Study Scheme & Syllabus of

Master of Technology Power System/

(M. Tech. Power System)

Batch 2018 onwards

By

Board of Study Electrical Engineering

Department of Academics

IK Gujral Punjab Technical University

Master of Technology in Power System

(M. Tech Power System)

It is a Post Graduate (PG) Programme of 2 years duration (4 semesters).

Additional Lectures/Tutorials: Need based additional Lectures/Tutorials may be introduced of any Course, however, the Credits of the course will not change.

Courses & Examination Scheme:

First Semester

Course Code	Course Type	Course Name	L	T	P	Marks Distribution		Total Marks	Credits
						Internal	External		
MTPS-101-18	Core 1 Theory	Power System Analysis	3	0	0	40	60	100	3
MTPS-102-18	Core 2 Theory	Power System Dynamics-I	3	0	0	40	60	100	3
MTPS-103X-18	Elective -I	Professional Elective-I	3	0	0	40	60	100	3
MTPS-104Y-18	Elective-II	Professional Elective-II	3	0	0	40	60	100	3
MTRM-101-18	--	Research Methodology and IPR	2	0	0	40	60	100	2
MTPS-105-18	Practical/ Laboratory 1	Power System Steady State Analysis Lab	0	0	4	60	40	100	2
MTPS-106-18	Practical/ Laboratory 2	Power System Dynamics lab	0	0	4	60	40	100	2
MTA-10X-18	Audit-I	Audit course-I	2	0	0	00	00	Satisfactory/ Non-satisfactory	Non-Credit
	TOTAL		**16**	**0**	**8**	**320**	**380**	**700**	**18**

Professional Elective/Audit	Course Code	Course Name	L	T	P	Marks Distribution Internal External		Total Marks	Credits
PE1	MTPS-103A-18	Smart Grids	3	0	0	40	60	100	3
	MTPS-103B-18	Dynamics of Electrical Machines	3	0	0	40	60	100	3
	MTPS-103C-18	Robotics and Automation	3	0	0	40	60	100	3
	MTPS-103D-18	Wind and Solar Systems	3	0	0	40	60	100	3
PE2	MTPS-104A-18	Electric and Hybrid Vehicles	3	0	0	40	60	100	3
	MTPS-104B-18	Design Aspects in Control	3	0	0	40	60	100	3
	MTPS-104C-18	PWM Converters and Applications	3	0	0	40	60	100	3
	MTPS-104D-18	FACTS and Custom Power Devices	3	0	0	40	60	150	3
Audit-I	MTA-101-18	English for Research Paper Writing	2	0	0	00	00	Satisfactory/ Non-satisfactory	Non-Credit
	MTA-102-18	Disaster Management	2	0	0	00	00	Satisfactory/ Non-satisfactory	Non-Credit
	MTA-103-18	Sanskrit for Technical Knowledge	2	0	0	00	00	Satisfactory/ Non-satisfactory	Non-Credit
	MTA-104-18	Value Education	2	0	0	00	00	Satisfactory/ Non-satisfactory	Non-Credit

Second Semester

Course Code	Course Type	Course Name	L	T	P	Marks Distribution		Total Marks	Credits
						Internal	External		
MTPS-201-18	Core 3 Theory	Power System Dynamics-II	3	0	0	40	60	100	3
MTPS-202-18	Core 4 Theory	Digital Protection of Power System	3	0	0	40	60	100	3
MTPS-203X-18	Elective -I	Professional Elective-III	3	0	0	40	60	100	3
MTPS-204Y-18	Elective-II	Professional Elective-IV	3	0	0	40	60	100	3
MTPR-101-18	--	Mini Project with Seminar	0	0	4	60	40	100	2
MTPS-205X-18	Practical/ Laboratory 3	Lab Elective 3	0	0	4	60	40	100	2
MTPS -206X-18	Practical/ Laboratory 4	Lab Elective 4	0	0	4	60	40	100	2
MTAC-201Z-18	Audit-II	Audit Course-II	2	0	0	00	00	Satisfactory/ Non-satisfactory	Non-Credit
	Total		**14**	**0**	**12**	**340**	**360**	**700**	**18**

Professional Elective/ Audit	Course Code	Course Name	L	T	P	Marks Distribution		Total Marks	Credits
						Internal	External		
PE3	MTPS-203A-18	Restructured Power Systems	3	0	0	40	60	100	3
	MTPS-203B-18	Advanced Digital Signal Processing	3	0	0	40	60	100	3
	MTPS-203C-18	Adaptive Learning & Control	3	0	0	40	60	100	3
	MTPS-203D-18	Power Apparatus Design	3	0	0	40	60	100	3
PE4	MTPS-204A-18	Power Quality	3	0	0	40	60	100	3
	MTPS-204B-18	Distributed Generation	3	0	0	40	60	100	3
	MTPS-204C-18	Networked and Multi-agent Control Systems	3	0	0	40	60	100	3
	MTPS-204D-18	Artificial Intelligence Techniques	3	0	0	40	60	150	3
Lab3	MTPS-205A-18	Power System Protection Lab	0	0	4	60	40	100	2
	MTPS-205B-18	Power Quality Lab	0	0	4	60	40	100	2
Lab4	MTPS-206A-18	Power Electronics Applications to Power Systems	0	0	4	60	40	100	2
	MTPS-206B-18	Smart Grids Lab	0	0	4	60	40	100	2
	MTPS-206C-18	Artificial Intelligence Lab	0	0	4	60	40	100	2
Audit -II	MTA-105-18	Constitution of India	2	0	0	00	00	Satisfactory/ Non-satisfactory	Non-Credit
	MTA-106-18	Pedagogy Studies	2	0	0	00	00	Satisfactory/ Non-satisfactory	Non-Credit
	MTA-107-18	Stress Management by Yoga	2	0	0	00	00	Satisfactory/ Non-satisfactory	Non-Credit
	MTA-108-18	Personality Development through Life Enlightenment Skills	2	0	0	00	00	Satisfactory/ Non-satisfactory	Non-Credit

Third Semester

Course Code	Course Type	Course Name	L	T	P	Marks Distribution		Total Marks	Credits
						Internal	External		
MTPS-301X-18	PE5	Professional Elective-V	3	0	0	40	60	100	3
MTOE-301X-18	OE	Open elective	3	0	0	40	60	100	3
MTPS-302-18	Major Project	Phase-I Dissertation	0	0	20	60	40	100	10
	Total		**6**	**0**	**20**	**140**	**160**	**300**	**16**

Professional/ Open Elective	Course Code	Course Name	L	T	P	Marks Distribution		Total Marks	Credits
						Internal	External		
PE5	MTPS-301A-18	Computational Methods	3	0	0	40	60	100	3
	MTPS-301B-18	HVDC	3	0	0	40	60	100	3
	MTPS-301C-18	Power System Transients	3	0	0	40	60	100	3
	MTPS-301D-18	Dynamics of Linear Systems	3	0	0	40	60	100	3
OE	MTOE-301A-18	Business analytics	3	0	0	40	60	100	3
	MTOE-301B-18	Industrial Safety	3	0	0	40	60	100	3
	MTOE-301C-18	Operations Research	3	0	0	40	60	100	3
	MTOE-301D-18	Cost Management of Engineering Projects	3	0	0	40	60	100	3
	MTOE-301E-18	Composite Materials	3	0	0	40	60	100	3
	MTOE-301F-18	Waste to Energy	3	0	0	40	60	100	3

Fourth Semester

Course Code	Course Type	Course Name	L	T	P	Marks Distribution		Total Marks	Credits
						Internal	External		
MTPS-401-18	Major Project	Phase-II Dissertation	0	0	32	-	-	S/US	**16**

Total Marks of M. Tech Program: 1700

Total Credits of M. Tech Program: 68

MTPS-101-18 **POWER SYSTEM ANALYSIS-I** **L T P**

Internal Marks: 40 **3 0 0**

External Marks: 60

Total Marks: 100

Course Objectives:-

Students will be able to:

1. Study various methods of load flow and their advantages and disadvantages
2. Understand how to analyze various types of faults in power system
3. Understand power system security concepts and study the methods to rank the contingencies
4. Understand need of state estimation and study simple algorithms for state estimation
5. Study voltage instability phenomenon

Syllabus

Units	Content	Hours
1	Load flow: Overview of Newton-Raphson, Gauss-Siedel, fast decoupled methods, convergence properties, sparsity techniques, handling Q-max violations in constant matrix, inclusion in frequency effects	8
2	AVR in load flow, handling of discrete variable in load flow, Fault Analysis: Simultaneous faults, open conductor faults, generalized method of fault analysis	8
3	Security Analysis: Security state diagram, contingency analysis, generator shift distribution factors	6
4	line outage distribution factor, multiple line outages, overload index ranking	6
5	Power System Equivalents: WARD REI. equivalents, State Estimation: Sources of errors in measurement Virtual and Pseudo, Measurement, Observability, Tracking state estimation, WSL method, bad data correction	8
6	Voltage Stability: Voltage collapse, P-V curve, multiple power flow solution, continuation power flow, optimal multiplies load flow, voltage collapse proximity indices	8

Suggested reading

1. J.J. Grainger &W.D. Stevenson, “Power system analysis ”, McGraw Hill ,2003
2. A. R. Bergen & Vijay Vittal , “Power System Analysis”, Pearson , 2000
3. L.P. Singh, “Advanced Power System Analysis and Dynamics”, New Age International, 2006
4. G.L. Kusic, “Computer aided power system analysis” Prentice Hall India, 1986
5. A.J. Wood, “Power generation, operation and control”, John Wiley, 1994

6. P.M. Anderson, “Faulted power system analysis” IEEE Press , 1995

Course outcomes- Students will be able to:

1. To calculate voltage phasors at all buses, given the data using various methods of load flow
2. Able to calculate fault currents in each phase
3. Rank various contingencies according to their severity
4. Estimate the bus voltage phasors given various quantities viz. power flow, voltages, taps, CB status etc
5. Estimate closeness to voltage collapse and calculate PV curves using continuation power flow

MTPS-102-18 **POWER SYSTEM DYNAMICS-I** **L T P**

Internal Marks: 40 **3 0 0**

External Marks: 60

Total Marks: 100

Course Objectives:- Students will be able to:
1. Study of system dynamics and its physical interpretation
2. Development of mathematical models for synchronous machine
3. Modeling of induction motor

Syllabus

Unit	Content	Hours
1	Synchronous Machines: Per unit systems, Park's Transformation (modified), Flux-linkage equation	8
2	Voltage and current equations, Formulation of State-space equations, Equivalent circuit	8
3	Sub-transient and transient inductance and Time constants, Simplified models of synchronous machines	6
4	Small signal model: Introduction to frequency model	8
5	Excitation systems and Philips-Heffron model, PSS Load modeling	8
6	Modeling of Induction Motors, Prime mover controllers	6

Suggested reading:-

1. P. M. Anderson & A. A. Fouad "Power System Control and Stability", Galgotia , New Delhi, 1981
2. J Machowski, J Bialek & J. R W. Bumby, "Power System Dynamics and Stability", John Wiley & Sons, 1997
3. P. Kundur, "Power System Stability and Control", McGraw Hill Inc., 1994.
4. E.W. Kimbark, "Power system stability", Vol. I & III, John Wiley & Sons, New York 2002

Course Outcomes: Students will be able to:

1. Understand the modeling of synchronous machine in details
2. Carry out simulation studies of power system dynamics using MATLAB-SIMULINK, MI POWER
3. Carry out stability analysis with and without power system stabilizer (PSS)
4. Understand the load modeling in power system

MTPS-103A-18 **SMART GRIDS** **L T P**

Internal Marks: 40 **3 0 0**

External Marks: 60

Total Marks: 100

Course Objectives:- Students will be able to:
1. Study of system dynamics and its physical interpretation
2. Development of mathematical models for synchronous machine
3. Modeling of induction motor

Syllabus

Unit	Content	Hours
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	8
2	Introduction to Smart Meters, Real Time Prizing, 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 Automation	8
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)	8
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	8
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
6	Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN) Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Basics of CLOUD Computing & Cyber, Security for Smart Grid, Broadband over Power line (BPL), IP based protocols	6

Suggested reading

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

Course Outcomes:-Students will 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

MTPS-103B-18 DYNAMICS OF ELECTRICAL MACHINES L T P

Internal Marks: 40 3 0 0

External Marks: 60

Total Marks: 100

Course Objectives:
Students will be able to:
1. Learn Performance characteristics of machine.
2. To understand the dynamics of the machine.
3. To understand how to determine stability of machine.
4. Learn the synchronous machine analysis.

Syllabus		
Units	**Content**	**Hours**
1	Stability. Primitive 4 Winding Commutator Machine. Commutator Primitive Machine. Complete Voltage Equation of Primitive 4 Winding Commutator Machine.	6
2	Torque Equation. Analysis of Simple DC Machines using the Primitive Machine Equations. The Three Phase Induction Motor. Transformed Equations. Different Reference Frames for Induction Motor Analysis Transfer Function Formulation.	10
3	Three Phase Salient Pole Synchronous Machine. Parks Transformation- Steady State Analysis.	6
4	Large Signal Transient. Small Oscillation Equations in State Variable form Dynamical Analysis of Interconnected Machines.	6
5	Large Signal Transient Analysis using Transformed Equations. DC Generator /DC Motor System.	8
6	Alternator /Synchronous Motor System.	4

Suggested reading

1. D.P. Sengupta & J.B. Lynn," Electrical Machine Dynamics", The Macmillan Press Ltd. 1980

2. R Krishnan "Electric Motor Drives, Modeling, Analysis, and Control", Pearson Education., 2001

3. P.C. Kraus, "Analysis of Electrical Machines", McGraw Hill Book Company, 1987

4. I. Boldia & S.A. Nasar,,"Electrical Machine Dynamics", The Macmillan Press Ltd. 1992

5. C.V. Jones, "The Unified Theory of Electrical Machines", Butterworth, London. 1967

Course Outcomes : Students will be able to:

1. Formulation of electrodynamic equations of all electric machines and analyze the performance characteristics

2. Knowledge of transformations for the dynamic analysis of machines

3. Knowledge of determination of stability of the machines under small signal and transient conditions

4. Study about synchronous machine

MTPS-103C-18 **ROBOTICS AND AUTOMATION** **L T P**

Internal Marks: 40 **3 0 0**

External Marks: 60

Total Marks: 100

Course objectives

1. To study the various parts of robots and fields of robotics
2. To study the various kinematics and inverse kinematics of robots
3. To study the trajectory planning for robot
4. To study the control of robots for some specific applications

	Syllabus	
Unit	**Content**	**Hours**
1	Basic Concepts: Definition and origin of robotics, different types of robotics Various generations of robots, degrees of freedom, Asimov's laws of robotics, dynamic stabilization of robots	6
2	Power Sources and Sensors: Hydraulic, pneumatic and electric drives Determination of HP of motor and gearing: ratio, variable speed arrangements, path determination, micro machines in robotics Machine vision, ranging, laser, acoustic, magnetic, fiber optic and tactile sensors	8
3	Manipulators, Actuators and Grippers: Construction of manipulators, manipulator dynamics and force control Electronic and pneumatic manipulator control circuits, end effectors	8
4	Kinematics and Path Planning: Solution of inverse kinematics problem Multiple solution Jacobian work envelop, hill climbing techniques, Robot programming languages	6
5	Manufacturing and non- manufacturing applications, robot cell design, selection of robot	6
6	Robot Control: Linear methods, Non-linear methods	4

Suggested reading

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G. "Industrial Robotics", McGraw-Hill Singapore, 1996

2. Ghosh, "Control in Robotics and Automation: Sensor Based Integration", Allied Publishers, Chennai, 1998

3. Deb. S.R., "Robotics technology and flexible Automation", John Wiley, USA 1992

4. Asfahl C.R., "Robots and manufacturing Automation", John Wiley, USA 1992

Course Outcomes

Students will be able to

1. Obtain forward, reverse kinematics and dynamics model of the industrial robot arm
2. Propose and synthesize control law for a given application
3. Classify robots and decide specifications depending on the applications

MTPS-103D-18 **WIND AND SOLAR SYSTEMS** **L T P**

Internal Marks: 40 **3 0 0**

External Marks: 60

Total Marks: 100

Course Objectives:-Students will be able to:
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

Syllabus

Unit	Content	Hours
1	Historical development and current status, characteristics of wind power generation, network integration issues	8
2	Generators and power electronics for wind turbines, power quality standards for wind turbines, Technical regulations for interconnections of wind farm with power systems	8
3	Isolated wind systems, reactive power and voltage control, economic aspects	8
4	Impacts on power system dynamics, power system interconnection	8
5	Introduction of solar systems, merits and demerits, concentrators, various applications	6
6	Solar thermal power generation, PV power generation, Energy Storage device, Designing the solar system for small installations	6

Suggested reading

1. Thomas Ackermann, Editor, "Wind power in Power Systems", John Willy and sons ltd.2005
2. Siegfried Heier, "Grid integration of wind energy conversion systems", John Willy and sons ltd., 2006
3. K. Sukhatme and S.P. Sukhatme, "Solar Energy". Tata MacGraw Hill, Second Edition, 1996

Course Outcomes:- Students will be able to:

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

MTPS-104A-18 **ELECTRIC AND HYBRID VECHILES** **L T P**

Internal Marks: 40 **3 0 0**

External Marks: 60

Total Marks: 100

Course Objectives:- Students will be able to:
1. To understand upcoming technology of hybrid system
2. To understand different aspects of drives application
3. Learning the electric Traction

Syllabus

Units	Content	Hours
1	History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles Impact of modern drive-trains on energy supplies Basics of vehicle performance, vehicle power source characterization Transmission characteristics Mathematical models to describe vehicle performance	8
2	Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies Power flow control in hybrid drive-train topologies Fuel efficiency analysis.	8
3	Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies Power flow control in hybrid drive-train topologies Fuel efficiency analysis.	8
4	Introduction to electric components used in hybrid and electric vehicles Configuration and control of DC Motor drives Configuration and control of Introduction Motor drives configuration and control of Permanent Magnet Motor drives Configuration and control of Switch Reluctance Motor drives, drive system efficiency	8
5	Matching the electric machine and the internal combustion engine (ICE) Sizing the propulsion motor, sizing the power electronics Selecting the energy storage technology Communications, supporting subsystems	8
6	Introduction to energy management and their strategies used in hybrid and electric vehicle Classification of different energy management strategies Comparison of different energy management strategies Implementation issues of energy strategies	6

Suggested reading

1.Sira -Ramirez, R. Silva Ortigoza, “Control Design Techniques in Power Electronics Devices”, Springer.

2. Siew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse, "Sliding mode control of switching Power Converters"

Course Outcomes :-

Students will be able to:

1. Acquire knowledge about fundamental concepts, principles, analysis and design of hybrid and electric vehicles.

2. To learn electric drive in vehicles / traction.

MTPS-104B-18 **DESIGN ASPECTS IN CONTROL** **L T P**

Internal Marks: 40 **3 0 0**

External Marks: 60

Total Marks: 100

Course Objectives

1. The student is introduced to the tools and techniques of control system design
2. Introduction to various aspects of controller design philosophy
3. Learning PID Controller

Syllabus

Unit	Content	Hours
1	System Modelling, review of concepts	4
2	FOPDT and SOPDT systems and identification Smith Predictor and its Variations	8
3	PID Controllers – review PID Tuning – Ziegler Nichols, Cohen-Coon Techniques	6
4	State feedback review – pole placement, Eigen structure assignment, Eigen structure – time response relation, Controller gain selection, controller robustness, disturbance rejection	6
5	Frequency Domain Loop Shaping Lag, Lead and Lag-lead compensators, Zero dynamics in servo control, Unstable zero dynamics – control design	8
6	Observer – concept and design, Case studies - Applications	4

Suggested reading

1. Karl J. Astrom, Richard M. Murray, “Feedback Sytems : An Introduction for Scientists and Engineers”, Princeton University Press, 2010.

2. Thomas Kailath : “Linear Systems”, Prentice-Hall

Course Outcomes

Students will be able to

1. Model a control system given its parameters

2. Decide gains of the controllers like PI,PID in a given control system

MTPS-104C-18 PWM CONVERTERS AND APPLICATIONS L T P

Internal Marks: 40 3 0 0

External Marks: 60

Total Marks: 100

Course Objectives:
Students will be able to:
1. Understand the concepts and basic operation of PWM converters, including basic circuit operation and design.
2. Understand the steady-state and dynamic analysis of PWM converters along with the applications like solid state drives and power quality.

Syllabus

Units	Content	Hours
1	AC/DC and DC/AC power conversion Overview of applications of voltage source converters and current source converters.	6
	Pulse width modulation techniques for bridge converters Bus clamping PWM. Space vector based PWM. Advanced PWM techniques	6
2	Practical devices in converter. Calculation of switching and conduction power losses.	4
3	Compensation for dead time and DC voltage regulation. Dynamic model of PWM converter. Multilevel converters. Constant V/F induction motor drives.	8
4	Estimation of current ripple and torque ripple in inverter fed drives. Line-side converters with power factor compensation	8
5	Active power filtering. Reactive power compensation. Harmonic current compensation. Selective harmonic elimination PWM technique for high power electric drives	8

Suggested reading

1. Mohan, Undeland and Robbins, “Power Electronics: Converters, Applications and Design”, John’s Wiley and Sons.

2. Erickson RW, “Fundamentals of Power Electronics”, Chapman and Hall.

3. Vithyathil. J, “Power Electronics: Principles and Applications”, McGraw Hill.

Course Outcomes: Students will be able to:

1. Knowledge concepts and basic operation of PWM converters, including basic circuit operation

and design

2. Learn the steady-state and dynamic analysis of PWM converters along with the applications like solid state drives and power quality

3. Able to recognize and use the following concepts and ideas: Steady-State and transient modelling and analysis of power converters with various PWM techniques.

MTPS-104D-18 FACTS AND CUSTOM POWER DEVICESS L T P

Internal Marks: 40 3 0 0

External Marks: 60

Total Marks: 100

Course Objectives:

Students will be able to:

1. To learn the active and reactive power flow control in power system
2. To understand the need for static compensators
3. To develop the different control strategies used for compensation

Syllabus

Unit	Content	Hours
1	Reactive power flow control in Power Systems – Control of dynamic power unbalances in Power System, Power flow control -Constraints of maximum transmission line loading –Benefits of FACTS Transmission line compensation, Uncompensated line -Shunt compensation - Series compensation –Phase angle control. Reactive power compensation, Shunt and Series compensation principles – Reactive compensation at transmission and distribution level.	6
2	Static versus passive VAR compensator, Static shunt compensators: SVC and STATCOM - Operation and control of TSC, TCR and STATCOM - Compensator control, Comparison between SVC and STATCOM.	8
3	Static series compensation: TSSC, SSSC -Static voltage and phase angle regulators – TCVR and TCPAR Operation and Control – Applications, Static series compensation – GCSC, TSSC, TCSC and Static synchronous series compensators and their Control.	6
4	SSR and its damping Unified Power Flow Controller: Circuit Arrangement, Operation and control of UPF, Basic Principle of P and Q control- Independent real and reactive power flow control- Applications.	6
5	Introduction to interline power flow controller. Modeling and analysis of FACTS Controllers – Simulation of FACTS controllers Power quality problems in distribution systems, harmonics, Loads that create harmonics, modeling, harmonic propagation, series and parallel resonances, mitigation of harmonics, passive filters, active filtering – shunt, series and hybrid and their control.	6
6	Voltage swells, sags, flicker, unbalance and mitigation of these problems by power line conditioners- IEEE standards on power quality.	6

Suggest Reading

1. K R Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International Publishers, 2007
2. X P Zhang, C Rehtanz, B Pal, "Flexible AC Transmission Systems- Modelling and Control",
3. N.G. Hingorani, L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.
4. K.S.Suresh kumar ,S. Ashok , "FACTS Controllers & Applications", E-book edition, Nalanda Digital Library, NIT Calicut,2003
5. G T Heydt, "Power Quality", McGraw-Hill Professional, 2007
6. T J E Miller, "Static Reactive Power Compensation", John Wiley and Sons, Newyork, 1982.

Course Outcomes: - Students will be able to:

1. Acquire knowledge about the fundamental principles of Passive and Active Reactive Power Compensation Schemes at Transmission and Distribution level in Power Systems.
2. Learn various Static VAR Compensation Schemes like Thyristor/GTO Controlled Reactive Power Systems, PWM Inverter based Reactive Power Systems and their controls.
3. To develop analytical modeling skills needed for modeling and analysis of such Static VAR Systems.

MTRM-101-18 **RESEARCH METHODOLOGY AND IPR** **L T P**

Internal Marks: 40 **2 0 0**

External Marks: 60

Total Marks: 100

Course Objectives:-Students will be able to:
1. To understand research problem formulation and research ethics
2. To understand about control of information technology
3. To understand the need of IPR & its protection

Syllabus

Unit	Content	Hours
1	Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations	8
2	Effective literature studies approaches, analysis Plagiarism, Research ethics	4
3	Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee	6
4	Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT	8
5	Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications	4
6	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

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.

5. Mayall , "Industrial Design", McGraw Hill, 1992
6. Asimov , "Introduction to Design", Prentice Hall, 1962.
7. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
8. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008
9. Niebel, "Product Design", McGraw Hill, 1974.

Course Outcomes:

At the end of this course, students will be able to

1. Understand research problem formulation. Analyze research related information
2. Follow research ethics
3. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
4. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
5. 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.

MTPS-105-18 POWER SYSTEM STEADY STATE ANALYSIS LAB L T P

Internal Marks: 60 0 0 4

External Marks: 40

Total Marks: 100

Course Objectives:-

Students will be able:

1. To understand power system problems
2. To understand how to analyze the power system load flow studies, forecasting & unit Commitment.
3. To understand the role of power electronic devices.

Syllabus

Sr. No.	List of Experiments
1	Power Systems & Power Electronics Lab
2	Computer Simulation Lab
3	Simulation of IGBT Inverters.
4	Simulation of Thyristor Converters.
5	Transient Stability Studies.
6	Short Circuit Studies.
7	Load Flow Studies
8	Load Forecasting and Unit Commitment

Course Outcomes:- Students will be able to

1. Understand the power system operational problems.
2. Apply the load flow methods, fault analysis techniques and unit commitment of units.
3. Applications of power electronic devices in power system.

MTPS-106-18 **POWER SYSTEM DYNAMICS LAB** **L T P**

Internal Marks: 60 **0 0 4**

External Marks: 40

Total Marks: 100

Course Objectives:- Students will be able :

1. To understand the stability analysis for single machine system
2. To understand the stability analysis for single machine system using models.
3. Development of simulink model for excitation system using MATLAB.

Syllabus

Sr. No.	List of Experiments
1	To develop a MATLAB program to study small signal stability analysis of single machine infinite bus system using classical machine model.
2	To develop a MATLAB program to study small signal stability analysis of single machine infinite bus system using Type B1 model.
3	To develop a simulink model of IEEE type 1(1968) excitation system using MATLAB.
4	To develop a MATLAB program to study small signal stability analysis of single machine infinite bus system using Type B1 –effect of excitation system.
5	To develop a MATLAB program to study small signal stability analysis of single machine infinite bus system using Type B1 machine model with simple excitation system- effect of PSS.

Course Outcomes:- Students will be able to

1. Do stability analysis for small signal stability
2. Analyze the single machine system using models
3. Simulink models considering excitation systems

MTA-101A-18 **ENGLISH FOR PAPER WRITING** **L T P**

Internal Marks: 00 **2 0 0**

External Marks: 00

Total Marks: 00

Course Objectives:- Students will be able to:

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

Syllabus

Units	Contents	Hours
1	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing, Redundancy, Avoiding Ambiguity and Vagueness	4
2	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction	4
3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	4
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,	4
5	skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	4
6	useful phrases, how to ensure paper is as good as it could possibly be the first time submission	4

Suggested Studies:

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

Course Outcome:- Students will be able to learn

1. Improve writing and readability levels for English
2. How to write and what write according to section
3. Skills in title writing

MTA-101B-18 **DISASTER MANAGEMENT** **L T P**

Internal Marks: 00 **2 0 0**

External Marks: 00

Total Marks: 00

Course Objectives: -Students will be able to:

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.

Syllabus

Units	Contents	Hours
1	Introduction, Disaster: Definition, Factors and Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	4
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	4
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	4
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.	4
5	Risk Assessment, Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co- Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.	4
6	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.	4

Suggested readings:

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.

Course Outcome:- Student will be able

1. Know, how to reduce disaster risk and humanitarian response.
2. Policy and practice for disaster risk reduction
3. Understand the practical relevance of conflict situations and standards of humanitarian response in that situation
4. Planning, programming and strength and weakness of disaster risk management

MTA-101C-18 **SANSKRIT FOR TECHNICAL EDUCATION** **L T P**

Internal Marks: 00 **2 0 0**

External Marks: 00

Total Marks: 00

Course Objectives:- Students will be able to:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Syllabus

Units	Content	Hours
1	Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences	8
2	Order Introduction of roots Technical information about Sanskrit Literature	8
3	Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics	8

Suggested reading

1. "Abhyaspustakam" – Dr.Vishwas, Sanskrit-Bharti Publication,New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Outcome:- Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

MTA-101D-18 **VALUE EDUCATION** **L T P**

Internal Marks: 00 **2 0 0**

External Marks: 00

Total Marks: 00

Course Objectives:- Students will be able to:

1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

Syllabus

Units	Content	Hours
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	4
2	Importance of cultivation of values, Sense of duty. Devotion, Self-reliance, Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity, Patriotism, Love for nature, Discipline	6
3	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, 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	6
4	Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation, Equality, Nonviolence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively	6

Suggested reading

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

Course outcomes:-Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

MTPS-201-18 **POWER SYSTEM DYNAMICS-II** **L T P**
Internal Marks: 40 **3 0 0**
External Marks: 60
Total Marks: 100

Course Objectives:-Students will be able to:
1. Study of power system dynamics
2. Interpretation of power system dynamic phenomena
3. Study of various forms of stability

Syllabus

Unit	Content	Hours
1	Basic Concepts of Dynamic Systems and Stability Definition, Small Signal Stability (Low Frequency Oscillations) of Unregulated and Regulated System	8
2	Effect of Damper, Flux Linkage Variation and AVR	8
3	Large Signal Rotor Angle Stability, Dynamic Equivalents And Coherency, Direct Method of Stability Assessment, Stability Enhancing Techniques, Mitigation Using Power System Stabilizer	8
4	Asynchronous Operation and Resynchronization, Multi-Machine Stability	6
5	Dynamic Analysis of Voltage Stability, Voltage Collapse	6
6	Frequency Stability, Automatic Generation Control, Primary and Secondary Control, Sub-Synchronous Resonance and Counter Measures	8

Suggested reading

1. P. Kundur, "Power System Stability and Control", McGraw Hill Inc, 1994
2. J. Machowski, Bialek, Bumby, "Power System Dynamics and Stability", John Wiley & Sons, 1997
3. L. Leonard Grigsby (Ed.); "Power System Stability and Control", Second edition, CRC Press, 2007
4. V. Ajjarapu, "Computational Techniques for voltage stability assessment & control"; Springer, 2006

Course Outcomes:- Students will be able to:

1. Gain valuable insights into the phenomena of power system including obscure ones.
2. Understand the power system stability problem.
3. Analyze the stability problems and implement modern control strategies.
4. Simulate small signal and large signal stability problems.

MTPS-202-18 DIGITAL PROTECTION OF POWER SYSTEM L T P
Internal Marks: 40 3 0 0
External Marks: 60
Total Marks: 100

Course Objectives:- Students will be able to:
1. Study of numerical relays
2. Developing mathematical approach towards protection
3. Study of algorithms for numerical protection

Syllabus

Unit	Content	Hours
1	Evolution of digital relays from electromechanical relays, Performance and operational characteristics of digital protection	6
2	Mathematical background to protection algorithms, Finite difference techniques	6
3	Interpolation formulae, Forward, backward and central difference interpolation, Numerical differentiation, Curve fitting and smoothing, Least squares method, Fourier analysis, Fourier series and Fourier transform, Walsh function analysis	8
4	Basic elements of digital protection, Signal conditioning: transducers, surge protection, analog filtering, analog multiplexers, Conversion subsystem: the sampling theorem, signal aliasing, Error, sample and hold circuits, multiplexers, analog to digital conversion, Digital filtering concepts, The digital relay as a unit consisting of hardware and software	8
5	Sinusoidal wave based algorithms, Sample and first derivative (Mann and Morrison) algorithm, Fourier and Walsh based algorithms	8
6	Fourier Algorithm: Full cycle window algorithm, fractional cycle window algorithm, Walsh function based algorithm, Least Squares based algorithms, Differential equation based algorithms, Traveling Wave based Techniques, Digital Differential Protection of Transformers, Digital Line Differential Protection, Recent Advances in Digital Protection of Power Systems	8

Suggested reading

1. A.G. Phadke and J. S. Thorp, “Computer Relaying for Power Systems”, Wiley/Research studies Press, 2009
2. A.T. Johns and S. K. Salman, “Digital Protection of Power Systems”, IEEE Press,1999
3. Gerhard Zeigler, “Numerical Distance Protection”, Siemens Publicis Corporate Publishing, 2006
4. S.R. Bhide “Digital Power System Protection” PHI Learning Pvt.Ltd.2014

Course Outcomes:- Students will be able to:

1. Learn the importance of Digital Relays

2. Apply Mathematical approach towards protection
3. Learn to develop various Protection algorithms

MTPS-203A-18 **RESTRUCTURED POWER SYSTEMS** **L T P**
Internal Marks: 40 **3 0 0**
External Marks: 60
Total Marks: 100

Course Objectives: -Students will be able to:
1. Understand what is meant by restructuring of the electricity market
2. Understand the need behind requirement for deregulation of the electricity market
3. Understand the money, power & information flow in a deregulated power system

Syllabus

Unit	Content	Hours
1	Fundamentals of restructured system, Market architecture, Load elasticity Social welfare maximization.	8
2	OPF: Role in vertically integrated systems and in restructured markets, congestion management.	8
3	Optimal bidding, Risk assessment, Hedging, Transmission pricing, Tracing of power.	8
4	Ancillary services, Standard market design, Distributed generation in restructured markets.	8
5	Developments in India, IT applications in restructured markets.	6
6	Working of restructured power systems, PJM, Recent trends in Restructuring.	6

Suggested reading

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.
3. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, "Operation of restructured power systems", Kluwer Academic Pub., 2001.
4. Mohammad Shahidehpour, MuwaffaqAlomoush, "Restructured electrical power systems: operation, trading and volatility", Marcel Dekker.

Course Outcomes: -Students will be able to:

1. Describe various types of regulations in power systems.
2. Identify the need of regulation and deregulation.
3. Define and describe the Technical and Non-technical issues in Deregulated Power Industry.
4. Identify and give examples of existing electricity markets.
5. Classify different market mechanisms and summarize the role of various entities in the market.

MTPS-203B-18 ADVANCED DIGITAL SIGNAL PROCESSING L T P
Internal Marks: 40 3 0 0
External Marks: 60
Total Marks: 100

Course Objectives: -Students will be able to:
1. To understand the difference between discrete-time and continuous-time signals
2. To understand and apply Discrete Fourier Transforms (DFT).

Syllabus

Unit	Content	Hours
1	Discrete time signals, Linear shift invariant systems- Stability and causality, Sampling of continuous time signals- Discrete time Fourier transform- Discrete Fourier series- Discrete Fourier transform, Z transform-Properties of different transforms.	8
2	Linear convolution using DFT, Computation of DFT Design of IIR digital filters from analog filters, Impulse invariance method, Bilinear transformation method.	8
3	FIR filter design using window functions, Comparison of IIR and FIR digital filters, Basic IIR and FIR filter realization structures, Signal flow graph representations Quantization process and errors, Coefficient quantisation effects in IIR and FIR filters.	8
4	A/D conversion noise- Arithmetic round-off errors, Dynamic range scaling, Overflow oscillations and zero Input limit cycles in IIR filters, Linear Signal Models.	8
5	All pole, All zero and Pole-zero models, Power spectrum estimation- Spectral analysis of deterministic signals, Estimation of power spectrum of stationary random signals.	6
6	Optimum linear filters, Optimum signal estimation, Mean square error estimation, Optimum FIR and IIR Filters.	6

Suggested reading

1. Sanjit K Mitra, "Digital Signal Processing: A computer-based approach ",TataMc Grow-Hill Edition1998
2. Dimitris G .Manolakis, Vinay K. Ingle and Stephen M. Kogon, "Statistical and Adaptive Signal Processing", Mc Grow Hill international editions. -2000

Course Outcomes:- Students will be able to:

1. Knowledge about the time domain and frequency domain representations as well analysis of discrete time signals and systems
2. Study the design techniques for IIR and FIR filters and their realization structures.
3. Acquire knowledge about the finite word length effects in implementation of digital filters.

4. Knowledge about the various linear signal models and estimation of power spectrum of stationary random signals
5. Design of optimum FIR and IIR filters

MTPS-203C-18 **ADAPTIVE LEARNING AND CONTROL** **L T P**
Internal Marks: 40 **3 0 0**
External Marks: 60
Total Marks: 100

Course Objectives: -
1. To introduce adaptive and learning techniques for control design for uncertain dynamical Systems.
2. Introduction to learning based control.

Syllabus

Unit	Content	Hours
1	Introduction to adaptive control, Direct and indirect adaptive control, Model reference adaptive control, Parameter convergence, Persistence of excitation	8
2	Review of Lyapunov stability theory	6
3	Adaptive back stepping, Adaptive control of nonlinear systems, Composite adaptation, Robust adaptive control	8
4	Neural Network-based control	6
5	Reinforcement learning-based control	6
6	Repetitive learning control, Predictive control, Robust adaptive control	6

Suggested reading
1. H. K. Khalil, "Nonlinear Systems", 3rd edition, Prentice Hall, 2002
2. S. Sastry and M. Bodson, "Adaptive Control", Prentice-Hall, 1989
3. K. S. Narendra and A. M. Annaswamy, "Stable Adaptive Systems", Prentice-Hall, 1989
4.J.J.E. Slotine, and W. Li, "Applied Nonlinear Control", Prentice-Hall, 1991
5.P. Ioannou& B. Fidan, "Adaptive Control Tutorial", SIAM, Philadelpia, PA, 2006

Course Outcomes: Students will be able to
1. Understand detailed knowledge of classical system identification and the development and properties of various methods
2. Understand detailed knowledge of on-line parameter estimation
3. Understand knowledge of adaptive control systems and their development and properties
4. Understand knowledge of methods and tools for stability analysis of adaptive systems

MTPS-203D-18 **POWER APPARATUS DESIGN** **L T P**
Internal Marks: 40 **3 0 0**
External Marks: 60
Total Marks: 100

Course Objectives: -Students will be able to:
1. Study the modelling analysis of rotating machine.
2. Learning electromagnetic energy conversion
3. To know about rating of machines.

Syllabus

Unit	Content	Hours
1	Principles of Design of Machines -Specific loadings, choice of magnetic and electric loadings, Real and apparent flux densities, temperature rise calculation, Separation of main dimension for DC machines, Induction machines and synchronous machines, Design of Transformers-General considerations, output equation, emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling.	8
2	Specific loadings, choice of magnetic and electric loadings Real and apparent flux -densities, temperature rise calculation, Separation of main dimension for DC machines, Induction machines and synchronous machines, Heating and cooling of machines, types of ventilation, continuous and intermittent rating.	8
3	General considerations, output equation, emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling tubes, Calculation of losses, efficiency and regulation, Forces winding during short circuit.	8
4	General considerations, output equation, Choice of specific electric and magnetic loadings, efficiency, power factor, Number of slots in stator and rotor, Elimination of harmonic torques.	8
5	Design of stator and rotor winding, slot leakage flux, Leakage reactance, equivalent resistance of squirrel cage rotor, Magnetizing current, efficiency from design data.	6
6	Types of alternators, comparison, specific loadings, output co-efficient, design of main dimensions, Introduction to Computer Aided Electrical Machine Design Energy efficient machines.	6

Suggested reading

1. Clayton A.E, "The Performance and Design of D.C. Machines", Sir I. Pitman & sons, Ltd.
2. M.G. Say, "The Performance and Design of A.C. Machines ", Pitman
3. Sawhney A.K, "A course in Electrical Machine Design", DhanpatRai & Sons, 5th Edition

Course Outcomes: - Students will be able to:

1. To give a systematic approach for modeling and analysis of all rotating machines under both transient and steady state conditions with the dimensions and material used
2.
3. Ability to model and design all types of rotation machines including special machines

MTPS-204A-18 **POWER QUALITY** **L T P**
Internal Marks: 40 **3 0 0**
External Marks: 60
Total Marks: 100

Course Objectives: -Students will be able to:
1. Understand the different power quality issues to be addressed
2. Understand the recommended practices by various standard bodies like IEEE,IEC, etc on voltage& frequency, harmonics
3. Understanding STATIC VAR Compensators.

Syllabus

Unit	Content	Hours
1	Introduction-power quality-voltage quality-overview of power quality Phenomena, classification of power quality issues-power quality measures and standards-THD-TIF-DIN-C message weights-flicker factor transient phenomena-occurrence of power quality problems, power acceptability curves-IEEE guides, standards and recommended practices.	8
2	Harmonics-individual and total harmonic distortion, RMS value of a harmonic waveform- Triplex harmonics-important harmonic introducing devices-SMPS-Three phase power converters- arcing devices saturable devices-harmonic distortion of fluorescent lamps-effect of power system harmonics on power system equipment and loads.	8
3	Modeling of networks and components under non-sinusoidal conditions transmission and distribution systems, Shunt capacitors-transformers-electric machines-ground systems loads that cause power quality problems, power quality problems created by drives and its impact on drive.	8
4	Power factor improvement- Passive Compensation, Passive Filtering , Harmonic, Resonance, Impedance Scan Analysis- Active Power Factor Corrected Single Phase Front End, Control Methods for Single Phase APFC, Three Phase APFC and Control Techniques, PFC Based on Bilateral Single Phase and Three Phase Converter.	8
5	Static VAR compensators-SVC and STATCOM Active Harmonic Filtering-Shunt Injection , Filter for single phase, three-phase three-wire and three-phase four wire systems, d-q domain control of three phase shunt active filters uninterruptible power supplies constant voltage transformers, series active power filtering techniques for harmonic cancellation and isolation.	8
6	Dynamic Voltage Restorers for sag, swell and flicker problems. Grounding and wiring introduction , NEC grounding requirements-reasons for grounding, typical grounding and wiring problems solutions to grounding and wiring problems.	8

Suggested readings:-

1. G.T. Heydt, "Electric power quality", McGraw-Hill Professional, 2007
2. Math H. Bollen, "Understanding Power Quality Problems", IEEE Press, 2000
3. J. Arrillaga, "Power System Quality Assessment", John wiley, 2000
4. J. Arrillaga, B.C. Smith, N.R. Watson & A. R.Wood ,"Power system Harmonic Analysis", Wiley, 1997

Course Outcomes: - Students will be able to:

1. Acquire knowledge about the harmonics, harmonic introducing devices and effect of harmonics on system equipment and loads
2. To develop analytical modeling skills needed for modeling and analysis of harmonics in networks and components
3. To introduce the student to active power factor correction based on static VAR compensators and its control techniques
4. To introduce the student to series and shunt active power filtering techniques for harmonics.

MTPS-204B-18 **DISTRIBUTED GENERATION** **L T P**
Internal Marks: 40 **3 0 0**
External Marks: 60
Total Marks: 100

Course Objectives:
Students will be able to:
1. To understand renewable energy sources.
2. To gain understanding of the working of off-grid and grid-connected renewable energy generation schemes.

Syllabus

Units	Content	Hours
1	Need for Distributed generation. Renewable sources in distributed generation and current scenario in Distributed Generation	**6**
2	Planning of DGs. Sitting and sizing of DGs optimal placement of DG sources in distribution systems. Grid integration of DGs Different types of interfaces, Inverter based DGs and rotating machine based interfaces. Aggregation of multiple DG units.	**8**
3	Technical impacts of DGs. Transmission systems Distribution Systems De-regulation Impact of DGs upon protective relaying. Impact of DGs upon transient and dynamic stability of existing distribution systems, Steady-state and Dynamic analysis.	**6**
4	Economic and control aspects of DGs Market facts. Issues and challenges Limitations of DGs, Voltage control techniques. Reactive power control, Harmonics Power quality issues, Reliability of DG based systems.	**8**
5	Introduction to micro-grids. Types of micro-grids: autonomous and non-autonomous grids Sizing of micro-grids. Modeling & analysis of Micro-grids with multiple DGs. Micro-grids with power electronic interfacing units.	**8**
6	Transients in micro-grids, Protection of micro-grids, Case studies, Advanced topics	**8**

Suggested reading

1. H. Lee Willis, Walter G. Scott, "Distributed Power Generation – Planning and Evaluation",
Marcel Decker Press.
2. M.Godoy Simoes, Felix A.Farret, "Renewable Energy Systems – Design and Analysis with
Induction Generators", CRC press.

3. Stuart Borlase. "Smart Grid: Infrastructure Technology Solutions" CRC Press

Course outcomes
Students will be able to:
1. To understand the planning and operational issues related to Distributed Generation.
2. Acquire Knowledge about Distributed Generation Learn Micro-Grids

MTPS-204C-18 NETWORKED AND MULTI-AGENT CONTROL SYSTEMS

	L	T	P
Internal Marks: 40	**3**	**0**	**0**

External Marks: 60
Total Marks: 100

Course Objectives:
1. To analyze and design control systems for networked and multi-agent systems
2. Understand network optimization techniques

Syllabus

Units	Content	Hours
1	Overview of networked systems, Graph Theory Fundamentals	6
2	Graph-based Network Models, Network Optimization	8
3	Consensus Problem: cooperative control, leader-follower architecture	6
4	Control under Communication Constraints, Formation Control, Swarming and Flocking, Collision Avoidance	8
5	Game Theoretic Control of Multi-Agent Systems	6
6	Applications: Multi-robot/vehicle coordination, Sensor Networks, Social Networks, Smart Grids, Biological Networks	8

Suggested reading
1. C. Godsil and G. Royle, "Algebraic Graph Theory", Springer, 2001
2.M. Mesbahi and M. Egerstedt , "Graph Theoretic Methods in Multi-Agent Networks", Princeton University Press, 2010
3.F. Bullo, J. Cortes, and S. Martinez, "Distributed Control of Robotic Networks", Princeton, 2009
4.Wei Ren, Randal W. Beard, "Distributed Consensus in Multi-vehicle Cooperative Control, Communications and Control Engineering Series", Springer-Verlag, London, 2008

Course Outcomes: Students will be able to
1. Understand multi-agent control systems
2. Know network optimization techniques and its applications
3. Design multi-robot or vehicle coordination systems

MTPS-204D-18 ARTIFICIAL INTELLIGENT TECHNIQUES L T P
Internal Marks: 40 3 0 0
External Marks: 60
Total Marks: 100

Course Objectives:-Students will be able to: 1.Understanding fuzzy logic, ANN 2.Understanding GA & EP		
Syllabus		
Units	**Content**	**Hours**
1	Biological foundations to intelligent Systems, Artificial Neural Networks, Single layer and Multilayer Feed Forward NN LMS and Back Propagation Algorithm, Feedback networks and Radial Basis Function Networks	8
2	Fuzzy Logic, Knowledge Representation and Inference Mechanism Defuzzification Methods.	8
3	Fuzzy Neural Networks, some algorithms to learn the parameters of the network like GA.	8
4	System Identification using Fuzzy and Neural Network.	6
5	Genetic algorithm, Reproduction cross over, mutation, Introduction to evolutionary program.	8
6	Applications of above mentioned techniques to practical problems.	6

Suggested reading

1. J M Zurada , "An Introduction to ANN",Jaico Publishing House
2. Simon Haykins, "Neural Networks", Prentice Hall
3. Timothy Ross, "Fuzzy Logic with Engg. Applications", McGraw. Hill
4. Driankov, Dimitra, "An Introduction to Fuzzy Control", Narosa Publication
5. Golding, "Genetic Algorithms", Addison-Wesley Publishing Com

Course Outcomes: - Students will be able to:

1. Learn the concepts of biological foundations of artificial neural networks
2. Learn Feedback networks and radial basis function networks and fuzzy logics
3. Identifications of fuzzy and neural network
4. Acquire the knowledge of GA

MTPS-205A-18 **POWER SYSTEM PROTECTION LAB** **L T P**
Internal Marks: 60 **0 0 4**
External Marks: 40
Total Marks: 100

Course Objectives:-Students will be able : 1. To understand power system protection through feeders. **2.** To understand the transformer protection, reverse power and induction relay.	
Syllabus	
Sr. No.	**List of Experiments**
1	Introduction to Power System Protection
2	Impact of Induction Motor Starting on Power System
3	Modelling of Differential Relay using MATLAB
4	Radial Feeder Protection
5	Parallel Feeder Protection
6	Principle of Reverse Power Protection
7	Differential Protection of Transformer
8	To the study time Vs. voltage characteristics of over voltage induction relay

Course Outcome;- Student will be able

1. Understand the performance of protection relays with feeders
2. Modelling of relay and understand principle of different relays.

MTPS-205B-18 **POWER QUALITY LAB** **L T P**
Internal Marks: 60 **0 0 4**
External Marks: 40
Total Marks: 100

Course Objectives:-Students will be able :

1. To understand phenomena of power quality
2. To study and analyze the harmonics distortion
3. Understand the grounding and wiring techniques.

Syllabus

Sr. No.	**List of Experiments**
1	To understand power quality phenomena.
2	To monitor the power quality for current and power transformers.
3	To obtain the current harmonics drawn by power electronics interface.
4	To analyze the harmonic distortion.
5	To study and analyze the grounding and wiring techniques.

Course Outcome;- Student will be able

1. Understand and analyze power quality
2. Performance and analysis of occurrence of harmonics
3. Knowledge of grounding techniques

MTPS-206A-18 POWER ELECTRONICS APPLICATIONS TO POWER SYSTEMS

	L	T	P
Internal Marks: 60	**0**	**0**	**4**

External Marks: 40
Total Marks: 100

Course Objectives:-Students will be able :

1. To understand and analyze the performance of thyristor, converters and inverters
2. Applications of power electronics in operation of power system.

Syllabus

Sr. No.	**List of Experiments**
1	Study of three phase line commutated thyristor converter circuit
2	To study the performance of three phase variable frequency drive
3	Switching characteristics of MOSFET and IGBT
4	Performance analysis of Buck and Boost converter
5	Study of three phase PWM and non PWM inverter

Course Outcome:- Student will be able to

1. Understand and analyze the performance of converters and inverters as power electronics application.
2. Performance analysis of drive

MTPS-206B-18 **SMART GRIDS LAB** **L T P**
Internal Marks: 60 **0 0 4**
External Marks: 40
Total Marks: 100

Course Objectives:-Students will be able :

1. To understand smart grid structure
2. Understand the microgrid
3. Understand power quality issues in smart grid.

Syllabus

Sr. No.	List of Experiments
1	To study the components of smart grid.
2	To analyze the geographic information system for smart grid.
3	Formation of microgrid and protection and control of grid.
4	Understand power quality issues in grid connected renewable energy sources
5	Performance analysis of smart meters.

Course Outcome:- Student will be able **to:**

1. To understand structure of smart grid and micro grid
2. Power quality issues for grid connected renewable sources

MTPS-206C-18 **ARTIFICIAL INTELLIGENCE LAB** **L T P**
Internal Marks: 60 **0 0 4**
External Marks: 40
Total Marks: 100

Course Objectives:-Students will be able :

1. To understand applications of artificial intelligence technqiues
2. Designing of control system using these techniques.
3. Customization of controlling variables.

Syllabus

Sr. No.	**List of Experiments**
1	Write A Program For Best First Search.
2	Write A Program to Generate the output for A* Algorithm.
3	Write a Program To Show the Tic Tac Toe Game for 0 and X.
4	Write A Program For Expert System By Using Forward Chaining.
5	Comparing the Search Methods.
6	Implement the Greedy Search Algorithm.
7	Implement the min-max Algorithm.
8	Adding a Heuristic.

Course Outcome:- Student will be able to:

1. Increase in efficiency of system using these techniques.
2. Develop a comparison with basic controlling techniques and hence, draw a conclusion.

MTA-105-18 **CONSTITUTION OF INDIA** **L T P**
Internal Marks: 00 **2 0 0**
External Marks: 00
Total Marks: 00

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.

Syllabus

Units	Content	Hours
1	History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working).	4
2	Philosophy of the Indian Constitution: Preamble, Salient Features.	4
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.	4
4	Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.	4
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, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.	4
6	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.	4

Suggest Reading

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. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

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.

MTA-106-18 **PEDAGOGY STUDIES** **L T P**
Internal Marks: 00 **2 0 0**
External Marks: 00
Total Marks: 00

Course Objectives: Students will be able to:

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

Syllabus

Units	Content	Hours
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.	4
2	Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.	2
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? Theory of change, Strength and nature of the body of evidence for effective pedagogical practices, Pedagogic theory and pedagogical approaches, Teachers' attitudes and beliefs and Pedagogic strategies.	4
4	Professional development: alignment with classroom practices and follow up support, Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes.	4
5	Research gaps and future directions, Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.	2

Suggested reading

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.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

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?

MTA-107-18 **STRESS MANAGEMENT BY YOGA** **L T P**
Internal Marks: 00 **2 0 0**
External Marks: 00
Total Marks: 00

Course Objectives: Students will be able to:

1. To achieve overall health of body and mind
2. To overcome stress

Syllabus

Units	Content	Hours
1	Definitions of Eight parts of yog. (Ashtanga).	4
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	2
3	Asan and Pranayam i) Various yog poses and their benefits for mind & body ii)Regularization of breathing techniques and its effects-Types of pranayama.	4

Suggested reading

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

Course Outcomes:- Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

MTA-108 -18 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

L	T	P
2	0	0

Internal Marks: 00
External Marks: 00
Total Marks: 00

Course Objectives: Students will be able to:
1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

Syllabus

Units	Content	Hours
1	Neetisatakam-Holistic development of personality, Verses- 19,20,21,22 (wisdom), Verses- 29,31,32 (pride & heroism), Verses- 26,28,63,65 (virtue), Verses- 52,53,59 (dont's), Verses- 71,73,75,78 (do's).	8
2	Approach to day to day work and duties, Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48, Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, Chapter 18-Verses 45, 46, 48.	8
3	Statements of basic knowledge, Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68, Chapter 12 -Verses 13, 14 15, 16, 17, 18, Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39, Chapter18 – Verses 37,38,63.	8

Suggested reading

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.

Course Outcomes: Students will be able to

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.

MTPS-301A-18 **COMPUTATIONAL METHODS** **L T P**
Internal Marks: 40 **3 0 0**
External Marks: 60
Total Marks: 100

Course Objectives: Students will be able to:
1. Understand mathematical models of lower level engineering problems
2. Learn how to solve nonlinear equations numerically
3. Introduction to fundamental matrix algebra concepts
4. Solving simultaneous linear equations numerically

Syllabus

Units	Content	Hours
1	Formulation and solution of linear system of equations, Gauss elimination, LU, QR decomposition, iteration methods (Gauss-Seidal), convergence of iteration methods, Singular value decomposition and the sensitivity of rank to small perturbation	8
2	Newton‘s divided difference, interpolation polynomials, Lagrange interpolation polynomials	8
3	Non-linear regression, multiple linear regression, general linear least squares	8
4	Vector spaces, Basis vectors, Orthogonal/Unitary transform, Fourier transform, Laplace transform	6
5	Local and global minima, Line searches, Steepest descent method, Conjugate gradient method, Quasi Newton method, Penalty function	8
6	Graphs and Matrices, simple graph, cyclic graph, complete graph, properties of the Laplacian matrix and relation with graph connectivity Non-negative matrices. Applications of graph theory to engineering problems	8

Suggested reading

1. Steven C. Chapra and Raymond P. Canale “Numerical Methods for Engineers”, , McGraw

Hill
2. Hines and Montrogmery, John"Probability and Statistics in Engineering and Management Studies",
3. R. B. Bapat "Graphs and Matrices", , TRIM Series, Hindustan Book Agency, 2011

Course Outcomes: Students will be able to
1. Know the concept and steps of problem solving - mathematical modelling , solution and implementation
2. Knowledge and understanding of, and the ability to use, mathematical techniques
3. Understand and apply mathematical reasoning

MTPS-301B-18 **HVDC** **L T P**
Internal Marks: 40 **3 0 0**
External Marks: 60
Total Marks: 100

Course Objectives:
Students will be able to:
1. Understand state of the art HVDC technology.
2. Learn the Methods to carry out modeling and analysis of HVDC system frontier-area power flow regulation.

Syllabus

Units	Content	Hours
1	Development of HVDC Technology, DC versus AC Transmission, Selection of converter configuration.	**6**
2	Rectifier and Inverter operation, Digital Simulation of converters, Control of HVDC converters and Systems	**8**
3	Individual phase control, Equidistant firing controls, Higher level controls. Characteristics and non-characteristics harmonics filter design. Fault development and protection.	**6**
4	Interaction between AC-DC power systems. Over voltages on AC/DC side, multi-terminal HVDC systems, control of MTDC systems	**6**
5	Modelling of HVDC systems, per unit system, Representation for power flow solution, representation for stability studies.	**6**
6	Introduction to relevant national and international standards, safe clearances for HV, Study regulations for HV tests, Digital techniques in HV measurements.	**6**

Suggested reading

1. J. Arrillaga, "High Voltage Direct Transmission", Peter Peregrinus Ltd. London, 1983.
2. K. R. Padiyar, "HVDC Power Transmission Systems", Wiley Eastern Ltd., 1990.
3. E. W. Kimbark, "Direct Current Transmission", Vol. I, Wiley Interscience, 1971.
4. Erich Uhlmann, "Power Transmission by Direct Current", B.S. Publications, 2004.

Course Outcomes: Students will be able to:
1. To expose the students to the state of the art HVDC technology.
2. Knowledge of modelling and analysis of HVDC system for inter-area power flow regulation.
3. Study of Neetishatakam will help in developing.

MTPS-301C-18 **POWER SYSTEM TRANSIENTS** **L T P**
Internal Marks: 40 **3 0 0**
External Marks: 60
Total Marks: 100

Course Objectives: -Students will be able to:
1. Learn the reasons for occurrence of transients in a power system
2. Understand the change in parameters like voltage & frequency during transients
3. To know about the lightning phenomenon and its effect on power system

Syllabus

Unit	Content	Hours
1	Fundamental circuit analysis of electrical transients, Laplace Transform method of solving simple Switching transients, Damping circuits -Abnormal switching transients, Three-phase circuits and transients, Computation of power system transients.	8
2	Principle of digital computation – Matrix method of solution, Modal analysis-Z transform- Computation using EMTP, Lightning, switching and temporary over voltages, Lightning , Physical phenomena of lightning.	8
3	Interaction between lightning and power system, Influence of tower footing resistance and Earth Resistance, Switching: Short line or kilometric fault, Energizing transients - closing and re-closing of lines, line dropping, load rejection – over voltages induced by faults.	8
4	Switching HVDC line, Travelling waves on transmission line, Circuits with distributed Parameters, Wave Equation, Reflection, Refraction, Behaviour of Travelling waves at the line terminations, Lattice Diagrams – Attenuation and Distortion, Multi-conductor system and Velocity wave.	8
5	Insulation co-ordination: Principle of insulation co-ordination in Air Insulated substation (AIS) and Gas Insulated Substation (GIS) Coordination between insulation and protection level, Statistical approach.	6
6	Protective devices, Protection of system against over voltages, lightning arresters, substation earthling.	6

Suggested reading

1. Allan Greenwood, "Electrical Transients in Power System", Wiley & Sons Inc. New York, 1991.

Course Outcomes: - Students will be able to:

1. Knowledge of various transients that could occur in power system and their mathematical formulation
2. Ability to design various protective devices in power system for protecting equipment and personnel
3. Coordinating the insulation of various equipments in power system
4. Modelling the power system for transient analysis

MTPS-301D-18 **DYNAMICS OF LINEAR SYSTEMS** **L T P**
Internal Marks: 40 **3 0 0**
External Marks: 60
Total Marks: 100

Course Objectives:-Students will be able to:
1. To understand the linear system and its functions
2. To understand the stability analysis of linear systems and implement the same in MATLAB

Syllabus

Units	Content	Hours
1	State variable representations of systems, transfer function and transfer function matrix, solutions of state equations.	8
2	Observability and controllability, minimal realization of MIMO systems, analysis of linear time varying systems, the concepts of stability.	8
3	Lyapunov stability analysis, Lyapunov function and its properties, controllability by state variable feedback.	6
4	Ackerman's Formula - stabilisation by output feedback, asymptotic observers for state measurement, observer design.	6
5	State space representation of discrete systems, solution of state equations, controllability and observabilty stability analysis using Lyapunov method.	6
6	State feedback of linear discrete time systems, design of observers - MATLAB Exercises.	8

Suggested reading

1. Thomas Kailath, "Linear Systems", Prentice Hall Inc., Englewood Cliffs, N.J. 1980.
2. K. Ogata, "State Space Analysis of Control Systems", Prentice Hall Inc., Englewood Cliffs, N.J., 1965.
3. K. Ogata, "Modern Control Engineering, (second edition)" , Prentice Hall Inc., Englewood Cliffs, N.J., 1990
4. M.Gopal, "Digital Control and State Variable Methods", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997

5. C.T. Chen, "Linear System Theory and Design", New York: Holt Rinehart and Winston ,1984
6. R.C. Dorf, and R. T. "Bishop, Modern Control Systems", Addison Wesley Longman Inc., 1999.

Course Outcomes:- Students will be able to:

1. To learn linear system modeling, analysis and design so as to obtain the ability to apply the same to engineering problems in a global perspective
2. Knowledge on carrying out detailed stability analysis of both linear and nonlinear systems
3. Design observers and controllers for linear systems
4. Acquire knowledge of discrete time linear systems modeling, analysis and design
5. Develop and utilize modern software tools for analysis and design of linear continuous and discrete time systems

MTOE-301A-18 **BUSINESS ANALYTICS** **L T P**
Internal Marks: 40 **3 0 0**
External Marks: 60
Total Marks: 100

Course Objectives:-Students will be able to:
1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Syllabus

Units	Content	Hours
1	Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics, Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.	9
2	Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.	8
3	Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.	9

	Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.	
4	Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.	10
5	Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.	8
6	Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.	4

Suggested reading

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.

Course Outcome:- Students will be able to:

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modelling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.

MTOE-301B-18 **INDUSTRIAL SAFETY** **L T P**
Internal Marks: 40 **3 0 0**
External Marks: 60
Total Marks: 100

Course Objectives:-Students will be able to:

1. Understand about industrial safety and maintenance engineering
2. Learn possible ways of prevention from wear and tear and methods of fault tracing
3. Understand periodic maintenance.

Syllabus

Units	Content	Hours
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.	8
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.	8
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.	8
4	Fault tracing: Fault tracing-concept and importance, decision tree concept,	8

	need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.	
5	Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.	8

Suggested reading:

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.

Course Outcome:- Student will be able to:

1. To know about industrial safety and ways of prevention of wear and tear
2. Learn about fault identification and periodic maintenance
3. To get knowledge about all safety measures

MTOE-301C-18 **OPERATIONS RESEARCH** **L T P**
Internal Marks: 40 **3 0 0**
External Marks: 60
Total Marks: 100

Course Objectives:-Students will be able to:

1. To learn the optimization techniques
2. How to formulate LPP and handling of Nonlinear programming
3. How to do the scheduling and sequencing of models.

Syllabus

Units	Content	Hours
1	Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.	8
2	Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming.	8
3	Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT.	8
4	Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.	8
5	Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.	8

Suggested reading

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. Panner selvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Course Outcomes: 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.

MTOE-301D-18 COST MANAGEMENT OF ENGINEERING PROJECTS **L T P**
Internal Marks: 40 **3 0 0**
External Marks: 60
Total Marks: 100

Course Objectives:-Students will be able to

1. To get knowledge about cost concept and cost management process
2. To know about meaning and process of project execution
3. To learn quantitative techniques and cost planning

Syllabus

Units	Content	Hours
1	Introduction and Overview of the Strategic Cost Management Process.	6
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.	6
3	Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non technical 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 charts and Network diagram. Project commissioning: mechanical and process.	10
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	10

	Variance Analysis. 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. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.	
5	Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.	8

Suggested reading:

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.

Course Outcomes: Student should be able to

1. Understand cost management process
2. To execute project considering cost factor
3. To manage planning of cost and learn about the techniques

MTOE-301E-18 **COMPOSITE MATERIALS** **L T P**
Internal Marks: 40 **3 0 0**
External Marks: 60
Total Marks: 100

Course Objectives:-Students will be able to:

1. To understand composite materials and their reinforcement
2. Manufacturing of matrix

Syllabus

Units	Content	Hours
1	Introduction, Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.	8
2	Reinforcements: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.	8
3	Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.	8
4	Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament	8

	winding method – Compression moulding – Reaction injection moulding. Properties and applications.	
5	Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.	8

Suggested text book reading:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

Suggested reference reading:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Course Outcome:- Student will be able to

1. Learn about composite materials and their process of reinforcement
2. Understand about strength and manufacturing of matrix

MTOE-301F-18 **WASTE TO ENERGY** **L T P**
Internal Marks: 40 **3 0 0**
External Marks: 60
Total Marks: 100

Course Objectives:-Students will be able to:

1. Understand classification of waste and about energy from waste
2. Process of biomass waste conversion to energy
3. To understand biomass waste properties.

Syllabus

Units	Content	Hours
1	Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.	8
2	Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.	8
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.	8
4	Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed	8

	combustors, Design, construction and operation - Operation of all the above biomass combustors.	
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 - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.	8

Suggested reading:

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.

Course Outcome:- Student will be able to

1. Know about the energy in biomass waste
2. Understand the biomass fuel conversion process for energy
3. Know about biomass waste properties