributed Generation in restructured markets, Developments in India, IT applications in restructured markets, Working of restructured power systems: PJM.

COURSE OUTCOME –
After successful completion of course, Students are expected to possess an in-depth understanding and Knowledge of the concepts and principles ofRestructured Power Systems terminology related toFundamentals of restructured system and to have an adequate knowledge in Social welfare maximization techniques for Congestion Management, Distributed Generation in restructured markets.

Reference Books:
1. Understanding electric utilities and de-regulation, LorrinPhilipson, H. Lee Willis, Marcel Dekker Pub., 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, MuwaffaqAlomoush, Marcel Dekker Pub., 2001

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AISECT University, Bhopal (M.P.)
Scheme of Examination

Department: Electrical & Electronics Engineering

Subject Code	Subject Name	Credits	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			Major	Minor	Sessional.	End Sem	Lab Work			
TMPS 205	Power System Transients	4(3+1+0)	50	20	30	-	-	100	3 hr	-

Pattern:
The question paper will consist of six questions. Question no. 1 will have 10 objective questions of 10 marks, covering entire syllabus. Objective questions should have right mix of questions to test the logic, problem solving skill and reasoning. Each objective question should have four choices to pick up from. Remaining five questions will carry 08 marks each, one from each of the five units of the syllabus and may have internal choice. These five questions will have two parts A & B, preferably one theoretical and other numerical/short notes. Questions should test the concepts, knowledge and application. Candidates are required to answer all the questions.

COURSE OBJECTIVE-

The primary objective of the course is to introduce operation principles ofPower System Transientsterminology related toOrigin and nature of transients and surgesand to have an adequate knowledge in Current chopping in circuit breakers techniques for Lightning phenomena.

UNIT 1
Origin and nature of transients and surges. Equivalent circuit representations. Lumped and distributed circuit transients. Line energisation and de-energisation transients. Earth and earthwire effects.

UNIT 2
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 3
Lightning phenomena. Influence of tower footing resistance and earth resistance. Traveling waves in distributed parameter multi-conductor lines, parameters as a function of frequency.

UNIT 4
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 5

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

COURSE OUTCOME –

After successful completion of course, Students are expected to possess an in-depth understanding and Knowledge of the concepts and principles ofPower System Transients terminology related toOrigin and nature of transients and surges and to have an adequate knowledge in Current chopping in circuit breakers techniques for Lightning phenomena.

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

AISECT University, Bhopal (M.P.)
Scheme of Examination

Department: Electrical & Electronics Engineering

Subject Code	Subject Name	Credits	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			Major	Minor	Sessional.	End Sem	Lab Work			
TMPS 206	Lab-III Advance Power System Lab	1(0+0+1)	-	-	-	25	25	50	-	2 hr.

List of Experiments

1. Study of Power System economics & trading.
2. Separation of eddy current & iron losses of single phase transformer.
3. To perform slip test on synchronous machine and to determine d-axis & q-axis reactance.
4. To measure the direct axis sub transient reactance of synchronous machine.
5. To measure the quadrature axis sub transient reactance of synchronous machine

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AISECT University, Bhopal (M.P.)
Scheme of Examination

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			Theory			Practical		Total	Theory	Practical
			Major	Minor	Sessional.	End Sem	Lab Work			
TMPS 207	Lab-IV Computer application in Power Systems Lab	1(0+0+1)	-	-	-	25	25	50	-	2 hr.

List of Experiments

1. To develop a program in Matlab for information of Y-bus matrix for N bus system.
2. Load flow solution for 3-bus system using Gauss- Seidel, Newton Raphson and FDLF methods upto 3 iteration.
3. Load flow solution for IEEE 6-bus and 30-bus system in Matlab using Newton Raphson method.
4. To determine the effect of compensation on voltage profile of IEEE 6-bus system by using Mi Power / MATLAB Software.

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AISECT University, Bhopal (M.P.)
Scheme of Examination

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			Theory			Practical		Total	Theory	Practical
			Major	Minor	Sessional.	End Sem	Lab Work			
TMPS 301	Power System Instrumentation	4(3+1+0)	50	20	30	-	-	100	3 hr	-

COURSE OBJECTIVE-

The primary objective of the course is to introduce operation principles ofPower System Instrumentationterminology related toIntroduction to Transducers, sensorsand to have an adequate knowledge in measurement techniques for Gas analysers, power plantsSignal conditioning of inputs.

UNIT 1
Introduction to instrumentation and control of energy systems, display instruments, recorders.

UNIT 2
Transducers, sensors, actuators such as pressure, temperature, velocity, speed,volume, torque and solar flux measuring devices, current, voltage and power factor.

UNIT 3
Gas analysers, power plants and industrial instrumentation and pollution monitoring devices.

UNIT 4
Signal conditioning of inputs, single channel and multichannel data acquisition system,D/A and A/D converters, data loggers, supervisory control.

UNIT 5
Data transmission systems, Advantage and disadvantage of digital transmission over analog. Time division multiplexing, pulse modulation, digital modulation.

COURSE OUTCOME –

After successful completion of course, Students are expected to possess an in-depth understanding and Knowledge of the concepts and principles ofPower System Instrumentationterminology related toIntroduction to Transducers, sensorsand to have an adequate knowledge in measurement techniques for Gas analysers, power plantsSignal conditioning of inputs.

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, DhanpatRai 4. 4. Instrumentation devices and systems by C.S.Rangan and G.R. Sharma, TMH

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AISECT University, Bhopal (M.P.)
Scheme of Examination

Department: Electrical & Electronics Engineering

Subject Code	Subject Name	Credits	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			Major	Minor	Sessional.	End Sem	Lab Work			
TMPS 302	DSP & its Application	4(3+1+0)	50	20	30	-	-	100	3 hr	-

COURSE OBJECTIVE-
The primary objective of the course is to introduce operation principles ofDSP &its terminology related toIntroduction to DSPApplicationand to have an adequate knowledge in Discrete Time Signal and Systems techniques for voltage, current, power and energy.
Design Of Digital Filter, DSP Application.

UNIT 1
Introduction to DSP - Classification of signals, Multichannel and multi dimensionalcontinuous 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 2
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 3
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 4
Design Of Digital Filter - Design of linear phase FIR filter using window & frequencysampling method. Design of equiripple linear phase filters. Comparision of design methods for linear phase FIR filters. Design of IIR filters from analog filters. Direct Design Technique for digital IIR filters.

UNIT 5
DSP Application - Introduction to digital signal processors chips, case study of different DSP applications. Application of filters to analog & digital signal processor, FET spectrum analyzer.

COURSE OUTCOME –
After successful completion of course, Students are expected to possess an in-depth understanding and Knowledge of the concepts and principles ofDSP & its terminology related

toIntroduction to DSPApplicationand to have an adequate knowledge in Discrete Time Signal and Systems techniques for voltage, current, power and energy.
Design Of Digital Filter, DSP Application.

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

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AISECT University, Bhopal (M.P.)
Scheme of Examination

Department: Electrical & Electronics Engineering

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			Theory			Practical		Total	Theory	Practical
			Major	Minor	Sessional.	End Sem	Lab Work			
TMPS 303	Power Controller	4(3+1+0)	50	20	30	-	-	100	3 hr	-

COURSE OBJECTIVE-
The primary objective of the course is to introduce operation principles ofPower Controllerterminology related to Various power semiconductor devices and to have an adequate knowledge in Analysis & design of 1-φ bridge converter techniques for Analysis & design of voltage commutated,Detailed analysis of 1-φ VSI, 3-φ VSI**.**

UNIT 1
Various power semiconductor devices i.e. SCR, GTO, MOSFET, BJT, IGBT & MCT's & their protect ion, series-parallel operation, Heat sink calculations, Design of firing circuit for converters, choppers & inverters.

UNIT 2
Analysis & design of 1-φ bridge converter, 3-φ 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 3
Analysis & design of voltage commutated, current commutated and load commutated choppers, multiquadrant choppers, chopper for tract ion application. Resonant choppers, SMPS.

UNIT 4
Detailed analysis of 1-φ VSI, 3-φ 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 &limitat ion of current source inverters over VSI, 1-ö and 3-ö CSI. Resonant inverters.

UNIT 5
1-φ to 1-φ, 3-φ to 3-φ cyclo converter circuits, circulating current scheme, non-circulating current operation, Mean output voltage, harmonics in supply current waveform & input – powerfactor. Concept of power quality

COURSE OUTCOME –
After successful completion of course, Students are expected to possess an in-depth understanding and Knowledge of the concepts and principles ofPower Controllerterminology

related to Various power semiconductor devices and to have an adequate knowledge in Analysis & design of 1-φ bridge converter techniques for Analysis & design of voltage commutated,Detailed analysis of 1-φ VSI, 3-φ VSI**.**

Reference Books:

1. Thyristorised Power Cont rollers - G.K.Dubey, Doradla, Joshi, Sinha
2. Power Elect ronics - C.W.Lander
3. Power Elect ronics - Rashid
4. Thyristorised power cont rolled converters &cycloconverters - B.R.Pelly
5. Power Elect ronics - N.Mohan
6. Power Elect ronicsApplicat ion - Vithyathil.

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AISECT University, Bhopal (M.P.)
Scheme of Examination

Department: Electrical & Electronics Engineering

Subject Code	Subject Name	Credits	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			Major	Minor	Sessional.	End Sem	Lab Work			
TMPS 304	Special Machines	4(3+1+0)	50	20	30	-	-	100	3 hr	-

COURSE OBJECTIVE-
The primary objective of the course is to introduce operation principles ofSpecial Machinesterminology related to Square wave permanent magnet brushless dc motor and to have an adequate knowledge in Sine wave permanent magnet brushless dc motor techniques for Switched reluctance motor, Linear Induction Motors, Stepper motor.

UNIT 1
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 2
Sine wave permanent magnet brushless dc motor, torque &emf equation, Inductance of phase winding, synchronous reactance, phasor diagram, torque-speed characteristics.

UNIT 3
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 4
Linear Induction Motors, construction, performance, thrust-speed characteristic,application, end effect.

UNIT 5
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.

COURSE OUTCOME –
After successful completion of course, Students are expected to possess an in-depth understanding and Knowledge of the concepts and principles ofSpecial Machinesterminology related to Square wave permanent magnet brushless dc motor and to have an adequate

knowledge in Sine wave permanent magnet brushless dc motor techniques for Switched reluctance motor, Linear Induction Motors, Stepper motor.

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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Scheme of Examination

Department: Electrical & Electronics Engineering

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			Theory			Practical		Total	Theory	Practical
			Major	Minor	Sessional.	End Sem	Lab Work			
TMPS 305	Advanced Electrical Drives	4(3+1+0)	50	20	30	-	-	100	3 hr	-

COURSE OBJECTIVE-
The primary objective of the course is to introduce operation principles ofAdvanced Electrical Drivesterminology related to Electrical Drives Introductionand to have an adequate knowledge in D.C.Drive, speed torque techniques for Induct ion Motor Drives, Synchronous Motor Drives, Introduction of Brushless dc motor.

UNIT 1
Electrical Drives Introduction, Choice of Electrical Drives, Dynamics of Electrical Drives, Concept of Multi-quadrant operation, Components of load torques. Selection of motor power rating.

UNIT 2
D.C.Drive, speed torque, speed control. Starting, Breaking. Controlled rectified fed DC drive,chopper cont rolled dc drives. Close loop control of d. c. drive. Introduction of transient analysis.

UNIT 3
Induct ion 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, singlephase I.M. Close loop control of I.M. Drives.

UNIT 4
Synchronous Motor Drives, cylindrical rotor wound field motor, salient pole wound field motor, synchronous reluctance motor, Hysterisis synchronous motor, operation from fixed frequency supply, start ing, breaking, synchronous motor variable speed drives, starting large synchronous machines.

UNIT 5
Introduction of Brushless dc motor, stepper motor and switch reluctance motor drives, solar and battery powered drives, Tract ion Drives, Energy conservation in Electrical Drives.

COURSE OUTCOME –
After successful completion of course, Students are expected to possess an in-depth understanding and Knowledge of the concepts and principles ofAdvanced Electrical Drivesterminology related to Electrical Drives Introduction and to have an adequate

knowledge in D.C.Drive, speed torque techniques for Induct ion Motor Drives, Synchronous Motor Drives, Introduction of Brushless dc motor.

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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