Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute under Mumbai University)

Andheri (W), Mumbai – 400058

COURSE CONTENTS

(M. Tech. in Power Electronics & Power System)

Semester I

Academic Year: 2024-25

Sardar Patel College of Engineering, Andheri (West), Mumbai 400058
Year: 2024-2025

List of Courses

Advanced Power Electronics

Course Code	Course Name
PC-MTPX101	Advanced Power Electronics

Course pre-requisites	Power Electronics

Course Objectives

The objectives of this course are

1. To understand the switching behaviour of power electronics devices
2. To study the different power electronics circuits such as AC-DC, DC-AC converters
3. To demonstrate the design of power electronics circuit for different applications

Course Outcomes

Upon successful completion of the course, students should be able to

1. to classify and demonstrate the switching behavior of the power electronic devices
2. Analyze, design and select proper converters for various applications in electrical engineering

Course Content

Module No.	*Details*	*Hrs.*
1	**Advanced solid state devices:** • MOSFETs, IGBT, GTO, IGCT etc. • Power modules, intelligent power modules, gating circuits. • Thermal design, protection. • Digital signal processors used in their control	4
2	**Non-isolated dc-dc converters:** Buck, boost, Buck-boost, Cuk, SEPIC, Zeta in DCM and CCM **Isolated dc-dc converters:** Flyback, forward, Cuk, SEPIC, Zeta, half bridge, push-pull. Bridge in DCM and CCM Non-Isolated and Isolated dc-dc converters application in SMPS, UPS, welding and lighting systems. Analysis and design methodology (Case study based on IEEE papers)	8
3	**Modeling and control of DC to DC converters:** Review of classical methods of modeling. State space model of various ideal and non-ideal dc to dc converters, state space averaging techniques, small signal analysis, transfer function, feedback control, compensator design, voltage feed forward PWM control, current mode control, slope compensation, comparison of current mode and voltage mode control.	6
4	**Three-phase improved power quality dc-ac converters:** VSC, multilevel VSCs, multi pulse VSCs, PWM CSC (current voltage source converters).Analysis and design methodology **Multi pulse ac-dc converters:** Diode and thyristor based converters. Refer IEEE papers for case study.	6
5	Implementation aspects, modification of power circuit for four quadrant operation of inverter	6

6	**Applications of power electronic converters:** Residential applications, Industrial applications, Electric utility applications, Renewable energy technology applications. Case study based on IEEE papers	6
7	**Soft switching techniques:** Loss reduction in power electronic switches. Soft switching in DC-DC converters, Resonant soft switching converters. Case study based on IEEE papers	

Text Books	
1	N. Mohan, T. M. Undeland & W. P. Robbins, "Power Electronics: Converter, Applications & Design", John Wiley & Sons, 3rd edition sept. 2002, © 2003.
2	M.H. Rashid, "Power Electronics: Circuits Devices and Applications", Prentice Hall of India, 3rd edition 1994.
Reference Books	
1.	K. Bose, "Power Electronics & A.C. Drives", Prentice Hall, 2002.
2.	B. Xinbo Ruan "Soft-switching PWM Full-Bridge converters Topologies, Control & Design", John Wiley & Sons, Inc. 1st edition April 2014, © 2018

Sr. No.	Examination	Module
1	T-I	1,2
2	T-II	3,4
3	End Sem	1 to 7

Computer Aided Power System Analysis

Course Code	Course Name
PC-MTPX102	Computer Aided Power System Analysis

Course pre-requisites	PSA, PSOC, Numerical techniques, programming skills

Course Objectives

The objectives of this course are
1. To understand analysis of power systems using Computer methods.
2. To understand the advance techniques in the solution of power flow problem.
3. To understand the solution methods and techniques involved in power system analysis.
4. To understand the behavior of power system under healthy and faulty condition.

Course Outcomes

At the end of the course, students will demonstrate the ability to
1. Analyze the power system under symmetrical and unsymmetrical fault condition using Zbus
2. Appraise the use of matrix computation and optimization in the field of power system
3. Evaluate state of the complex power system by various state estimation tools.
4. Investigate the behavior of power system under different operating conditions

Course Content

Module No.	*Details*	*Hrs.*
1	**Mathematical concepts:** Sparse Matrices: Sparsity directed Optimal Ordering Schemes, Solution Algorithms – LU Factorization Numerical methods to solve non-linear equation: Gauss-Seidel, Newton Raphson method, Optimization Methods: Nonlinear constraint optimization, Lagrangian Multiplier approach, Linear programming, Least square Estimation	5
2	**AC Power Flow Analysis:** Preparing/using data files required for power flow studies such as line data, generation data, and bus data. Ybus formation by Power flow solution algorithms such as Gauss Siedel, Newton Raphson, Fast Decoupled and DC power flow for multi- machine or IEEE systems. Power flow studies for distribution systems.	6
3	**Analysis of Faulted Power System:** Symmetrical and Asymmetrical Faults, Zbus Formulation, Short Circuit Analysis of Large Power Systems using Zbus.	5
4	**Power System stability:** Numerical solution of Swing equation using Forward Euler method, Runge-kutta 4^{th} order method, and stability study of multi-machine system.	6
5	**Load Forecasting Techniques:** classification of forecasting, Introduction to time series, Linear regression, forecasting methodologies, estimation of average, trend & periodic components, time series approach, kalman filter approach, long term load forecasting for system planning. Introduction to Machine learning approach for load forecasting. Error analysis in load forecasting.	8

6	**Power System State Estimation**: Introduction, Network Topology Processing, observability analysis, Linear and non-linear state estimation	6
7	**Security Analysis:** Basic Concepts, Static Security Analysis at Control Centre, Contingency Analysis, Contingency Selection.	6

Term Work

Term work shall comprise of

1. Tutorials based on each module in the syllabus content
2. MCQ examination

Text Books

1. Kothari. D.P, Nagrath I.J., "Modern Power System Analysis" ,TMH publication.
2. Prabha Kundur, "Power System stability and Control", TMH Publication.

Reference Books

1. Grainger John J., Stevenson William D., "Power system Analysis", MC Graw Hill.
2. Chakrabarti .A, Halder.S, "Power System Analysis-Operation and Control", PHI
3. Hadi Sadat, "Power System Analysis", MC Graw Hill
4. S. A. Soman, S. A. Khaparde, Shubha Pandit, "Computational Methods for Large Sparse Power System Analysis: An Object Oriented Approach", Springer
5. M. A. Pai, D. Chatterjee, "Computer Techniques in Power System Analysis", McGraw Hill Education
6. David S. Watkins, Fundamentals of Matrix Computations, 3rd Edition, Willey-Inter science, 2010

Sr. No.	Examination	Module
1	T-I	1,2
2	T-II	3,4
3	End Sem	1 to 7

Research Methodology and IPR

Course Code	Course Name
PC-MTPX103	Research Methodology and IPR

Course pre-requisites	

Course Objectives

The objectives of this course are

1. To develop an ability to identify, formulate research problem.
2. To develop an ability to apply knowledge of research methodology to engineering
3. Problems.
4. To carry out research on engineering problems.
5. To develop an ability to investigate the phenomenon in a critical manner.
6. Develop critical thinking to find business opportunities and to solve questions related to industries.
7. To get knowledge on various kinds of research questions and research designs

Course Outcomes

Upon successful completion of the course, students should be able

1. To carry out literature survey by using various research considerations
2. To formulate the problem statement using research considerations.
3. Understanding that when IPR would take such important place in growth of individuals and nation, it is needless to emphasize the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
4. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Course Content

Module No.	*Details*	*Hrs.*
1	**Introduction** Definition of Research: Research Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Definition and Dimension of a Theory, Functions and Characteristics; Types of Theory: General Theory and Particular/Empirical Theory. Cases and their Limitations; Causal Relations. Philosophy and validity of research. Objectives of research.	8
2	**Characteristics of research** Various functions that describe characteristics of research such as systematic, valid, verifiable, empirical and critical approach.	4
3	**Types of research** Pure and applied research. Descriptive and explanatory research. Qualitative and quantitative approaches.	6
4	**Research Procedure** Formulating the Research Problem, Literature Review, Developing the objectives, preparing the research design including sample Design, Sample size.	6
5	**Considerations in selecting research problem**	6

	Relevance, interest, available data, choice of data, Analysis of data, generalization and interpretation of analysis	
6	**Patent Rights:** Scope of Patent Rights. Licensing and transfer of Technology. Patent information and databases. Geographical Indications.	6
7	**New Developments in IPR:** Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	6

Text Books
Reference Books
1. Dawson, Catherine, 2002, *Practical Research Methods,* New Delhi, UBS Publishers' Distributors.
2. Kothari, C.R.,1985, *Research Methodology-Methods and Techniques,* New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, *Research Methodology-A Step-by-Step Guide for Beginners*, (2nd ed), Singapore, Pearson Education.
4. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
5. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Sr. No.	Examination	Module
1	T-I	1,2 and part of 3
2	T-II	Remaining part of 3,4 and part of module 5
3	End Sem	1 to 7

Distributed Generation and Micro Grid

Course Code	Course Name
PE-MTPX101	**Distributed Generation and Micro Grid**
Course pre-requisites	Power System

Course Objectives
The objectives of this course are 1. To illustrate the concept of distributed generation. 2. To analyse the impact of grid integration. 3. To study concept of Micro grid and its configuration
Course Outcomes
Upon successful completion of the course, students should be able to 1. Review the conventional power generation 2. Analyse the concept of distributed generation and installation 3. Design the grid integration system with conventional and non-conventional energy sources 4. Design AC and DC icro grid 5. Explain planning and operational issues related to Distributed Generation & micro grid

Course Content		
Module No.	***Details***	***Hrs.***
1	**Introduction:** Energy crises, Non-conventional energy (NCE) resources: review of Solar PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass, and tidal sources. Distributed vs Central Station Generation Sources of Energy **Distributed generations:** Concept of distributed generations, topologies, selection of sources, regulatory standards/ framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547, DG installation classes, security issues in DG Implementations. Energy storage elements: Batteries, ultra-capacitors, flywheels. Captive power plants	6
2	**Impact of grid integration:** Requirements for grid interconnection, limits on operational parameters, voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues.	6
3	**Basics of a micro grid:** Concept and definition of micro grid, micro grid drivers and benefits, review of sources of micro grids, typical structure and configuration of a micro grid, AC and DC micro grids, Power Electronics interfaces in DC & AC micro grids.	6
4	**Control and operation of micro grid:** Modes of operation and control of micro grid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active & communication based techniques, micro grid communication infrastructure	6

5	Impact of Distributed Generation on the Power System. Power Quality Disturbances. Power quality issues in micro grids, regulatory standards, Micro grid economics	4
6	Control of DG inverters, phase locked loops, current control and DC voltage control for standalone and grid parallel operations. Protection of the converter Relaying and protection: distributed generation interconnection relaying, sensing using CTs and PTs.	6
7	DG planning cost implications of power quality, cost of energy and net present value calculations and implications on power converter design. Economics of Distributed Generation-Case Studies	8

Term Work

Term work shall comprise of

1. Tutorials based on each module in the syllabus content
   Case study based on IEEE papers
2. MCQ examination

Reference Books

1. Technical literature-papers published in power electronics related journals and IEEE standards.
2. Ned Mohan, Tore M. Undeland, William P Robbins, "Power Electronics: Converters, Application, and Design". Wiley, 2002.
3. Ranjan Rakesh, Kothari D.P, Singal K.C, "Renewable Energy Sources and Emerging Technologies",2nd Ed. Prentice Hall of India ,2011
4. Math H. Bollen, Fainan Hassan," Integration of Distributed Generation in the Power System", July 2011, Wiley –IEEE Press
5. Loi Lei Lai, Tze Fun Chan, "Distributed Generation: Induction and Permanent Magnet Generators", October 2007, Wiley-IEEE Press.
6. Roger A. Messenger, Jerry Ventre, "Photovoltaic System Engineering", 3rd Ed, 2010

Sr. No.	Examination	Module
1	T-I	1,2
2	T-II	3,4
3	End Sem	1 to 7

Power Electronics Applications to Renewable Energy

Course Code	Course Name
PE-MTPX102	Power Electronics Applications to Renewable Energy

Course pre-requisites	Power Electronics

Course Objectives

The objectives of this course are

1. To get exposure to wind and solar systems
2. To understand the factors involved in installation and commissioning of a Solar or Wind plant.
3. Learning the dynamics involved when interconnected with power system grid

Course Outcomes

Upon successful completion of the course, students should be able

1. Appreciate the importance of energy growth of the power generation from the renewable energy sources and participate in solving these problems
2. Demonstrate the knowledge of the physics of wind power and solar power generation and all associated issues so as to solve practical problems.
3. Demonstrate the knowledge of physics of solar power generation and the associated issues
4. Identify, formulate and solve the problems of energy crises using wind and solar energy

Course Content

Module No.	*Details*	*Hrs.*
1	**Solar Photovoltaic (PV) Systems**: PV cell concepts, Mathematical representation and basic performance characteristic, performance with series parallel combination of cells with identical and non-identical cell combination. **Energy Storage devices**.	6
2	**Power Electronics for PV applications:** Maximum Power point Tracking (MPPT) analysis. Algorithm for MPPT.	6
3	**Solar Energy System:** Analysis and Design of solar system for small and large installations- case study. Refer IEEE papers for case studies	6
4	**Wind Energy Systems:** Basic concept and Mathematical representation and basic performance characteristics and control strategy.	6
5	Generators and power electronics for wind turbines, power quality standards for wind turbines, Technical regulations for interconnections of wind farm with power systems. Isolated wind systems, reactive power and voltage control, economic aspects Case study based on IEEE papers	6
6	Analysis and Design of wind energy system for small & large installations Case study. Refer IEEE papers for case studies	6
7	**Grid connected wind and Solar Energy conversion systems:** Grid connectors, connection issues, its impacts on power	6

	system quality & dynamics –analysis	

Term Work

Term work shall comprise of

1.Tutorials based on . Using hardware such as latest microcontroller/processor such as Arduino, TI DSP, Atmel uC, Lattice CPLD evaluation board with peripherals.

2.MCQ examination

Text Books

1. K. Sukhatme and S.P. Sukhatme, "Solar Energy". Tata McGraw Hill, Second Edition, 1999
2. Mukund R Patel " Wind and Solar Power Systems: Design, Analysis, and Operation" 2nd edition CRC Taylor Francis, 2006.

Reference Books

1. Thomas Ackermann, Editor, "Wind power in Power Systems", John Wiley and sons ltd.2005
2. Siegfried Heier, "Grid integration of wind energy conversion systems", John Wiley and sons ltd., 2006

Sr. No.	Examination	Module
1	T-I	1,2
2	T-II	3,4
3	End Sem	1 to 7

Modeling and Analysis of Electrical Machines

Course Code	Course Name
PE-MTPX103	**Modeling and Analysis of Electrical Machines**

Course pre-requisites	Electrical Machines

Course Objectives

The objectives of this course are

1. To understand the representation electrical machines by the set of mathematical equations.
2. To realize the real behaviour of electrical machines.
3. To study the concepts of space phasors and frame transformation

Course Outcomes

Upon successful completion of the course, students should be able to

1. Implement the mathematical representation of electrical machines.
2. Demonstrate the reference frame theory and its application for representation of induction machine model.
3. Analyse the behaviour of induction machine from its mathematical model

Course Content

Module No.	***Details***	***Hrs.***
1	**Magnetically Coupled Circuits:** Coupled Circuit with and without Leakage Linear Magnetic System, Nonlinear Magnetic System, Computer Simulation of Coupled Circuits with and without leakage	5
2	**Electromechanical Energy Conversion:** Energy Relationship, Energy in Coupling Fields, Graphical Interpretation of Energy Conversion, Electromagnetic and Electrostatic Forces and Torques, Steady State and Dynamic Performance of and Electromechanical System	6
3	Machine Windings and Air Gap EMF, Winding Inductances and Voltage Equations: Synchronous Machine, Induction Machine	5
4	**Reference Frame Theory:** Introduction, Equations of Transformation Change of Variables, Stationary Circuit Variables, Transformed to the Arbitrary Frame, Resistive Elements, Inductive Elements, Capacitive Elements, Commonly used Reference Frame, Transformation between Reference Frames, Transformation of a Balanced Set, Balanced Steady State Phasor Relationships, Balanced Steady State Voltage Equations, Variables Observed from Several Frame of Reference Case study based on IEEE papers	8
5	**Theory of Symmetrical Induction Machines:** Voltage Equations in Machine Variables, Torque Equations in Machine Variables, Equations of Transformation for Rotor Circuits, Voltage Equations in Arbitrary Reference Frame Variables Case study based on IEEE papers	5
6	**Symmetrical Induction Machines Steady State and Dynamic Characteristics:**	8

	Analysis of Steady State Operation, Free Acceleration Characteristics, Free Acceleration Characteristics Viewed from Various Reference Frames, Dynamic Performance during Sudden Changes in Load Torque, Dynamic Performance during a Three Phase fault at Machine Terminals	
7	**Introduction to Synchronous Machine Theory:** Voltage Equations in Machine Variables, Torque Equations in Machine Variables, Stator Voltage Equations in Arbitrary Reference Frame Variables, Voltage Equations in Rotor Reference Frame Variables- Parks Equations, Torque Equation in Substitute Variables, Rotor Angle and Angle between Rotors.	5

Term Work
Term work shall comprise of 1. Tutorials based FEM simulation software such as COMSOL, Maxwell, Quickfield etc should be used to analyse machine design and behaviour 2. Case study based on IEEE papers 3. MCQ examination
Text Books
1. R. Krishnan, "Electric Motor & Drives: Modeling, Analysis and Control", Prentice Hall of India 2015. 2. P. C. Krause, "Analysis of Electrical Machinery and Drive System," Wiley IEEE Press, Third edition, 2013
Reference Books
1. Charles Kingsley, Jr., A.E. Fitzgerald, Stephen D. Umans, "Electric Machinery", Tata McGraw Hill, Seventh edition, 2013. 2. Ned Mohan, "Advanced electrical drives Analysis, Control and Modeling using Simulink", Wiley, 2014.

Sr. No.	Examination	Module
1	T-I	1,2
2	T-II	3,4
3	End Sem	1 to 7

Reliability Assessment of Power System

Course Code	Course Name
PE-MTPX104	**Reliability Assessment of Power System**

Course pre-requisites	Power System

Course Objectives

The objectives of this course are

1. The course will give a comprehensive overview of power system reliability.
2. Evaluation of conventional and non-conventional power generation system reliability.
3. To learn Modern Trends in Power system Reliability analysis

Course Outcomes

Upon successful completion of the course, students should be able to

1. Able to have a thorough understanding of the main principles in power system reliability analysis, knowledge of different methods and tools for reliability analysis
2. Able to interpret some advanced concepts of power system reliability that will be useful for engineering professional practice in the power sector operation and planning.
3. Able to model and analyse power system with respect to reliability of supply

Course Content

Module No.	***Details***	***Hrs.***
1	**Power system Reliability:** Introduction, Basic reliability Concepts, Terms and Definitions, outage, failure rate, and outage rate availability, unavailability, Reliability function, Mean time to failure, Hazard Rate Function, Bathtub Curve. Hierarchical levels of Power system Functional Zones	6
2	**Reliability of Systems:** Serial Configuration, Parallel Configuration, Combined Series – Parallel Systems, System Structure Faction, Minimal Cuts and Minimal Paths. Reliability models, Markov process, Monte Carlo Simulation.	6
3	**Generation system reliability analysis:** Introduction, Probabilistic generating unit models, Probabilistic load models, Effective load, Reliability analysis for an Isolated system	6
4	**Generating Capacity reliability Evaluation**: Static Generating capacity: Introduction, Basic probability methods and Frequency & Duration method, capacity outage probability table, recursive algorithm, Evaluation of: loss of load indices, Loss of load expectation & Loss of energy Spinning Generating capacity: Introduction, load forecast uncertainty de rated capacity levels	6
5	Reliability evaluation of: Grid connected PV and Concentrated	6

	Solar Power (CSP) system, Wind energy system - Case study. Cost estimation, Economic and Technical Analysis of Distributed Generation Connection: Wind Farm & PV system Case Study	
6	Distributed Generation and its impacts on distribution system and reliability & Evaluation technique – Case study.	6
7	Modern Trends in Power system Reliability analysis, XML Annotations for power system reliability data representation, Web service based power system reliability data generation model. XMLised Power System Reliability Data Generation Service Interface & Implementation	6

Term Work
Term work shall comprise of 1. Tutorials based on each module in the syllabus content 2. MCQ examination
Text Books
1. Roy Billinton and Ronald N. Allan, "Reliability Evaluation of Power System," Plenum, Press, 2nd edition, 1996.
Reference Books
1 R.L. Sullivan, "Power System Planning," Tata McGraw Hill Publishing Company, 1st edition,1997. **2** Roy Belington and Ronald N Allan, "Reliability Assessment of Large Electric Power Systems", Kluwer academic publishers, 2nd edition 1995. **3** X. Wang and J.R. McDonald, "Modern Power System Planning", McGraw Hill, 1994. **4** Ali Chowdhury, Don Koval, "Power distribution system reliability- Practical methods and applications", Wiley- IEEE press, April 2011.

Sr. No.	Examination	Module
1	T-I	1,2
2	T-II	3,4
3	End Sem	1 to 7

Restructuring and Deregulation of Power System

Course Code	Course Name
PE-MTPX105	**Restructuring and Deregulation of Power System**

Course pre-requisites	Power system-I and power system –II

Course Objectives

The objectives of this course are

1. To differentiate between vertically integrated and deregulated power system.
2. Challenges faced in operating restructured power system with reliability, security and economic efficiency.
3. Reforms adopted by developing country like India

Course Outcomes

Upon successful completion of the course, students should be able to

1. Identify different electrical market designs.
2. Understand fundamentals of micro economics.
3. Determine the suitable pricing method for centralised and decentralised trading.
4. Understand ancillary service and congestion management requirement of restructured power system

Course Content

Module No.	*Details*	*Hrs.*
1	**Introduction of restructured power system.** • Reasons for restructuring and deregulation of power system • Entities involved • Different model of competition • Electrical market, market of commodities	**6**
2	**Fundamentals of micro economics** • Consumer behaviour • Supplier behaviour • Market equilibrium • Various cost of production • Long term and short-term cost • Types of markets • Markets with imperfection competition	**8**
3	**Introduction to optimization** • Linear optimization • Convexity • Duality • KKT condition • Lagrange multiplier • Optimal dispatch of generation	**6**

4	**Optimal Power Flow and Congestion Management.** • Optimal power flow – AC and DC formulation • Spot Pricing • Decentralized trading over the transmission network. • Centralized trading over the transmission network.	**8**
5	**Participating in markets for electrical energy** • Consumer's perspective • Producer's perspective	**4**
6	**System security and ancillary service** • Ancillary service needs • Obtaining ancillary service • Buying ancillary service • Selling ancillary service	**5**
7	**Reforms in Indian Power Sector** • Frame work of Indian power sector • Electricity act 2003 and amendments • Transmission system cost allocation • Power exchanges – Day ahead market, real-time market • Deviation settlement mechanism • Ongoing and future developments	**5**
Term Work		
Term work shall comprise of 1. Tutorials based on Case study based on IEEE papers 2. MCQ examination		

Text Books

1. Daniel Krischen and Goran Strbac, "Fundamental of Power System Economics", John Wiley and Sons Ltd ,2004.
2. Sally Hunt, "Making Competition Work in Electricity", John Wiley and Sons, Inc.,2002
3. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolean, "Operation of restructured Power systems", Kluwer Academic Pub., 2001.
4. Mohammad Shahidehpour, Muwaffaq Alomoush, "Restructured electrical power systems operation, trading and volatility", Marcel Dekker

Reference Books

1. Lorrin Philipson, H. Lee Willis, "Understanding electric utilities and de-regulation", Marcel Dekker Pub.1998.
2. Steven Stoft, "Power system economics: designing markets for electricity", John Wiley and Sons, 2002

Sr. No.	Examination	Module
1	T-I	1,2
2	T-II	3,4
3	End Sem	1 to 7

Optimization Techniques

Course Code	Course Name
PE-MTPX106	Optimization Techniques

Course pre-requisites	

Course Objectives

The objectives of this course are
1. Understand various classical optimization techniques
2. Understand intelligent optimization techniques

Course Outcomes

Upon successful completion of the course, students should be able to
1. Understand importance of optimization
2. Apply basic concepts of mathematics to formulate an optimization problem
3. Analyse and appreciate variety of performance measures for various optimization problems

Course Content

Module No.	*Details*	*Hrs.*
1	Introduction to Classical Methods & Linear Programming Problems Terminology, Design Variables, Constraints, Objective Function, Problem Formulation. Calculus method, Kuhn Tucker conditions, Method of Multipliers	7
2	Linear Programming Problem, Simplex method, Two-phase method, Big-M method, duality, Integer linear Programming, Dynamic Programming, Sensitivity analysis	7
3	Single Variable Optimization Problems: Optimality Criterion, Bracketing Methods, Region Elimination Methods, Interval Halving Method, Fibonacci Search Method, Golden Section Method. Gradient Based Methods: Newton-Raphson Method, Bisection Method, Secant Method, Cubic search method	7
4	Multi Variable and Constrained Optimization Technique, Optimality criteria, Direct search Method, Simplex search methods, Hooke-Jeve s pattern search method, Powells conjugate direction method, Gradient based method, Cauchy,,s Steepest descent method, Newton,,s method , Conjugate gradient method. Kuhn - Tucker conditions, Penalty Function, Concept of Lagrangian multiplier, Complex search method, Random search method	7
5	Intelligent Optimization Techniques: Introduction to Intelligent Optimization, Soft Computing, Genetic Algorithm: Types of reproduction operators, crossover & mutation, Simulated Annealing Algorithm, Particle Swarm Optimization (PSO) - Graph 7Grammer Approach – Example Problems	7

6	Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP	7

Term Work

Term work shall comprise of

1. Tutorials
2. MCQ examination

Text Books

1. S. S. Rao, "Engineering Optimization: Theory and Practice", Wiley, 2008.
2. K. Deb, "Optimization for Engineering design algorithms and Examples", Prentice Hall, 2005.

Reference Books

1. C.J. Ray, "Optimum Design of Mechanical Elements", Wiley, 2007.
2. R. Saravanan, "Manufacturing Optimization through Intelligent Techniques, Taylor & Francis Publications, 2006.
3. D. E. Goldberg, "Genetic algorithms in Search, Optimization, and Machine learning", Addison Wesley Longman Publishing, 1989.

Sr. No.	Examination	Module
1	T-I	1,2
2	T-II	3,4
3	End Sem	1 to 6

Electric Vehicle System Design

Course Code	Course Name
PE-MTPX107	Electric Vehicle System Design

Course pre-requisites	Machines I and Machines II

Course Objectives

1. To illustrate the design philosophies used in the EV domain.
2. To explore the selection of power and control architecture of EV drives
3. To study the design aspects of EV battery packs and other auxiliary systems

Course Outcomes

Upon successful completion of the course, students should be able to
1. Select and size the electric motor for a particular EV application and performance criteria
2. Select and size the battery pack to meet desired EV performance and
3. Design the EV drive system with functional safety considerations.
4. Illustrate the use of hybrid energy source for EV performance improvement
5. Illustrate the design aspects of Automotive Subsystem

Course Content

Module No.	*Details*	*Hrs.*
1	**Selection/ Sizing of EV Electric Motors** Electric Vehicle modelling, Tractive force calculations, Design considerations for 2W, 3W and 4W EVs; Torque, power and Speed requirement, Traction Limit, Maximum Acceleration Limit, Maximum Grade Limit, Vehicle Power Demand Vehicle Performance Envelope, and Vehicle Power Envelope; Vehicle Power Demand during Driving Cycles. Design considerations for EV motors and their cooling system. Application Examples of EV /HEV motors with vehicles and motor specifications.	08
2	**Selection/ Sizing of Battery pack and other Energy Resource:** Selection of type of Battery pack for 2W, 3W and 4W EVs, Battery pack sizing, Design considerations, Range per charge, range anxiety, EV motor power requirement, Impact of road conditions, environmental conditions and traffic conditions. High-Voltage Cabling and Disconnects, Safety in Battery Design, Testing for safety. Accelerated Reliability Testing of Electric Vehicles, Battery Cycle Life versus Peak Power and Rest Period. Selection and sizing of Fuel cell for FCEV, design considerations; Battery-ultra-capacitor hybrid combination sizing, performance analysis. Design considerations for Ultra-capacitor based EV, requirement of charging infra. Flywheel selection and sizing for EV/HEV applications.	06
3	**Automotive Subsystem Design:** Electronic Control Unit (ECU) and its Control Features, Communications between ECUs, Control Software Development:	04

	Software-in-the-Loop (SIL) Simulation and Hardware-in-the-Loop (HIL) Simulation. Acceleration and braking control, regenerative braking; Automotive Steering Systems. Design considerations of HVAC controller	
4	**EV System integration:** EMC design on ECU level, EMC design on system level and in special subsystems, Radiated emissions and Conducted emissions, EMI EMC measurements.	04
5	**Design of Charging Infrastructure-1:** Design considerations for AC charger: vehicle interface and charging protocol design. applicable charging standards. Installation guidelines and grid requirement for charger installations.	08
6	**Design of Charging Infrastructure-2:** Design of On-Board Charger (OBC)-Schematic, power topology and control, Power capacities, regenerative braking control. Design considerations of DC fast charger: vehicle interface and charging protocol design. Connectivity and applicable charging standards	06
7	**Design with Functional Safety of Automotive Electronics:** Functional Safety requirements of Automotive Electronics; ASIL identification and safety goal finalization, ISO 26262. Energy Storage integrity / protection: rupture and toxic gas management; low energy stranding, Unintended vehicle movement, shock protection, and Elimination of potential thermal/ explosive event. Hazard and Risk Analysis (HARA) for different situations, Testing of vehicles for compliance of safety norms	06
Term Work		
Term work shall comprise of 1. Tutorials based on each module in the syllabus content 2. MCQ examination		

Text Books / Reference Books
1. Design and Control of Automotive Propulsion Systems by Zongxuan Sun and Guoming Zhu, CRC Press, 2015
2. Electric Vehicle Machines and Drives Design, Analysis and Application by K. T. Chau, IEEE Press and Wiley, 2015
3. I. Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
4. M. Ehsani, Y. Gao, S.E. Gay and Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press. 2005
5. Sheldon Williamsom, Energy Management Strategies for Electric and Plug-in Hybrid Vehicles, Springer 2013
6. J. Larminie and J. Lowry, Electric Vehicle Technology Explained, Wiley, 2003
7. EMC and Functional Safety of Automotive Electronics by Kai Borgeest, IET, 2018

Sr. No.	Examination	Module

1	T-I	1 and 2
2	T-II	3 and 4
3	End Sem	1 to 7

Advanced Power Electronics Laboratory

Course Code	Course Name
PL-MTPX101	**Advanced Power Electronics Laboratory**

Course pre-requisites	Power Electronics

Course Objectives
The objectives of this course are 1. To realize of the real world problem of power electronics systems. 2. To study model of the power electronics systems. 3. To understand the techniques of voltage control using PWM techniques
Course Outcomes
Upon successful completion of the course, students should be able to 1. judge the results of the simulation study 2. Able to simulate the given electrical system for various operating conditions.
Course Content
Laboratory work to include at least Eight MATLAB Simulations/mini project (refer IEEE papers as case study and implement) **Using hardware such as latest microcontroller/processor such as Arduino, TI DSP, Atmel uC, Lattice CPLD evaluation board with peripherals atleast for some experiments.** 1. Study and simulate the switching characteristics MOSFETs, IGBT, GTO. 2. Simulation of Isolated and non-isolated DC-DC converters and verifying their applications in UPS, SMPS etc. 3. Simulating state space model of buck, boost converters. 4. VSC and CSC converters simulation 1 and 3 phase 5. Multi pulse DC-AC converters simulations based on papers or case study 6. Implementation of four quadrant operation of converter using inverters 7. Simulation study of soft switching techniques. ZCS and ZVS refer papers. 8. Applications of power electronics in residential, industrial etc case study
Term Work
Term work shall comprise of 1. Laboratory internal examination 2. MCQ or viva voce examination

Text Books
Reference Books
1. N. Mohan, T. M. Undeland & W. P. Robbins, “Power Electronics: Converter, Applications and Design”, John Wiley & Sons, 3rd edition sept. 2002, © 2003. 2. M.H. Rashid, “Power Electronics: Circuits Devices and Applications”, Prentice Hall of India,3rd edition 1994. 3. B. K. Bose, “Power Electronics & A.C. Drives”, Prentice Hall, 2002. 4. Xinbo Ruan “Soft-switching PWM Full-Bridge converters Topologies, Control & Design”, John Wiley & Sons, Inc. 1st edition April 2014, © 2018

Computer Aided Power System Analysis Laboratory

Course Code	Course Name
PL-MTPX102	**Computer Aided Power System Analysis Laboratory**

Course pre-requisites	Power System

Course Objectives
The objectives of this course are 1. To understand analysis of power systems using Computer methods. 2. To understand the advance techniques in the solution of power flow problem. 3. To understand the solution methods and techniques involved in power system analysis. 4. To understand the behviour of power system under healthy and faulty condition.
Course Outcomes
Upon successful completion of the course, students should be able to 1. Appraise the use of computational methods in the solution of power flow problem 2. Investigate the behaviour of power system under different operating conditions.

Course Content
Laboratory work to include at least Eight Simulations or mini projects based on reference papers. (refer IEEE papers) 1. Write MATLAB code for 4x4 Y bus matrix formation. 2. Write MATLAB code for 5X5 Y bus matrix formation 3. Compute Y bus in matlab for the following 14 bus system 4. Case study Newton Raphson method refer paper. 5. Case study Guass Siedel method refer paper. 6. LU decomposition code and case study. 7. Compute Y bus in MATLAB for the following 30 bus system 8. Seminar based on case study.
Term Work
Term work shall comprise of 1. Experiments 2. MCQ examination
Text Books
1. Kothari. D.P, Nagrath I.J., “Modern Power System Analysis” ,TMH publication. 2. Prabha Kundur, “Power System stability and Control”, TMH Publication.
Reference Books

1. Grainger John J., Stevenson William D., "Power system Analysis", MC Graw Hill.
2. Chakrabarti .A, Halder.S, "Power System Analysis-Operation and Control", PHI
3. Hadi Sadat, "Power System Analysis", MC Graw Hill
4. S. A. Soman, S. A. Khaparde, Shubha Pandit, "Computational Methods for Large Sparse Power System Analysis: An Object Oriented Approach", Springer
5. M. A. Pai, D. Chatterjee, "Computer Techniques in Power System Analysis", McGraw Hill Education
6. David S. Watkins, Fundamentals of Matrix Computations, 3rd Edition, Willey-Inter science, 2010

Constitution of India

Course Code	Course Name
IK-MTPX101	Constitution of India

Course pre-requisites	

Course Objectives
Students will be able to: 1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective. 2. To address the growth of Indian opinion regarding modern Indian intellectuals" constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism. 3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution
Course Outcomes
Students will be able to: 1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics. 2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India. 3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution. 4. Discuss the passage of the Hindu Code Bill of 1956

Course Content

Module No.	*Details*	*Hrs.*
1	History of Making of the Indian Constitution: History Drafting, Committee, (Composition & Working)	3
2	Philosophy of the Indian Constitution: Preamble Salient Features	3
3	Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.	3
4	Organs of Governance: Model Curriculum of Engineering & Technology PG Courses [Volume -II][194], Parliament, Composition ,Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions	3
5	Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat.	3
6	Elected officials and their roles, CEO Zila Pachayat: Position and	3

	role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy	
7	Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women	3

Reference Books

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. 4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Sr. No.	Examination	Module
1	T-I	1,2 and part of 3
2	T-II	Remaining part of 3,4 and part of module 5
3	End Sem	1 to 7

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute under Mumbai University)
Andheri (W), Mumbai – 400058

COURSE CONTENTS

(M.Tech. in Power Electronics & Power System)

Semester II

Academic Year: 2024-25

List of Courses

Power System Dynamics and Control

Course Code	Course Name
PC-MTPX201	**Power System Dynamics and Control**

Course pre-requisites	Power System

Course Objectives
The objectives of this course are 1. To study the stability considerations in power system. 2. To understand the different stability of power system and multi-machine stability concept 3. To study of voltage stability, PV, QV and PQ curves 4. To study of improving the stability of power system
Course Outcomes
Upon successful completion of the course, students should be able to 1. Understand and appreciate the stability concept in the power network. 2. Apply the effects of various electrical parameter on stability

Course Content

Module No.	***Details***	***Hrs.***
1	Introduction to Power System Stability • Power system operation and control • Stability problems faced by power systems • Impact on power system operation control • Concept of equilibrium, small and large Disturbance in stability • Analysis using Numerical Integration Techniques	6
2	Modeling of a Synchronous Machine • Physical characteristics • Rotor position dependent Model • D-Q transformation, Parks transformation • Model with Standard parameters • Steady state Analysis of synchronous machine • Short circuit transient analysis of a synchronous machine • Synchronous machine connected to infinite Bus	6
3	Modeling of Exciters and prime mover system, transmission lines and load	6
4	Transient stability, swing equation, equal area criterion, solution of swing equation, Numerical methods, Euler method, Runge-Kutta method, critical clearing time and angle, effect of excitation system and governors, Application of power system stability	6
5	Multi machine stability, extended equal area criterion, transient	6

	energy function approach	
6	Methods of improving stability, transient stability enhancement High speed fault clearing ,steam turbine fast valving, high speed excitation systems, small signal stability enhancement power 6system stabilizers voltage stability enhancement, reactive power control.	6
7	Voltage stability, generation aspects, transmission system aspects, load aspects, PV curve, QV curve, PQ curve, analysis with static loads, load ability limit, sensitivity analysis, continuation power flow analysis, Instability mechanisms-examples	6

Text Books
1. Kundur, P., "Power System Stability and Control", McGraw-Hill International Editions, 1994. **2.** K. R. Padiyar, Power System Dynamics, Stability & Control, 2nd Edition, B.S. Publications, Hyderabad, 2002.
Reference Books
1. Anderson, P.M. and Fouad, A.A., "Power System Control and Stability", John Wiley, second edition 2003. **2.** Van Cutsem, T. and Vournas, C., "Voltage Stability of Electric Power Systems", Springer **3.** P. Sauer & M.A.Pai, Power System Dynamics & Stability, Prentice Hall, 1997.

Sr. No.	Examination	Module
1	T-I	1,2
2	T-II	3,4
3	End Sem	1 to 7

Advanced Control of Electrical Drives

Course Code	Course Name
PC-MTPX202	Advanced Control of Electrical Drives

Course pre-requisites	Electrical Drives

Course Objectives

The objectives of this course are

1. To study the torque-speed characteristics of AC and DC drives and different types of load
2. To discuss modification of torque speed characteristics of AC and DC motors as per load requirements.
3. To understand the power modulators and control strategies
4. To study steady state stability of the motor load system and higher level control of ac drives.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Apply the knowledge of electrical drives system for various applications such as flexible production systems, energy conservation, renewable energy, transportation etc., making Electric Drives an enabling technology.
2. Understand the basic requirements placed by mechanical systems on electric drives.
3. Apply the basic principles of power electronics in drives using switch-mode converters and pulse width modulation to synthesize the voltages in dc and ac motor drives.
4. Understand the need of modification of the torque speed characteristics of machines. Describe the operation of induction machines in steady state and dynamic condition.
5. Appreciate the speed control of induction motor drives in an energy efficient manner using power electronics with higher level control technique such as vector control.

Course Content

Module No.	*Details*	*Hrs.*
1	Review: Basics of AC and DC Drives	4
2	Principle of phase control, Fundamental relations; Analysis of series and separately excited DC motor with single-phase and three-phase converters, Continuous and discontinuous armature current operations; Current ripple and its effect on performance; Operation with freewheeling diode; Implementation of braking schemes; Drive employing dual converter. Constant torque and constant horsepower operations.	6
3	Modeling of DC drive elements: Equivalent circuit, transfer	6

	function of self, separately excited DC motors, Linear Transfer function model of power converters, Sensing and feedback elements, Closed loop speed control, Current and speed loops, P, PI and PID controllers response comparison, Simulation of converter and chopper fed DC drive.	
4	AC voltage controller fed induction machine operation, Energy conservation issues ,V/f operation theory, requirement for slip and stator voltage compensation, CSI fed induction machine , Operation and characteristics	8
5	Field oriented control of induction machines , DC drive analogy, Direct and Indirect methods, Flux vector estimation.	6
6	Direct torque control of Induction Machines, Torque expression with stator and rotor fluxes, DTC control strategy	6
7	Synchronous motor control, Brush and Brushless excitation, Load Commutated inverter fed drive.	6

Text Books
1. G. K. Dubey, "Power Semiconductor controlled Drives", Prentice Hall Inc., New Jersey, 1989. 2. R. Krishnan, "Electric Motor Drives – Modeling, Analysis and Control", Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.
Reference Books
1. G. K. Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi, 2001. 2. B. K. Bose "Modern Power Electronics and AC Drives", Pearson Education (Singapore) Pte. Ltd., New Delhi, 2003. 3. Vedam Subramanyam, "Electric Drives – Concepts and Applications", Tata McGraw-Hill Publishing company Ltd., New Delhi, 2002.

Sr. No.	Examination	Module
1	T-I	1,2
2	T-II	3,4
3	End Sem	1 to 7

Seminar/Mini Project

Course Code	Course Name
PC-MTPX203	**Seminar/Mini Project**

Course pre-requisites	

Course Outcomes		
1. Student will be able to apply the skill of presentation and communication techniques. 2. Student will be able to use the knowledge of the fundamentals of subjects to search the related literature. 3. Student will be able to analyze the available resources and to select most appropriate one.		
Sr. No.	**Course content (Seminar):**	***Hrs.***
1	The student gathers and presents information/data about seminar topic allotted to him/her. The report and presentation shall include review of literature, case studies if applicable and findings about recent trends in the area of seminar topic. On completion of the work the student shall prepare a report and will give a Seminar on the report.	**48**
	Course Content (Mini Project):	
1	The mini project work extends for a single semester and exposes the student to develop and present his/her work related to specific topic. The work at this stage may involve review of literature, laboratory experimental work, case study, field data collection and analysis etc. On completion of the exhaustive literature work the student shall prepare a report and will give a Seminar on the report.	**48**
	Guidelines for Seminar-II/Mini Project	
1.	Seminar/ mini project should be based on thrust areas in Electrical Engineering (Power Electronics and Power System aspect is appreciated)	
2.	Students should do literature survey and identify the topic of seminar/ mini project and finalize in Consultation with mentor/Guide/Supervisor.	
3.	Students should use multiple literatures and understand the topic and compile the report in standard format as in front of Examiners.	
	Assessment Guidelines:	
1.	Quality of Literature survey and Novelty in the topic	
2.	Relevance to the specialization	
3.	Understanding of the topic	
4.	Quality of Written and Oral Presentation	

Advanced Techniques in Power System Protection

Course Code	Course Name
PE-MTPX201	**Advanced Techniques in Power System Protection**

Course pre-requisites	Switchgear and Protection

Course Objectives
The objectives of this course are to 1. Understand the art and science of numerical relay technology. 2. Demonstrate the hardware description of relaying system
Course Outcomes
Upon successful completion of the course, students should be able to **1.** Exposure to the modern protection practices. **2.** Appreciate new trends in relay technologies

Course Content

Module No.	***Details***	***Hrs.***
1	**Review of Relaying Practices:** Evolution of digital relays from electromechanical relays, Review of protection philosophies for transmission lines, generators and transformers. Modeling of Current and voltage transformers	5
2	**Mathematical background to protection algorithms:** Finite difference Techniques, Interpolation formulae-Forward, backward and central difference, interpolation, Numerical differentiation, Curve fitting and smoothing, Least squares method, Fourier series and Fourier transform	8
3	**Numerical Relay :** architecture, sampling theorem, anti-aliasing filter, Fourier Algorithm, Full cycle window algorithm for phasor estimation	5
4	**Transmission Line Protection:** Distance relay scheme for three phase line, Different relay algorithms for distance protection, Out of step blocking and tripping schemes.	8
5	**Digital differential Protection**: protection of generator, transformer, bus bar protection, Travelling wave based protection schemes.	8
6	**Adaptive Relaying:** Need for adaptive relaying, Adaptive relaying for transmission lines, transformer, Auto-reclosing.	4
7	**Wide Area Measurement Applications:** WAMS architecture, WAMS based out of step relaying, supervision of back up zones, Intelligent load shedding, Intelligent islanding. Travelling Wave based techniques	4

Term Work
Term work shall comprise of . 1. Tutorials include case study of IEEE papers and some real time data study 2. MCQ examination

Text Books
1. A.G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", Wiley/Research studies Press, 2009
Reference Books
1. A.T. Johns and S. K. Salman, "Digital Protection of Power Systems", IEEE Press,1999 **2.** Gerhard Ziegler, "Numerical Distance Protection", Siemens Publicis Corporate Publishing, 2006 **3.** S.R. Bhide "Digital Power System Protection" PHI

Sr. No.	Examination	Module
1	T-I	1,2
2	T-II	3,4
3	End Sem	1 to 7

Smart Grid Technologies

Course Code	Course Name
PE-MTPX202	**Smart Grid Technologies**

Course pre-requisites	Power System

Course Objectives
The objectives of this course are 1. To understand the concept of smart grid and its advantages over conventional grid 2. To understand smart metering techniques 3. To learn wide area measurement techniques 4. Understand the problems associated with integration of distributed generation & its solution through smart grid.
Course Outcomes
Upon successful completion of the course, students should be able to 1. Appreciate the difference between smart grid & conventional grid 2. Apply smart metering concepts to industrial and commercial installations 3. Formulate solutions in the areas of smart substations ,distributed generation and wide area measurements 4. Come up with smart grid solutions using modern communication technologies

Course Content

Module No.	***Details***	***Hrs.***
1	**Introduction to Smart Grid:** Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Concept of Robust Self Healing Grid, Present development & International policies in Smart Grid, Threats and security in smart grid	
2	**Introduction to Smart Meters:** Real Time Pricing. Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid. Smart Sensors, Home & Building Automation, Smart Substations, Substation Automation, Feeder Auto	
3	Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection. Smart storage like Battery. SMES, Pumped Hydro. Compressed Air Energy Storage, Wide Area Measurement System (WAMS). Phase Measurement Unit (PMU)	
4	**Concept of micro-grid:** Need & applications of micro-grid Formation of micro-grid, Issues of Interconnection. Protection & control of micro-grid, Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators. Fuel-cells. Micro-turbines, Captive power plants. Integration of renewable energy sources.	

5	**Power Quality & EMC in Smart Grid**: Power Quality issues of grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid. Web based Power Quality monitoring. Power Quality Audit	
6	Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighbourhood Area Network (NAN), Wide Area Network (WAN), Bluetooth. ZigBee	
7	GPS, Wi-Fi, Wimax based communication, Wireless Mesh Network, Basics of cloud computing and cyber security for smart grid, Broadband Over Power Line(BPL), IP protocols	

Term Work

Term work shall comprise of

1.Tutorials include case study of IEEE papers and some real time data study

2. MCQ examination

Text Books

1. Ali Keyhani, "Design of smart power grid renewable energy systems", Wiley IEEE,2011
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response",CRC Press ,2009

Reference Books

1. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, "Smart Grid: Technology and Applications", Wiley 2012
2. Stuart Borlase,"Smart Grid :Infrastructure , Technology and solutions " CRC Press
3. A.G. Phadke, "Synchronized Phasor Measurement and their Applications", Springer

Sr. No.	Examination	Module
1	T-I	1,2
2	T-II	3,4
3	End Sem	1 to 7

DSP Control in Power Electronics

Course Code	Course Name
PE-MTPX203	**DSP Control in Power Electronics**

Course pre-requisites	Digital Electronics

Course Objectives

The objectives of this course are

1. To understand comparison of microcontrollers and digital signal processors
2. To learn and implement DSP programming
3. To understand internal details of DSP architecture, peripheral, addressing modes, interrupt structure, hardware multiplier

Course Outcomes

Upon successful completion of the course, students should be able to

1. Understand and use new /advanced DSP
2. Implement the basic power electronics control algorithm such as PWM techniques using DSPs

Course Content

Module No.	***Details***	***Hrs.***
1	Review of microcontrollers and digital signal processors, architecture, peripheral modules.	6
2	Typical processors for control implementation, memory organization, CPU details	6
3	Addressing modes interrupt structure, hardware multiplier, pipelining, Fixed and floating-point data representations, Assemblers, linkers and loaders.	6
4	Binary file formats for processor executable files, Typical structure of timer interrupt driven programs, Implementing digital processor based control systems for power electronics.	6
5	Reference frame transformations, PLL implementations, machine models, harmonic and reactive power compensation, space vector PWM.	6
6	Numerical integration methods. Comparison in terms of time step, stability	6
7	Multitasking concepts for power electronics implementations, The need for multitasking, various multitasking method	6

Term Work

Term work shall comprise of

1. Tutorials using hardware such as latest microcontroller/processor such as Arduino, TI DSP, Atmel uC, Lattice CPLD evaluation board with peripherals.
2. MCQ examination

Text Books

1.N. Mohan, “Power Electronics”, third edition, John Wiley and Sons.

Reference Books
1. K. Ogata, "Discrete-Time Control Systems", second edition, Pearson Education Asia.

Sr. No.	Examination	Module
1	T-I	1,2
2	T-II	3,4
3	End Sem	1 to 7

Power Quality and FACTS

Course Code	Course Name
PE-MTPX204	Power Quality and FACTS

Course pre-requisites	Power System

Course Objectives

The objectives of this course are

1. Understand the characteristics of ac transmission and the effect of shunt and series reactive compensation.
2. Understand the working principles of FACTS devices and their operating characteristics.
3. Understand the basic concepts of power quality.
4. Understand the working principles of devices to improve power quality.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Understand the characteristics of ac transmission and the effect of shunt and series reactive compensation.
2. Understand the working principles of FACTS devices and their operating characteristics.
3. Understand the basic concepts of power quality.
4. Understand the working principles of devices to improve power quality.

Course Content

Module No.	*Details*	*Hrs.*
1	Transmission Lines and Series/Shunt Reactive Power Compensation Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.	**04**
2	Thyristor-based Flexible AC Transmission Controllers (FACTS) Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter.	**06**
3	Voltage Source Converter based (FACTS) controllers Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM andSpace Vector Modulation. STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and	**08**

	Control. Working principle of Interphase Power Flow Controller. Other Devices: GTO Controlled Series Compensator. Fault Current Limiter.	
4	Application of FACTS Application of FACTS devices for power-flow control and stability improvement. Simulation example of power swing damping in a single- machine infinite bus system using a TCSC. Simulation example of voltage regulation of transmission mid-point voltage using a STATCOM	**06**
5	Power Quality Problems in Distribution Systems Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc- offsets, fluctuations. Flicker and its measurement. Tolerance of Equipment: CBEMA curve.	**04**
6	DSTATCOM Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters. Synchronous Reference Frame Extraction of Reference Currents. Current Control Techniques in for DSTATCOM	**08**
7	Dynamic Voltage Restorer and Unified Power Quality Conditioner Voltage Sag/Swell mitigation: Dynamic Voltage Restorer – Working Principle and Control Strategies. Series Active Filtering. Unified Power Quality Conditioner (UPQC): Working Principle. Capabilities and Control Strategies.	**06**

Term Work

Term work shall comprise of

1. Tutorials include case study of IEEE papers and some real time data study
2. MCQ examination

Text Books

1. J. Arrillaga, M. R. Watson, S. Chan, Power System Quality Assessment, John Wiley and Sons.

Reference Books

1. M. H. J. Bollen, Understanding Power Quality Problems, Voltage Sag and Interruptions, New York IEEE press, 2000 Series on Power Engineering.
2. R. C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty, Electrical Power System Quality, McGraw Hill Publication:
3. EnriquesAcha, Manuel Madrigal, Power System Harmonics – Computer Modeling and Analysis, John Wiley and Sons Ltd.
4. Ewald F. Fuchs, Mohammad A. S. Masoum, Power Quality in Power Systems and Electrical Machines.
5. G. J. Heydt, Electric Power Quality, Stars in Circule publications.
6. IEEE Std. 519-1992, IEEE recommended practices and requirements for harmonics control in electrical power system

Sr. No.	Examination	Module
1	T-I	1,2
2	T-II	3,4
3	End Sem	1 to 7

Nonlinear Control Theory

Course Code	Course Name
PE-MTPX 205	**Nonlinear Control Theory**

Course pre-requisites	Control System

Course Objectives		
The objectives of this course are 1. To introduce the nature of nonlinearities found in systems and control 2. To learn standard methods of analysis and design in nonlinear system.		
Course Outcomes		
Upon successful completion of the course, students should be able to 1. Understand and apply concepts of linear algebra for system analysis. 2. Understand mathematical models of various nonlinear systems. 3. Analyze performance of linear and nonlinear system and design controller		
Course Content		
Module No.	***Details***	***Hrs.***
1	**Non-linear systems:** Introduction, behavior of non-linear system, common physical non linearity- saturation, friction, backlash, dead zone, relay, multi variable non-linearity.	4
2	**Phase Plane Analysis:** Concept of phase plane, constructing phase portrait, Phase plane analysis of linear systems, Phase plane analysis of nonlinear systems, Existence of limit cycles.	7
3	**Fundamentals of Lyapunov theory:** equilibrium points, concept of stability, linearization of nonlinear systems, Local stability, Lyapunov Equation, Lyapunov‟s direct method, Stability and instability theorems.	8
4	System analysis based on Lyapunov‟s direct method and Control Design based on Lyapunov‟s direct method.	6
5	**Describing Functions:** Stability analysis and limit cycles, Linear compensation methods, General describing functions of common nonlinearities, Relative stability.	5
6	**Feedback linearization:** feedback linearization and canonical form, Input-state linearization, Input- output linearization.	5
7	**Control design for nonlinear system:** Control design using linearized model, Lyapunov method of control design, control design using feedback linearization and back stepping.	7
Term Work		
Term work shall comprise of 1. Tutorials 2. MCQ examination		

Text Books
1. Slotine, J. E. & Weiping Li, Applied Nonlinear Control, Prentice-Hall, [1991] 2. Khalil, Hasan K., Nonlinear Systems, Macmillan Publishing, [1992]
Reference Books
1. Chi-Tsong Chen, "Linear Systems Theory and Design", Oxford University Press New York, 1999. 2. T. Kailath, "Linear Systems", Prentice-Hall, New Jersey, 1980, Science and Business Media 2008. 3. Gilbert Strang, " Linear Algebra and its Application", Fourth Edition CENGAGE Learning 4. Ogata, K., Modern Control Engineering, Prentice-Hall, [2002] 5. Gopal, M., Modern Control System Theory, John Wiley Eastern Ltd. New Delhi, [1984] 6. Friedland, B., Control System Design, McGraw-Hill, [1986] 7. Ogata, K., State Space Analysis of Control Systems, Prentice-Hall, [1967] 8. Kuo, B. C., Automatic Control Systems, Prentice-Hall, [1987]

Sr. No.	Examination	Module
1	T-I	1,2
2	T-II	3,4
3	End Sem	1 to 7

Renewable Energy Sources and Grid Integration

Course Code	Course Name
PE-MTPX206	Renewable Energy Sources and Grid Integration

Course pre-requisites	Power System –I , Power Electronics

Course Objectives

The objectives of this course are
1. To study the energy scenario and the consequent growth of the power generation from renewable energy sources.
2. To study the basic physics of wind, solar, tidal, and geothermal generation power generation.
3. To study the power electronic interfaces for wind and solar generation.
4. To study social and environmental of various RES
5. To study Life cycle cost of wind and solar.

Course Outcomes

Upon successful completion of the course, students should be able to
1. Understand the energy scenario and the consequent growth of the power generation from renewable energy sources.
2. Estimate the wind, solar and small hydro power generation.
3. Understand the power electronic interfaces for wind and solar generation.
4. Evaluate the socio-environmental impact of various RES
5. Analyse the life cycle cost of wind and solar energy.

Course Content

Module No.	*Details*	*Hrs.*
1	**History of RES and basic concepts**: Graphs - global and Indian statistics, heat transfer, essential of fluid dynamics	4
2	**Wind Energy**: Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics- probability distributions, Wind speed and power-cumulative distribution functions. Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent- Magnet Synchronous Generators, Social and environmental aspects. Life cycle cost	8
3	**Solar Energy**: Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability. **Solar photovoltaic:** Technologies-Amorphous, mono crystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Maximum Power Point Tracking (MPPT) algorithms. **Solar thermal Electric System**: Concentrating solar power system, low temperature solar thermal, non-grid solar thermal applications. Life cycle cost	10
4	**Bulk solar and Wind farms**: Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behaviour during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.	6

5	**Small Hydro**: stream flow, measuring flow, dam, diversion, measuring head calculating power.	4
6	**Tidal power**: Power from a tidal barrage, tidal resonance, kinetic energy of tidal currents, generation of tidal energy, advantages and disadvantages of tidal energy. **Geothermal power generation:** Introduction to Geophysics, dry rock and hot aquifer analysis, harnessing geothermal resources, social and environmental aspects	6
7	**Cogeneration Introduction:** Need for cogeneration, Principle of cogeneration, technical options for cogeneration, classification of cogeneration systems, Factors influencing cogeneration choice, important technical parameters for cogeneration	4

Term Work

Term work shall comprise of

1. Tutorials
2. MCQ examination.

Text Books

1.John Twidell,Tony Weir, "Renewable energy resources", Routledge; 4th edition (November 30, 2021).

2.T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005.

3.P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill,1984.

. 4.G. M. Masters, "Renewable and Efficient Electric Power Systems**",** John Wiley and Sons 2004.

5. William Shepherd, "Electricity Generation using wind power", World Scietific

Reference Books

1. S. C. Bhatia, "Advanced Renewable Energy Systems", CRC Press, 2014
2. J.F. Manwel,J G Mcgowan., "Wind Energy Explained: Theory, design and application", Wiley Publications.
3. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications, 2004
4. 1547 IEEE standard

Sr. No.	Examination	Module
1	T-I	1,2
2	T-II	3, Part of 4
3	End Sem	1 to 7

Business Analytics

Course Code	Course Name
OE-MTPX201	**Business Analytics**

Course pre-requisites	

Course Objectives
The objectives of this course are 1. Understand business analysis 2. Understand transforming and financial requirements 3. Recent trends in business
Course Outcomes
Upon successful completion of the course, students WILL have a comprehensive understanding of business analytics methods

Course Content

Module No.	***Details***	***Hrs.***
1	**Business Analysis**: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst, Stakeholders: the project team, management, and the front line, Handling Stakeholder Conflicts.	7
2	**Life Cycles:** Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.	7
3	**Forming Requirements**: Overview of Requirements, Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.	7
4	**Transforming Requirements**: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modelling, Business Process Modelling	7
5	**Finalizing Requirements**: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements. Managing Requirements Assets: Change Control, Requirements Tools	7

6	**Recent Trends in**: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.	7

Reference Books
1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press. 2. Business Analytics by James Evans, persons Education.

Sr. No.	Examination	Module
1	T-I	1,2
2	T-II	3,4
3	End Sem	1 to 6

Industrial Safety

Course Code	Course Name
OE-MTPX202	Industrial Safety

Course pre-requisites	

Course Outcomes
At the end of the course students will be able to 1. Understand basic safety norms, rules and regulations and hazards 2. Understand maintenance of utility systems and its service life expectancy 3. Understand fault and diagnostics and preventive measures 4. Understand repair cycles of machines and trouble shootings

Course Content

Module No.	*Details*	*Hrs.*
1	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.	4
2	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 relation with replacement economy, Service life of equipment.	4
3	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	4
4	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	4

	general causes.	
5	Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor	4
6	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	4
7	Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance	4

Reference Books

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Sr. No.	Examination	Module
1.	**T-I**	1,2 and part of 3
2.	**T-II**	Remaining part of 3,4 and part of module 5
3.	**End Sem**	1 to 7

Operations Research

Course Code	Course Name
OE-MTPX203	**Operations Research**

Course pre-requisites	

Course Outcomes
At the end of the course, the student should be able to 1. Students should able to apply the dynamic programming to solve problems of discreet and continuous variables. 2. Students should able to apply the concept of non-linear programming 3. Students should able to carry out sensitivity analysis 4. Student should able to model the real world problem and simulate it.

Course Content

Module No.	***Details***	***Hrs.***
1	Optimization Techniques, Model Formulation, models, General L. R Formulation, Simplex Techniques, Sensitivity Analysis,	5
2	Formulation of a LPP - Graphical solution revised simplex method- duality theory - dual simplex method - sensitivity analysis parametric programming	6
3	Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem – CPM/PERT	5
4	Scheduling and sequencing – single server and multiple server models – deterministic inventory models –	5
5	Inventory Control Models, Probabilistic inventory control models – Geometric Programming.	5
6	Competitive Models, Single and Multi-channel Problems, Sequencing Models	5
7	Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation	5

Reference 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
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Sr. No.	Examination	Module
1.	**T-I**	1,2 and part of 3
2.	**T-II**	Remaining part of 3,4 and part of module 5
3.	**End Sem**	1 to 7

Cost Management of Engineering Projects

Course Code	Course Name
OE-MTPX204	Cost Management of Engineering Projects

Course pre-requisites	

Course Outcomes
At the end of the course students will be able to 1. Estimate project cost and project commisioning 2. Analyse cost behaviour in project 3. Know different project strategies 4. Apply quantitative techniques for cost management of engineering projects

Course Content

Module No.	*Details*	*Hrs.*
1	Introduction and Overview of the Strategic Cost Management Process	4
2	Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational Control; Provision of data for Decision-Making.	4
3	Project: meaning, Different types, why to manage, cost overrun centres, various stages of project execution: conception commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and Documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar chart sand Network diagram. Project commissioning: mechanical and process	8
4	Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis.	8
5	Pricing strategies: Pareto Analysis. Target Costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.	6
6	Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement	6

	of Divisional profitability pricing decisions including transfer pricing.	
7	Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.	6

Reference Books

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Sr. No.	Examination	Module
1.	**T-I**	1,2 and part of 3
2.	**T-II**	Remaining part of 3,4 and part of module 5
3.	**End Sem**	1 to 7

Waste to Energy

Course Code	Course Name
OE-MTPX205	**Waste to Energy**

Course pre-requisites	

Course Outcomes
At the end of the course students will be able to 1. Classify waste from ebergy recovery point of view 2. Know biomass pyrolysis and gasification 3. Understand biomass combustion 4. Understand working of biogas plant and importance of biomass energy programme in India

Course Content

Module No.	***Details***	***Hrs.***
1	Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors	6
2	Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.	6
3	Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.	6
4	Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.	6
5	Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion	6
6	Direct combustion - biomass gasification - pyrolysis And	

	liquefaction - biochemical conversion - anaerobic digestion	
7	Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.	6

Reference Books

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley &Sons, 1996.

Sr. No.	Examination	Module
1.	**T-I**	1,2 and part of 3
2.	**T-II**	Remaining part of 3,4 and part of module 5
3.	**End Sem**	1 to 7

Linear Algebra & Matrix Computation

Course Code	Course Name
OE-MTPX206	Linear Algebra & Matrix Computation

Course pre-requisites	Engineering Mathematics

Course Objectives
Objectives of this course are 1. To make student conversant with fundamentals of Linear Algebra. 2. To impart knowledge about various concepts of matrix computation. 3. To learn the complexity in solving least square problems. 4. To understand concepts of Eigen Value and Eigen vectors.
Course Outcomes
Upon successful completion of the course, students should be able 1. To apply theoretical concepts of vector spaces to solve linear equations. 2. To analyse various properties such as rank, subspaces, norm, condition number, eigen value etc. of a given matrix. 3. To compare complexity of various matrix decomposition methods. 4. To solve least square problem with different matrix computation techniques 5. To suitably select various matrix computation tools to solve real life complex problems.

Course Content

Module No.	***Details***	***Hrs.***
1	**Introduction:** Over-view of the course, applications in various engineering fields, **Vector-spaces:** Fields, definition of a vector-space, examples, subspaces, sums and intersections of subspaces, span, linear independence, bases, dimension, basis extension, coordinates, calculations of bases concerning solutions of linear equations.	4
2	**Linear maps:** Definition, examples, null/kernel space, range/image space, matrix representations of linear maps, row-rank, column-rank, rank-nullity theorem, algebra of linear maps, linear functions	4
3	**Gaussian elimination:** Basic Gaussian elimination without pivoting, LU decomposition, Gaussian elimination with pivoting. Positive definite matrices, A brief discussion on sparsity.	6
4	**Sensitivity and round-off errors:** Vector norms, matrix norms. Condition number. Perturbation, residual, round-off errors. Error propagation in Gaussian elimination.	6
5	**Least Squares Problem:** Orthogonal matrices, rotators and reflectors. Solution of the least squares problem, the full-rank case.	8

	Gram-Schmidt process. Singular value Decomposition (SVD): Introduction, Some basic applications, least squares problem	
6	**Eigenvalues and Eigenvectors:** The power method. Unitary similarity transform, Schur's theorem, normal matrices, spectral theorem of normal matrices. Hessenberg and tri-diagonal matrices, reduction to these forms. The QR algorithm. A brief discussion on sparsity.	8
7	**Applications:** a) Graphs, KCL and KVL b) Solving linear ODEs c) The geometry of gradient descent d) Best approximation e) Multi-agent systems.	6

Text / Reference Books

1. K. Hoffman and R. Kunze, Linear Algebra, Pearson, 2015.
2. G. Strang, Linear algebra and its applications (4th Edition).
3. David S. Watkins, Fundamentals of Matrix Computations, 3rd Edition, Willey-Inter science, 2010.
4. Gene H. Golub and Charles F. Van Loan, Matrix Computations, 4th Edition, The Johns Hopkins University Press, 2013.

Sr. No.	Examination	Module
1	T-I	1, 2
2	T-II	3, 4
3	End Sem	1 to 7

Project Management

Course Code	Course Name
OE-MTPX207	**Project Management**

Course pre-requisites	Basics of Electrical Engineering, Basics of statistics and mathematics, general knowledge about working of organizations

Course Objectives

The objectives of this course are

1. Get familiarized with basics of project management, its organization and project management framework.
2. Learn five important project management process groups, namely: initiating, planning, executing, monitoring & control, closing and ten important project management knowledge areas.
3. Understand the relationship between project management process groups and knowledge areas.

Course Outcomes

Upon successful completion of the course, students should be able TO

1. Explain basics of Project Management, its organization and project management framework.
2. Perform project management process group and knowledge area mapping.
3. Solve a case study using step-by-step process of managing projects and explain why each step is necessary.

Course Content

Module No.	*Details*	*Hrs.*
1	**Introduction** • Basics of project management, operations management and organizational strategy, • Project management framework, organizational structures, • Project Management Processes – Initiating, Planning, Executing, Monitoring & Control, Closing.	03
2	**Project Integration Management** • Integrated change control, Developing project management plan and project charter, • Project selection, corrective action, preventive action, defect repair, change control board, • Cost benefit analysis, Net present value, internal rate of return, payback period, present value, economic value added, • Opportunity costs, sunk costs, law of diminishing returns, working capital, depreciation. **Project Scope Management**	04

	• Scope baseline, WBS, Project scope statement, WBS dictionary, benefits and uses of WBS • Requirement documentation, requirements traceability matrix, requirements management plan	
3	**Project Time Management** • Schedule baseline, schedule compression, Network diagram, • Precedence Diagramming Method (PDM), Three point estimating, analogous estimating, parametric estimating, • Schedule management plan, resource optimization, Critical path method, Program Evaluation Review Technique (PERT). **Project Cost Management** • Earned value measurement, Earned value monitoring, cost baseline, cost budget, Cost management plan, • Reserve analysis, contingency reserve, management reserves, cost risk, • Variable / fixed costs, direct / indirect costs, life cycle costing, value analysis, control thresholds, cost of quality, Return of Interest (RoI), and discounted cash flow. **Project Quality Management** • Seven basic quality improvement tools – control chart, Pareto diagram, Cause and effect diagram, flow chart, scatter diagram, histogram. Use of s-curve in project monitoring. • Quality assurance tools and techniques – Affinity diagram, tree diagrams, process decision program charts, matrix diagrams, prioritization matrices, network diagrams.	09
4	**Project Human Resource Management** • Role of PM, sponsor, stakeholders, functional manager, portfolio manager, program manager, • HR management plan, recognition and reward systems, team building, stages of team formation and development, team types. • Conflict Management, • Responsibility Assignment Matrix (RAM), RACI Chart, • Motivation theory, Management and Leadership styles, **Project Communication Management** • Communication models, channels, method, communication blockers.	04
5	**Project Risk Management** • Risk management plan, risk response strategies, threats, opportunities, risk register, contingency plans, fallback plans, residual risks, secondary risks, • Risk types and categories, SWOT analysis, **Project Procurement Management** • Procurement management plan, types of agreements and contract types, advantages and disadvantages of each contract type, • PM's role in procurement, procurement documents : RFP, IFB, RFQ, RFI, • Types of procurement, procurement negotiations, centralized / decentralized contracting, contract interpretation, price, profit, cost, target price, sharing ratio, ceiling price	06
6	**Project Stakeholder Management** • Stakeholder analysis, stakeholder register, stakeholder expectations,	03

	stakeholder engagement, • Power and interest grid, stakeholders engagement assessment matrix	
7	**Professional and Social Responsibility** • Project management traits in professional and social responsibility, • Code of Ethics and Professional conduct w. r. t. responsibility, respect, fairness, honesty. **Project Management Case Study / Activity**	05

Text Books
1. Rita Mulcahy, "PMP Exam Prep", Eight Edition, RMC Publications, Inc., 2013. 2. Kalpesh Ashar, "Project Management – Essentials You Always Wanted to Know", Vibrant Publishers, 2012. 3. Prasanna Chandra, "Projects: Planning, Analysis, Selection, Financing, Implementation and Review", McGraw Hill India, 2014.
Reference Books
1. Dennis Lock and Lindsay Scott, "Gower Handbook of People in Project Management", Routledge Publishers, NY, USA, 2016. 2. "A Guide to the Project Management Body of Knowledge (PMBOK Guide)", 5th Edition, Project Management Institute, USA. 3. David Cleland, "Project Management Handbook", 2nd Edition, Wiley, 1988.

Sr. No.	Examination	Module
1	T-I	1,2
2	T-II	3,4
3	End Sem	1 to 7

Sardar Patel College of Engineering, Andheri (West), Mumbai 400058
Year: 2024-2025

Artificial Intelligence

Course Code	Course Name
OE-MTPX208	Artificial Intelligence

Course pre-requisites	

Course Objectives

The objectives of this course are

1. Introduce to Artificial Intelligence
2. Understand problem solving methods
3. Discuss applications of AI

Course Outcomes

Upon successful completion of the course, students should be able TO

1. Develop a basic understanding of AI building blocks presented in intelligent agents
2. Choose an appropriate problem solving method and knowledge representation technique, analyze the strength and weaknesses of AI approaches to knowledge – intensive problem solving
3. Design models for reasoning with uncertainty as well as the use of unreliable information

Course Content

Module No.	*Details*	*Hrs.*
1	Introduction to Artificial Intelligence (AI) History of Artificial Intelligence, Intelligent Systems: Categorization of Intelligent System, Components of AI Program, Foundations of AI, Sub- areas of AI, Applications of AI, Current trends in AI	04
2	Intelligent Agents Agents and Environments, The concept of rationality, The nature of environment, The structure of Agents, Types of Agents, Learning Age	04
3	Problem solving 1 Solving problem by Searching: Problem Solving Agent, Formulating Problems, Example Problems. Uninformed Search Methods: Breadth First Search (BFS), Depth First Search (DFS), Depth Limited Search, Depth First Iterative Deepening(DFID), Informed Search Methods: Greedy best first Search A* Search , Memory bound edheuristic Search.	07
4	Problem solving 2 Local Search Algorithms and Optimization Problems: Hill-climbing search Simulated annealing, Local beam search, Genetic algorithms. Adversarial Search: Games, Optimal strategies, The minimax algorithm, Alpha-Beta Pruning.	07
5	Knowledge based Agents, The Wumpus World, The Propositional logic, First Order Logic: Syntax and Semantic, Inference in FOL,	10

	Forward chaining, backward Chaining, Knowledge Engineering in First-Order Logic, Unification, Resolution, Introduction to logic programming (PROLOG), Uncertain Knowledge and Reasoning: Uncertainty, Representing knowledge in an uncertain domain, The semantics of belief network, Inference in belief network.	
6	Planning and Learning The planning problem, Planning with state space search, Partial order planning, Hierarchical planning, Conditional Planning, Learning: Forms of Learning, Inductive Learning, Learning Decision Tree, Expert System: Introduction, Phases in building Expert Systems, ES Architecture, ES vs Traditional System.	06
7	Applications Natural Language Processing (NLP), Expert Systems.	04

Text Books
1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach "Second Edition" Pearson Education. 2. Saroj Kaushik "Artificial Intelligence" ,Cengage Learning.
Reference Books
1. George F Luger "Artificial Intelligence" Low Price Edition , Pearson Education., Fourth edition. 2. Ivan Bratko "PROLOG Programming for Artificial Intelligence", Pearson Education, Third Edition. 3. Elaine Rich and Kevin Knight "Artificial Intelligence" Third Edition 4. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989. 5. Hagan, Demuth, Beale, "Neural Network Design" CENGAGE Learning, India Edition

Sr. No.	Examination	Module
1	T-I	1,2, Part of 3
2	T-II	Part of 3,4, Part of 5
3	End Sem	1 to 7

Power system dynamics and control Laboratory

Course Code	Course Name
SE-MTPX201	**Power system dynamics and control Laboratory**

Course pre-requisites	Power System

Course Objectives

The objectives of this course are

1. To study the stability considerations in power system.
2. To understand the different stability of power system and multi-machine stability concept
3. To study of voltage stability, PV, QV and PQ curves
4. To study of improving the stability of power system

Course Outcomes

Upon successful completion of the course, students should be able

1. Understand and appreciate the stability concept in the power network.
2. Apply the effects of various electrical parameter on stability

Course Content

Laboratory work to include at least Eight Simulations/Programmes based on every module.

1. Construct the SIMULINK block diagram to obtain frequency deviation and power deviation step response for 2 area system.
2. Modelling of Automatic Generation control in multi area system.
3. Visualization of droop characteristics of Synchronous Generator
4. Small signal stability and transient stability analysis of single machine- Infinite bus.
5. To simulate study and analyse the effect of loading on long transmission line.
6. Find state space equation and output equation using MATLAB
7. Design of linear state feedback controller.
8. Use the MATLAB step function to obtain frequency deviation step response for a sudden load change.

Term Work

Term work shall comprise of

1.Experiments

.2. MCQ Examination

Text Books	
1.	Kundur, P., "Power System Stability and Control", McGraw-Hill International Editions, 1994.
2.	K. R. Padiyar, Power System Dynamics, Stability & Control, 2nd Edition, B.S. Publications, Hyderabad, 2002.
Reference Books	
1.	Anderson, P.M. and Fouad, A.A., "Power System Control and Stability", John Wiley, second edition 2003.
2.	Van Cutsem, T. and Vournas, C., "Voltage Stability of Electric Power Systems", Springer
3.	P. Sauer & M.A.Pai, Power System Dynamics & Stability, Prentice Hall, 1997.

Sardar Patel College of Engineering, Andheri (West), Mumbai 400058
Year: 2024-2025

Advanced Control of Electrical Drives Laboratory

Course Code	Course Name
SE-MTPX202	**Advanced Control of Electrical Drives Laboratory**

Course pre-requisites	Electrical Drives

Course Objectives

The objectives of this course are

1. To study the torque-speed characteristics of AC and DC drives and different types of load
2. To discuss modification of torque speed characteristics of AC and DC motors as per load requirements.
3. To understand the power modulators and control strategies
4. To study steady state stability of the motor load system and higher level control of ac drives

Course Outcomes

Upon successful completion of the course, students should be able to

1. Able to apply the knowledge of electrical drives system for various applications such as flexible production systems, energy conservation, renewable energy, transportation etc., making Electric Drives an enabling technology.
2. Able to understand the basic requirements placed by mechanical systems on electric drives.
3. Able to apply the basic principles of power electronics in drives using switch-mode converters and pulse width modulation to synthesize the voltages in dc and ac motor drives.
4. Able to understand the need of modification of the torque speed characteristics of machines. Describe the operation of induction machines in steady state and dynamic condition.
5. Able to appreciate the speed control of induction motor drives in an energy efficient manner using power electronics with higher level control technique such as vector control.

Course Content

Laboratory work to include at least Eight MATLAB Simulations/hardware experiments based on every module. (refer IEEE papers).

Using hardware such as latest microcontroller/processor such as Arduino, TI DSP, Atmel uC, Lattice CPLD evaluation board with peripherals atleast for some experiments .

1. Review and study of AC and DC drives
2. Analysis of series and separately excited DC motor with single-phase and three-phase converters, Continuous and discontinuous armature current.
3. Simulating drive in closed loop system

4. Simulation of 3 phase IM V/f operation theory
5. Field oriented control of induction machines using vector control scheme case study
6. Direct torque control of Induction Machines case study and papers
7. Simulation of Synchronous motor control.
8. Simulation of case study of any industry or IEEE Paper on application of drives .

Term Work

Term work shall comprise of

. 1. Experiments
2. MCQ examination

Text Books

1. G. K. Dubey, "Power Semiconductor controlled Drives", Prentice Hall Inc., New Jersey, 1989.
2. R. Krishnan, "Electric Motor Drives – Modeling, Analysis and Control", Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.

Reference Books

1. G. K. Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi,2001
2. B. K. Bose "Modern Power Electronics and AC Drives", Pearson Education (Singapore) Pte.Ltd., New Delhi, 2003.
3. Vedam Subramanyam, "Electric Drives – Concepts and Applications", Tata McGraw-Hill Publishing company Ltd., New Delhi, 2002.

English for Research Paper Writing

Course Code	Course Name
AE-MTPX201	**English for Research Paper Writing**

Course pre-requisites	Communication Skills

Course Objectives
The objectives of this course are 1. Understand that how to improve your writing skills and level of readability. 2. Learn about what to write in each section. 3. Understand the skills needed when writing a Title.
Course Outcomes
Students will be able to Write research paper, article, thesis

Course Content

Module No.	***Details***	***Hrs.***
1	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	3
2	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.	3
3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	3
4	Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.	3
5	Skills are needed when writing the Methods, skills needed when writing the Results	3
6	Skills are needed when writing the Discussion, skills are needed when writing the Conclusions	3
7	Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	3

Reference Books
1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) 2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press 3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman‟s book. 4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

Sr. No.	Examination	Module
1	T-I	1,2 and part of 3
2	T-II	Remaining part of 3,4 and part of module 5
3	End Sem	1 to 7

Personality Development through Life Enlightenment Skills

Course Code	Course Name
AE-MTPX202	Personality Development through Life Enlightenment Skills

Course pre-requisites	

Course Objectives

1. To learn to achieve the highest goal happily
2. 2. To become a person with stable mind, pleasing personality and determination
3. 3. To awaken wisdom in students

Course Outcomes

Students will be able to understand:

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life.
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity.
3. Study of Neetishatakam will help in developing versatile personality of students.

Course Content

Module No.	Details	Hrs.
1	Neetisatakam-Holistic development of personality: ▪ Verses- 19,20,21,22 (wisdom) ▪ Verses- 29,31,32 (pride & heroism) ▪	3
2	▪ Verses- 26,28,63,65 (virtue) ▪ Verses- 52,53,59 (dont's) ▪ Verses- 71,73,75,78 (do's)	3
3	Approach to day-to-day work and duties: ▪ Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48, ▪ Chapter 3-Verses 13, 21, 27, 35.	3
4	▪ Chapter 6-Verses 5,13,17, 23, 35, ▪ Chapter 18-Verses 45, 46, 48.	3
5	Statements of basic knowledge: ▪ Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 ▪ Chapter 12 -Verses 13, 14, 15, 16,17, 18	3
6	▪ Personality of Role model. Shrimad Bhagwad Geeta: Chapter2 Verses 17, Chapter 3-Verses 36,37,42,	3
7	▪ Chapter 4-Verses 18, 38,39 ▪ Chapter18 – Verses 37,38,63	3

Reference Books

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Sr. No.	Examination	Module
1	T-I	1
2	T-II	2
3	End Sem	1 to 3

Pedagogy Studies

Course Code	Course Name
AE-MTPX203	Pedagogy Studies

Course pre-requisites	

Course Objectives

1. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

Course Outcomes

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

Course Content

Module No.	Details	Hrs.
1	Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology and Searching.	3
2	Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.	3
3	Evidence on the effectiveness of pedagogical practices: Methodology for the in-depth stage: quality assessment of included studies, how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?	3
4	Theory of change, Strength and nature of the body of evidence for effective pedagogical practices, Pedagogic theory and pedagogical approaches,	3
5	Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community,	3

6	Research gaps and future directions, Research design, Contexts Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.	3
7	Teachers' attitudes and beliefs and Pedagogic strategies, Curriculum and assessment, Barriers to learning: limited resources and large class sizes	3

Reference Books

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

Sr. No.	Examination	Module
1	T-I	1,2 and part of 3
2	T-II	Remaining part of 3,4 and part of module 5
3	End Sem	1 to 7

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute under Mumbai University)
Andheri (W), Mumbai – 400058

COURSE CONTENTS

(M.Tech. in Power Electronics & Power System)

Semester III and IV

Academic Year: 2024-25

LIST OF COURSES

Sardar Patel College of Engineering, Andheri (West), Mumbai 400058
Year: 2024-2025

Value Education Course VE-MTPX301

Disaster Management

Course Code	Course Name
VE-MTPX301	Disaster Management

Course pre-requisites	

Course Outcomes
1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and Humanitarian response. 2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives. 3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations. 4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

Course Content

Module No.	*Details*	*Hrs.*
1	**Introduction** Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	5
2	**Repercussions Of Disasters And Hazards:** Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.	5
3	**Disaster Prone Areas In India** Study of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics	5
4	**Disaster Preparedness And Management** Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.	5
5	**Risk Assessment** Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment	5

6	**Global Co-Operation** In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.	5
7	**Disaster Mitigation** Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.	6

Reference Books
1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company. 2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi. 3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

Sr. No.	Examination	Module
1	T-I	1,2 and part of 3
2	T-II	Remaining part of 3,4 and part of module 5
3	End Sem	1 to 7

Sardar Patel College of Engineering, Andheri (West), Mumbai 400058
Year: 2024-2025

Value Education Course VE-MTPX302

Value Education

Course Code	Course Name
VE-MTPX302	Value Education

Course pre-requisites	

Course Objectives
1. Understand value of education and self- development 2. Imbibe good values in students 3. Let the should know about the importance of character
Course Outcomes
Students will be able to: 1. Knowledge of self-development 2.Learn the importance of Human values 3.Developing the overall personality
Course Content

Module No.	Details	Hrs.
1	Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism, Moral and non-moral valuation. Standards and principles, Value judgements	3
2	Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration, Truthfulness, Cleanliness.	3
3	Honesty, Humanity. Power of faith, National Unity, Patriotism. Love for nature ,Discipline.	3
4	Personality and Behavior Development - Soul and Scientific attitude, Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour.	3
5	Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation, Equality, Nonviolence ,Humility.	3
6	Universal brotherhood and religious tolerance, True friendship, Happiness Vs suffering, love for truth, Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature	3
7	Role of Women, Women empowerment, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively	3

Reference Books

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi.

Sr. No.	Examination	Module
1	T-I	1,2 and part of 3
2	T-II	Remaining part of 3,4 and part of module 5
3	End Sem	1 to 7

Introduction to Sustainability and Sustainable Development (VE-MTPX303)

Course Code	Course Name
VE-MTPX303	Introduction to Sustainability and Sustainable Development
Course pre-requisites	NA

Course Objectives

1. This course provides an in-depth understanding of sustainability and sustainable development goals to create a better- informed engineer, which will lead to a more sustainable action by all and for all.

Course Outcomes

Students will be able to:

1. Understand the basic concept of Sustainability and Sustainable Development (SD), history of SD, the environmental, social and economic dimensions of SD and be able to discuss the SD concept on the national as well as on the global scale with respect to engineering
2. Apply the fundamental concepts related to interaction of industrial and environmental/ecological systems, sustainability challenges facing the current generation, and systems-based approaches required for creating sustainable solutions for society.
3. Apply sustainable practices by utilizing the engineering knowledge and principles.
4. Deliberate on potential strategic options and tools for assessing SD (efficiency, sufficiency).

Course Content

Module No	Contents	Time (Hrs)
1	**Introduction**: What is sustainability and sustainable development? – definitions, Concept & components of sustainability **Limits to exponential growth on a finite planet**, Complexity of growth and equity, Environmental issues and crisis, Resource degradation, greenhouse gases, global warming, desertification, social insecurity, industrialization, globalization. **An Engineers role in sustainability**	02
2	**Sustainability perspective for Energy, Materials, Water, Food and Shelter:** World energy usage, Problems with fossil fuels Alternatives - reduction, efficiency, renewable energy. Impacts of material production, sources of waste, Problems with current waste management, Suggestions for reducing the impact of material use Water resource and use worldwide, Associated problems with current water systems, Sustainable water management, World food production, Usage of resources and environmental impacts, Alternatives - organic/local Current building styles and associated problems, Retrofit vs new build Sustainable Architecture	06
3	**Social & Economic Sustainability** Social sustainability - Components - equality, diversity, democracy, social cohesion, Issues - gender issue, poverty, environmental degradation, peace & justice, social sustainability performance - community engagement, community development, empowerment, health, volunteerism, etc. Economic sustainability - Relationship between macroeconomics policies, poverty and environment, Trade-offs between economic growth, social equity, and environmental sustainability, Role of international environmental agreements, green economy and climate change policies.	05
4	**Governance for Sustainable Development Systems**: Socio-economic policies for sustainable development, Strategies for implementing eco-development	03

	programmes, Policy responses to environmental degradation, Public participation - Demographic dynamics and sustainability, Integrated approach for resource protection and management.	
5	**Strategies and measurements of SD**: Introduction to Sustainability assessment, Environment Sustainability metrics – simple and complex indicators, Sustainability methods and assessment - green buildings, Renewable energy, CSR, Biodiversity, Technologies, human development index (HDI), sustainability development index (SDI), LCA	03
6	**The road to Sustainable Development** - National and International Contribution: National Contribution: Societal transformations. Institutional theory, Rural and Urban development, Action plan for implementing sustainable development International Contribution - Brundtland, Rio summit, SDGs, Conventions, Protocols & Agreements, Action plan for implementing sustainable development, Moral obligations and Operational guidelines, Role of developed countries in the sustainable development.	03
7	**Project Presentations**	04

Text Books:

1. Harris, J.M., Basic Principles for Sustainable Development, Global Development and Environment Institute, working paper 00-04. Available at:http://ase.tufts.edu/gdae/publications/Working_Papers/Sustainable%20 Development.PDF
2. Mackenthun, K.M., Basic Concepts in Environmental Management, 1 st edition, Lewis Publication, London, 1998.
3. Hjorth, P. and A. Bagheri, Navigating towards Sustainable Development: A System Dynamics Approach, In Futures, 38(1): 74-92, 2006.
4. Mog, J.M., Struggling with Sustainability – A Comparative Framework for Evaluating Sustainable Development Programs, World Development 32(12): 2139–2160, 2004.

Reference Books:

1. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-
2. Rating System, TERI Publications – GRIHA Rating System
3. Indian Green Building Council, IGBC Green Buildings rating system (New & Existing) - Abridged Reference Guide, Pilot Version, 2017.
4. IISD Commentary on the OECD's Draft Principles for International Investor Participation in Infrastructure (PDF – 68 kb)

Courses to refer

Sustainability and Engineering :
https://rdmc.nottingham.ac.uk/bitstream/handle/internal/112/Engineering%20Sustailability

Dissertation

Course Code	Course Name
DS-MTPX 301	**Dissertation**

Course pre-requisites	

Course Objective		
1. To inculcate self-learning and research aptitude among students to handle and Investigate a real life problem.		
Course Outcomes		
Student will be able to 1. Apply principles of ethics and standards, skill of presentation and communication techniques. 2. Integrate the knowledge of the fundamentals of subjects to search the related literature and devise solution. 3. Use knowledge for formulation / fabrication of the desired project. 4. Analyze the available resources and to select most appropriate one.		
Course Content		
Sr. No.	***Description***	***Hrs***
1	Student shall finalize a theme, related to his/her area of specialization for the dissertation work. Student shall prepare a report on the theme outlining importance of the theme of the study, objective, scope of work, methodology, and a review of literature published in the relevant area. The student shall present seminars on this report.	28 Per Week
Guidelines for Dissertation		
Students should do literature survey and identify the problem for Dissertation and finalize in consultation with Guide/Supervisor. Students should use multiple literatures and understand the problem. Students should attempt solution to the problem by analytical/simulation/experimental methods. The solution to be validated with proper justification and compile the report in standard format.		
Guidelines for Assessment of Dissertation		
Dissertation I should be assessed based on following points 1. Quality of Literature survey and Novelty in the problem 2. Clarity of Problem definition and Feasibility of problem solution 3. Relevance to the specialization 4. Clarity of objective and scope		

Co-curricular Course CC-MTPX401

Stress Management by Yoga

Course Code	Course Name
CC-MTPX401	Stress Management by Yoga

Course pre-requisites	BT107

Course Objectives
1. To achieve overall health of body and mind 2. To overcome stress
Course Outcomes
Students will be able to: 1. Develop healthy mind in a healthy body thus improving social health also 2. Improve efficiency

Course Content

Module No.	*Details*	*Hrs.*
1	➢ Definitions of Eight parts of yog. (Ashtanga)	5
2	➢ Yam and Niyam. Do`s and Don't's in life. i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan	5
3	Yoga & The Brain ➢ Brain Based Learning ➢ The Brain ➢ Teaching to the Developing Brain ➢ Supporting the Learning Brain with Yoga	5
4	Social Emotional Learning	5
5	POSITIVE CLASSROOM MANAGEMENT ➢ Transitions and Engagement ➢ Dynamic Teaching ➢ Understanding Behavior ➢ Classroom Boundaries	5
6	THE YOGA ENVIRONMENT ➢ Clothing ➢ Assistants • ➢ Adjustments	5
7	➢ Asan and Pranayam i) Various yog poses and their benefits for mind & body ii)Regularization of breathing techniques and its effects- ➢ Types of pranayam	6

Reference Books
1. ‘Yogic Asanas for Group Tarining-Part-I” : Janardan Swami Yogabhyasi Mandal, Nagpur 2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata.

Dissertation

Course Code	Course Name
DS-MTPX401	**Dissertation**

Course pre-requisites	DS-MTPX301

Course Outcomes

1. Student will be able to apply principles of ethics and standards, skill of presentation and communication techniques
2. Student will be able to integrate the knowledge of the fundamentals of subjects to search the related literature and devise solution
3. Student will be able to use knowledge for execution of the desired project and validation of the results obtained
4. Student will be able to analyze the experimental data/ findings

Course Content

Sr. No.	*Details*	*Hrs.*
1	Student shall study the problem of dissertation in the light of outcome of Stage I and Stage II seminars. On completion of data collection, analysis, and inferencing, the student shall prepare an interim report and shall present a seminar on the work done, before the submission of Synopsis.	28 Per Week

Guidelines for Assessment of Dissertation

Dissertation should be assessed based on following points

1. Quality of Literature survey and Novelty in the problem
2. Clarity of Problem definition and Feasibility of problem solution
3. Relevance to the specialization or current Research / Industrial trends
4. Clarity of objective and scope
5. Quality of work attempted
6. Validation of results
7. Quality of Written and Oral Presentation