

SYLLABUS
POWER SYSTEM

Class	M.TECH.	L	T	P	C
Semester/Year	III/II	3	-	-	3
Subject Name	POWER SYSTEM TRANSIENTS				
Subject Code	MEXPS20S301				
Paper	English				
	Hindi				
Max. Marks	100				

Course Objectives:

Students will be able to:

1. Learn the reasons for occurrence of transients in a power system.
2. Understand the change in parameters like voltage & frequency during transients.
3. To know about the lightning phenomenon and its effect on power system.

Course Outcomes: -Students will be able to:

- CO1.** Knowledge of various transients that could occur in power system and their mathematical formulation.
CO2. Ability to design various protective devices in power system for protecting equipment and personnel.
CO3. Coordinating the insulation of various equipments in power system.
CO4. Modelling the power system for transient analysis.
CO5. Knowledge Representation and Inference Mechanism.

Unit	Syllabus	Periods
UNIT-I	Fundamental circuit analysis of electrical transients Laplace Transform method of solving simple Switching transients Damping circuits- Abnormal switching transients, Three-phase circuits and transients Computation of power system transients	8
UNIT-II	Principle of digital computation – Matrix method of solution Modal analysis- Z transform- Computation using EMTP Lightning, switching and temporary over voltages, Lightning Physical phenomena of lightning.	9
UNIT-III	Interaction between lightning and power system Influence of tower footing resistance and Earth Resistance Switching: Short line or kilometric fault Energizing transients – closing and re-closing of lines line dropping, load rejection – over voltages induced by faults.	11
UNIT-IV	Switching HVDC line Travelling waves on transmission line Circuits with distributed Parameters Wave Equation Reflection, Refraction, Behaviour of Travelling waves at the line terminations Lattice	13

	Diagrams – Attenuation and Distortion Multi-conductor system and Velocity wave.	
UNIT-V	Insulation co-ordination: Principle of insulation co-ordination in Air Insulated substation (AIS) and Gas Insulated Substation (GIS) Co - ordination between insulation and protection level. Statistical approach Protective devices Protection of system against over voltages lightning arresters, substation earthing.	14

Text Books:

1. Greenwood, A., Electrical Transients in Power Systems, Wiley Inter-Science (1991).
2. Bewley, L.V. Travelling Waves on Transmission System, Power Publications Inc. (1993).

Reference Books

1. Rudenberg, R., Electric Stroke Waves in Power Systems, Harvard University Press (1998).
2. Gonen, T., Electric Power Transmission System Engineering: Analysis and Design, John Wiley and Sons (1997).

SYLLABUS
POWER SYSTEM

Class	M.TECH.	L	T	P	C
Semester/Year	III/II	3	-	-	3
Subject Name	FACTS AND CUSTOM POWER DEVICES				
Subject Code	MEXPS20S302				
Paper	English				
	Hindi				
Max. Marks	100				

Course Objectives: -Students will be able to:

1. Learn the active and reactive power flow control in power system.
2. Understand the need for static compensators.
3. Develop the different control strategies used for compensation.

Course Outcomes: -Students will be able to:

- CO1.** Acquire knowledge about the fundamental principles of Passive and Active Reactive.
CO2. Power Compensation Schemes at Transmission and Distribution level in Power Systems.
CO3. Learn various Static VAR Compensation Schemes like.
CO4. Thyristor/GTO Controlled Reactive Power Systems, PWM- Inverter based Reactive Power Systems and their controls.
CO5. Develop analytical modeling skills needed for modeling and analysis of such Static VAR Systems.

Unit	Syllabus	Periods
UNIT-I	Reactive power flow control in Power Systems Control of dynamic power unbalances in Power System - Power flow control Constraints of maximum transmission line loading Benefits of FACTS Transmission line compensation Uncompensated line -Shunt compensation, Series compensation Phase angle control Reactive power compensation Shunt and Series compensation principles Reactive compensation at transmission and distribution level.	8
UNIT-II	Static versus passive VAR compensator, Static shunt compensators: SVC and STATCOM Operation and control of TSC, TCR and STATCOM Compensator control Comparison between SVC and STATCOM.	9
UNIT-III	Static series compensation: TSSC, SSSC -Static voltage and phase angle regulators TCVR and TCPAR Operation and Control Applications, Static series compensation GCSC, TSSC, TCSC and Static synchronous series compensators and their Control.	11

UNIT-IV	SSR and its damping Unified Power Flow Controller Circuit Arrangement, Operation and control of UPFC Basic Principle of P and Q control Independent real and reactive power flow control-Applications.	13
UNIT-V	Introduction to interline power flow controller. Modeling and analysis of FACTS Controllers Simulation of FACTS controller Power quality problems in distribution systems, harmonics, loads that create harmonics modeling, harmonic propagation, series and parallel resonances mitigation of harmonics passive filters, active filtering – shunt, series and hybrid and their control Voltage swells, sags, flicker, unbalance and mitigation of these problems by power line conditioners IEEE standards on power quality.	14

Text Books:

1. K R Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age International Publishers, 2007.
2. X P Zhang, C Rehtanz, B Pal, “Flexible AC Transmission Systems- Modelling and Control”, Springer Verlag, Berlin, 2006.
3. AC Transmission Systems”, IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.

Reference Books:-

1. K.S. Sureshkumar, S.Ashok , “FACTS Controllers & Applications”, E-book edition, Nalanda Digital Library, NIT Calicut, 2003.
2. G T Heydt , “Power Quality”, McGraw-Hill Professional, 2007.
3. T J E Miller, “Static Reactive Power Compensation”, John Wiley and Sons, Network, 1982.

SYLLABUS
POWER SYSTEM

Class	M.TECH.	L	T	P	C
Semester/Year	III/II	3	-	-	3
Subject Name	INDUSTRIAL LOAD MODELING AND CONTROL				
Subject Code	MEXPS20S303				
Paper	English				
	Hindi				
Max. Marks	100				

Course Objectives: -Students will be able to:

1. Understand the energy demand scenario.
2. Understand the modeling of load and its ease to study load demand industrially.
3. Know Electricity pricing models.
4. Study Reactive power management in Industries.

Course Outcomes: -Students will be able to:

- CO1.** Load control techniques in industries and its application.
CO2. Learn different types of industrial processes.
CO3. Optimize the process using tools like LINDO and LINGO.
CO4. Apply load management to reduce demand of electricity during peak time.
CO5. Apply different energy saving opportunities in industries.

Unit	Syllabus	Periods
UNIT-I	Electric Energy Scenario-Demand Side Management-Industrial Load Management Load Curves-Load Shaping Objectives Methodologies- Barriers Classification of Industrial Loads Continuous and Batch processes -Load Modeling.	8
UNIT-II	Electricity pricing – Dynamic and spot pricing –Models Direct load control- Interruptible load control Bottom up approach- scheduling- Formulation of load Models Optimization and control algorithms - Case studies Reactive power management in industries controls-power quality impacts application of filters Energy saving in industries.	9
UNIT-III	Cooling and heating loads load profiling Modeling- Cool storage Types- Control strategies Optimal operation Problem formulation- Case studies.	11
UNIT-IV	Captive power units Operating and control strategies Power Pooling- Operation models Energy banking Industrial Cogeneration.	13

UNIT-V	Selection of Schemes Optimal Operating Strategies Peak load saving Constraints Problem formulation- Case study Integrated Load management for Industries.	14
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Text Books:

1. C.O. Bjork " Industrial Load Management - Theory, Practice and Simulations", Elsevier, the Netherlands,1989.
2. C.W. Gellings and S.N. Talukdar, Load management concepts. IEEE Press, New York, 1986, pp. 3-28.
3. Y. Manichaikul and F.C. Schweppe , " Physically based Industrial load", IEEE Trans. on PAS, April 1981.

Reference Books:-

1. H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Interscience Publication, USA, 1989.
2. I.J. Nagarath and D.P.Kothari, .Modern Power System Engineering., Tata McGraw Hill publishers, New Delhi, 1995.
3. IEEE Bronze Book- "Recommended Practice for Energy Conservation and cost effective planning in Industrial facilities", IEEE Inc, USA.

SYLLABUS

POWER SYSTEM

Class	M.TECH.	L	T	P	C
Semester/Year	III/II	3	-	-	3
Subject Name	BUSINESS ANALYTICS				
Subject Code	MEXPS20S304				
Paper	English				
	Hindi				
Max. Marks	100				

Course Objectives:

Students will be able to:

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques.
3. Understand relationships between the underlying business processes of an organization.
4. Gain an understanding of how managers use business analytics to formulate and solve.
5. Support managerial decision making.

Course Outcomes:

Students will be able to:

- CO1.** Demonstrate knowledge of data analytics.
CO2. Demonstrate the ability of think critically in making decisions based on data and deep analytics.
CO3. Demonstrate the ability to use technical skills in predicative.
CO4. Design modeling to support business decision-making.
CO5. Demonstrate the ability to translate data into clear, actionable insights.

Unit	Syllabus	Periods
UNIT-I	Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.	8

UNIT-II	Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.	9
UNIT-III	Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.	11
UNIT-IV	Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.	13
UNIT-V	Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making. Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.	14

Text Books:

1. "Big Data Demystified: How To Use Big Data, Data Science And AI To Make Better. Business Decisions And Gain Competitive Advantage" by David Stephenson PhD.
2. "Data Analytics For Beginners: Your Ultimate Guide To Learn And Master Data Analysis. Get Your Business Intelligence Right – Accelerate Growth And Close More Sales" by Victor Finch.
3. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.

Reference Books:-

1. "Data Strategy: How To Profit From A World Of Big Data, Analytics And The Internet Of Things" by Bernard Marr.
2. "Microsoft Excel Data Analysis and Business Modeling by Wayne L. Winston Naked Statistics: Stripping the Dread from the Data" by Charles Wheelan.
3. Business Analytics by James Evans, persons Education.

SYLLABUS
POWER SYSTEM

Class	M.TECH.	L	T	P	C
Semester/Year	III/II	3	-	-	3
Subject Name	INDUSTRIAL SAFETY				
Subject Code	MEXPS20S305				
Paper	English				
	Hindi				
Max. Marks	100				

Course Objectives:

Students will be able to:

1. Recognize and evaluate occupational safety and health hazards in the workplace.
2. Determine appropriate hazard controls following the hierarchy of controls.
3. Students will furthermore be able to analyze the effects of workplace exposures, injuries and illnesses, fatalities and the methods.
4. Prevent incidents using the hierarchy of controls, effective safety and health management systems and task oriented training.

Course Outcomes:

Students will be able to:

- CO1.** Evaluate workplace to determine the existence of occupational safety and health hazards.
- CO2.** Identify relevant regulatory and national consensus standards.
- CO3.** Along with best practices that are applicable.
- CO4.** Select appropriate control methodologies based on the hierarchy of controls.
- CO5.** Analyze injury and illness data for trends.

Unit	Syllabus	Periods
UNIT-I	Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.	8
UNIT-II	Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its	9

	relation with replacement economy, Service life of equipment.	
UNIT-III	Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.	11
UNIT-IV	Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.	13
UNIT-V	Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.	14

Text Books:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.

Reference Books:-

1. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
2. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

SYLLABUS
POWER SYSTEM

Class	M.TECH.	L	T	P	C
Semester/Year	III/II	3	-	-	3
Subject Name	OPERATIONS RESEARCH				
Subject Code	MEXPS20S306				
Paper	English				
	Hindi				
Max. Marks	100				

Course Objectives:

Students will be able to:

1. Impart knowledge in concepts and tools of Operations Research.
2. Understand mathematical models used in Operations Research .
3. Apply these techniques constructively to make effective business decisions.

Course Outcomes:

Students will be able to:

- CO1.** Students should able to apply the dynamic programming .
CO2. Solve problems of discreet and continuous variables.
CO3. Students should able to apply the concept of non-linear programming.
CO4. Students should able to carry out sensitivity analysis.
CO5. Student should able to model the real world problem and simulate it.

Unit	Syllabus	Periods
UNIT-I	Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.	8
UNIT-II	Formulation of a LPP - Graphical solution revised simplex method - duality theory – dual simplex method - sensitivity analysis - parametric programming.	9
UNIT-III	Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem – max flow problem - CPM/PERT.	11
UNIT-IV	Scheduling and sequencing - single server and multiple server models – deterministic inventory models - Probabilistic inventory control models - Geometric Programming.	13

UNIT-V	Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.	14
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Text Books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008.
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008.

Reference Books:-

1. Hitler Libermann Operations Research: McGraw Hill Pub. 2009.
2. Pannerselvam, Operations Research: Prentice Hall of India 2010.
3. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010.

SYLLABUS
POWER SYSTEM

Class	M.TECH	L	T	P	C
Semester/Year	III/II	-	-	20	10
Subject Name	Dissertation Phase – I				
Subject Code	MEXPS20S307				
Paper	English				
	Hindi				
Max. Marks	250				

Course Objectives:-

1. In this course unit, students will learn the process of research proposal writing, conducting research, and political science writing.
2. The focus is on preparing the Special Degree students for their research and dissertation writing.
3. Enable students to learn practical aspects of research.

Course Outcomes:-

Students will be able to:-

- CO1:** Synthesize knowledge and skills previously gained and applied to an in-depth.
- CO2:** Select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
- CO3:** Present the findings of their technical solution in a written report.
- CO4:** Present the work in International/ National conference or reputed journals.
- CO5:** Design linear programming approach using software.

Dissertation Phase – I

Guidelines for Dissertation Phase – I

1. As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.
2. The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.
3. After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred Model Curriculum of Engineering & Technology PG Courses [Volume -II].
4. literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits- Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.
5. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.
6. **Phase – I deliverables:** A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.
7. **Phase – I evaluation:** A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A.
8. In case of unsatisfactory performance, committee may recommend repeating the Phase-I work.

SYLLABUS
ROBOTICS & MECHATRONICS

Class	M.TECH	L	T	P	C
Semester/Year	IV/II	-	-	32	16
Subject Name	Dissertation Phase – II				
Subject Code	MEXPS20S401				
Paper	English				
	Hindi				
Max. Marks	500				

Course Objectives:-

1. In this course unit, students will learn the process of research proposal writing, conducting research, and political science writing.
2. The focus is on preparing the Special Degree students for their research and dissertation writing.
3. Enable students to learn practical aspects of research.

Course Outcomes:-

Students will be able to:-

- CO1:** Synthesize knowledge and skills previously gained and applied to an in-depth.
- CO2:** Select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
- CO3:** Present the findings of their technical solution in a written report.
- CO4:** Present the work in International/ National conference or reputed journals.
- CO5:** Design linear programming approach using software.

Dissertation Phase – II

Guidelines for Dissertation Phase – II

1. As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.
2. The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.
3. After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred Model Curriculum of Engineering & Technology PG Courses [Volume -II].
4. literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits- Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.
5. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.
6. **During phase – II**, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.
7. **Phase – II deliverables:** A dissertation report as per the specified format, developed system in the form of hardware and/or software, A record of continuous progress.
8. **Phase – II evaluation:** Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work.