Faculty of Engineering & Technology

Syllabus

For

Master of Technology (M. Tech.)

Electrical Engineering

(2018-20)

MASTER OF TECHNOLOGY

Semester I

Course Number	Subject	Scheme Of Studies Per Week			IA	EA	Total	Credits
		L	T	P				
MTEEPS101	Advanced Power System Analysis	3	0	0	50	100	150	3
MTEEPS102	Power System Dynamics-I	3	0	0	50	100	150	3
Electives(Any One)								
MTEEPS103A	Renewable Energy System	3	0	0	50	100	150	3
MTEEPS103B	Smart grids	3	0	0	50	100	150	3
MTEEPS103C	High Power Converters	3	0	0	50	100	150	3
MTEEPS103D	Wind and Solar Systems	3	0	0	50	100	150	3
Electives(Any One)								
MTEEPS104A	Electrical Power Distribution System	3	0	0	50	100	150	3
MTEEPS104B	Mathematical Methods for Power Engineering	3	0	0	50	100	150	3
MTEEPS104C	Pulse Width Modulation for PE Converters	3	0	0	50	100	150	3
MTEEPS104D	Electric and Hybrid Vehicles	3	0	0	50	100	150	3
MTEEPS105	Research Methodology and IPR	2	0	0	50	100	150	2
MTEEPS106	Audit Course – **1** AUDIT 1 and 2 : English for Research Paper Writing AUDIT 1 and 2: Disaster Management AUDIT 1 and 2 :	2	0	0	50	100	150	0

	Sanskrit For Technical Knowledge AUDIT 1 and 2 : Value Education AUDIT 1 and 2 : Constitution Of India AUDIT 1 and 2 : Pedagogy Studies AUDIT 1 and 2: Stress Management by Yoga AUDIT 1 and 2: Personality Development through Life Enlightenment Skills							
Practical/Viva Voce								
MTEEPS107	Power System Steady State Analysis Lab	0	0	4	60	40	100	2
MTEEPS108	Renewable Energy Lab	0	0	4	60	40	100	2
Total		16	0	8	370	580	950	18

Semester II

Course Number	Subject	Scheme Of Studies Per Week			IA	EA	Total	Credits
		L	T	P				
MTEEPS201	Digital Protection of Power System	3	0	0	50	100	150	3
MTEEPS202	Power System Dynamics-II	3	0	0	50	100	150	3
Electives(Any One)								
MTEEPS203A	Restructured Power Systems	3	0	0	50	100	150	3
MTEEPS203B	Advanced Digital Signal Processing	3	0	0	50	100	150	3
MTEEPS203C	Dynamics of Electrical Machines	3	0	0	50	100	150	3
MTEEPS203D	Power Apparatus Design	3	0	0	50	100	150	3
Electives(Any One)								
MTEEPS204A	Advanced Micro-Controller Based Systems	3	0	0	50	100	150	3
MTEEPS204B	SCADA System and Applications	3	0	0	50	100	150	3
MTEEPS204C	Power Quality	3	0	0	50	100	150	3
MTEEPS204D	AI Techniques	3	0	0	50	100	150	3
MTEEPS205	Audit Course – 2 AUDIT 1 and 2 : English for Research Paper Writing AUDIT 1 and 2: Disaster Management AUDIT 1 and 2 : Sanskrit For Technical Knowledge AUDIT 1 and 2 : Value Education AUDIT 1 and 2 : Constitution Of India AUDIT 1 and 2 : Pedagogy Studies AUDIT 1 and 2: Stress Management by Yoga AUDIT 1 and 2: Personality Development through Life Enlightenment Skills	2	0	0	0	0	0	0
Practical/Viva Voce								
MTEEPS206	Power System Protection Lab	0	0	4	60	40	100	2
MTEEPS207	Application to Power System Lab	0	0	4	60	40	100	2
MTEEPS208	Mini Project with Seminar	2	0	0	60	40	100	2
Total		14	0	8	380	520	900	18

Semester III

Course Number	Subject	Scheme Of Studies Per Week			IA	EA	Total	Credits
		L	T	P				
MTEEPS301A	Power System Transients	3	0	0	50	100	150	3
MTEEPS301B	FACTS and Custom Power Devices	3	0	0	50	100	150	3
MTEEPS301C	Industrial Load Modeling and Control	3	0	0	50	100	150	3
MTEEPS301D	Dynamics Of Linear Systems	3	0	0	50	100	150	3
MTEEPS302A	Business Analytics	3	0	0	50	100	150	3
MTEEPS302B	Industrial Safety	3	0	0	50	100	150	3
MTEEPS302C	Operations Research	3	0	0	50	100	150	3
MTEEPS302D	Cost Management of Engineering Projects	3	0	0	50	100	150	3
MTEEPS302E	Composite Materials	3	0	0	50	100	150	3
MTEEPS302F	Waste to Energy	3	0	0	50	100	150	3
MTEEPS303	Dissertation-I /Industrial Project	0	0	20	60	40	100	10
Total		6	0	20	160	240	400	16

Semester IV

Course Number	Subject	Scheme Of Studies Per Week			IA	EA	Total	Credits
		L	**T**	**P**				
MTEEPS401	Dissertation II	0	0	32	300	400	700	16
			Total		**300**	**400**	**700**	**16**

Syllabus

Semester – I

Course Number	Subject	Scheme Of Studies Per Week			IA	EA	Total	Credits
		L	T	P				
MTEEPS101	Advanced Power System Analysis	3	0	0	50	100	150	3
MTEEPS102	Power System Dynamics-I	3	0	0	50	100	150	3
Electives(Any One)								
MTEEPS103A	Renewable Energy System	3	0	0	50	100	150	3
MTEEPS103B	Smart grids	3	0	0	50	100	150	3
MTEEPS103C	High Power Converters	3	0	0	50	100	150	3
MTEEPS103D	Wind and Solar Systems	3	0	0	50	100	150	3
Electives(Any One)								
MTEEPS104A	Electrical Power Distribution System	3	0	0	50	100	150	3
MTEEPS104B	Mathematical Methods for Power Engineering	3	0	0	50	100	150	3
MTEEPS104C	Pulse Width Modulation for PE Converters	3	0	0	50	100	150	3
MTEEPS104D	Electric and Hybrid Vehicles	3	0	0	50	100	150	3
MTEEPS105	Research Methodology and IPR	2	0	0	50	100	150	2
MTEEPS106	Audit Course – **1** AUDIT 1 and 2 : English for Research Paper Writing AUDIT 1 and 2: Disaster Management AUDIT 1 and 2 : Sanskrit For Technical Knowledge AUDIT 1 and 2 : Value Education AUDIT 1 and 2 : Constitution Of India AUDIT 1 and 2 : Pedagogy Studies AUDIT 1 and 2: Stress Management by Yoga	2	0	0	50	100	150	0

	AUDIT 1 and 2: Personality Development through Life Enlightenment Skills							
Practical/Viva Voce								
MTEEPS107	Power System Steady State Analysis Lab	0	0	4	60	40	100	2
MTEEPS108	Renewable Energy Lab	0	0	4	60	40	100	2
Total		16	0	8	370	580	950	18

Advanced Power System Analysis (MTEEPS101)

Unit 1: Load flow: Overview of Newton-Raphson, Gauss-Siedel, fast decoupled methods, convergence properties, sparsity techniques, handling Qmax violations in constant matrix, inclusion in frequency effects, AVR in load flow, handling of discrete variable in load flow.

Unit 2: Fault Analysis**:** Simultaneous faults, open conductor's faults, generalized method of fault analysis.

Unit 3: Security Analysis: Security state diagram, contingency analysis, generator shift distribution factors line outage, distribution factor, multiple line outages, overload index ranking.

Unit 4: Power System Equivalents: WARD, REI.equivalents

Unit 5: State Estimation: Sources of errors in measurement, Virtual and Pseudo, Measurement, Observability, Tracking state estimation, WSL method, bad data correction.

Unit 6: Voltage Stability: Voltage collapse, P-V curve, multiple power flow solution, continuation power flow, optimal multiplies load flow, voltage collapse proximity indices.

TEXT BOOKS:

- J.J. Grainger &W.D.Stevenson, "Power system analysis", McGraw Hill, 2003
- R. Bergen & Vijay Vittal , "Power System Analysis" ,Pearson , 2000
- L.P. Singh, "Advanced Power System Analysis and Dynamics", New Age International, 2006
- G.L. Kusic, "Computer aided power system analysis", Prentice Hall India, 1986

REFERENCES:

- A.J. Wood, "Power generation, operation and control", John Wiley, 1994
- P.M. Anderson, "Faulted power system analysis", IEEE Press, 1995

Power System Dynamics-I (MTEEPS102)

Unit 1: Synchronous Machines: Per unit systems, Park's Transformation (modified) Flux-linkage equations.

Unit 2: Voltage and current equations, Formulation of State-space equations, Equivalent circuit.

Unit 3: Sub-transient and transient inductance and Time constants, Simplified models of synchronous machines.

Unit 4: Small signal model: Introduction to frequency model.

Unit 5: Excitation systems and Philips-Heffron model, PSS Load modeling.

Unit 6: Modeling of Induction Motors, Prime mover controllers.

TEXT BOOKS:

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

Renewable Energy System (MTEEPS103A)

Unit **1:** Introduction, Distributed vs Central Station Generation, Sources of Energy such as Micro-turbines**,** Internal Combustion Engines.

Unit 2: Introduction to Solar Energy, Wind Energy, Combined Heat and Power, Hydro Energy, Tidal Energy, Wave Energy**,** Geothermal Energy, Biomass and Fuel Cells.

Unit 3: Power Electronic Interface with the Grid

Unit 4: Impact of Distributed Generation on the Power System, Power Quality Disturbances Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning

Unit 5: Transmission System Operation**,** Protection of Distributed Generators

Unit 6: Economics of Distributed Generation, Case Studies

References:

- RanjanRakesh, Kothari D.P, Singal K.C, "Renewable Energy Sources and EmergingTechnologies", 2nd Ed. Prentice Hall of India ,2011

- Math H.Bollen, Fainan Hassan, "Integration of Distributed Generation in the Power System", July 2011, Wiley –IEEE Press

- Loi Lei Lai, Tze Fun Chan, "Distributed Generation: Induction and Permanent Magnet Generators", October 2007, Wiley-IEEE Press.

- Roger A.Messenger, Jerry Ventre, "Photovoltaic System Engineering", 3rd Ed, 2010

- James F.Manwell, Jon G.McGowan, Anthony L Rogers, "Wind energy explained: Theory Design and Application", John Wiley and Sons 2nd Ed, 2010

Smart Grids (MTEEPS103B)

Unit 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

Unit 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 .

Unit 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)

Unit 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.

Unit 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.

Unit 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

References:

- Ali Keyhani, "Design of smart power grid renewable energy systems", Wiley IEEE, 2011
- Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press, 2009
- JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, "Smart Grid: Technology and Applications", Wiley 2012
- Stuart Borlase, "Smart Grid: Infrastructure, Technology and solutions "CRC Press
- A.G.Phadke, "Synchronized Phasor Measurement and their Applications", Springer

High Power Converters (MTEEPS103C)

Unit 1: Power electronic systems, An overview of PSDs, multipulse diode rectifier, multipulse, SCR rectifier.

Unit 2: Phase shifting transformers, multilevel voltage source inverters: two level voltage source inverter, cascaded**,** H bridge multilevel inverter.

Unit 3: Diode clamped multilevel inverters, flying capacitor multilevel inverter.

Unit 4: PWM current source inverters, DC to DC switch mode converters.

Unit 5: AC voltage controllers: Cyclo-converters, matrix converter, Power conditioners and UPS.

Unit 6: Design aspects of converters, protection of devices and circuits

References:

- N. Mohan, T. M. Undeland and W. P. Robbins, "Power Electronics: Converter, Applications and Design", John Wiley and Sons, 1989
- M.H. Rashid, "Power Electronics", Prentice Hall of India, 1994
- B. K .Bose, "Power Electronics and A.C. Drives", Prentice Hall, 1986
- Bin Wu, "High power converters and drives", IEEE press, Wiley Enter science.

Wind and Solar Systems (MTEEPS103D)

Unit 1: Historical development and current status, characteristics of wind power generation**,** network integration issues

Unit 2: Generators and power electronics for wind turbines, power quality standards for wind turbines, Technical regulations for interconnections of wind farm with power systems.

Unit 3: Isolated wind systems, reactive power and voltage control, economic aspects

Unit 4: Impacts on power system dynamics, power system interconnection

Unit 5: Introduction of solar systems, merits and demerits, concentrators, various applications.

Unit6: Solar thermal power generation, PV power generation, Energy Storage device. Designing the solar system for small installations.

References:

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

Electrical Power Distribution System (MTEEPS104A)

Unit 1: Distribution of Power, Management, Power Loads, Load Forecasting Short-term & Long-term, Power System Loading, Technological Forecasting.

Unit 2: Advantages of Distribution Management System (D.M.S.), Distribution Automation: Definition, Restoration / Reconfiguration of Distribution Network, Different Methods and Constraints**,** Power Factor Correction.

Unit 3: Interconnection of Distribution, Control & Communication Systems, Remote Metering, Automatic Meter Reading and its implementation.

Unit 4: SCADA: Introduction, Block Diagram, SCADA Applied To Distribution Automation. Common Functions of SCADA, Advantages of Distribution Automation through SCADA.

Unit 5: Calculation of Optimum Number of Switches, Capacitors, Optimum Switching Device Placement in Radial, Distribution Systems, Sectionalizing Switches – Types, Benefits, Bellman's Optimality Principle, Remote Terminal Units, Energy efficiency in electrical distribution & Monitoring.

Unit6: Maintenance of Automated Distribution Systems, Difficulties in Implementing Distribution.
Automation in Actual Practice, Urban/Rural Distribution, Energy Management, AI techniques applied to Distribution Automation.

References:

- A.S. Pabla, "Electric Power Distribution", Tata McGraw Hill Publishing Co. Ltd., Fourth Edition.
- M.K. Khedkar, G.M. Dhole, "A Text Book of Electrical power Distribution Automation",
- University Science Press, New Delhi
- Anthony J Panseni, "Electrical Distribution Engineering", CRC Press
- James Momoh, "Electric Power Distribution, automation, protection & control", CRC Press

Mathematical Methods for Power Engineering (MTEEPS104B)

Unit 1: Vector spaces, Linear transformations, Matrix representation of linear transformation.

Unit 2: Eigen values and Eigen vectors of linear operator

Unit 3: Linear Programming Problems, Simplex Method, Duality**,** Non Linear Programming problems

Unit 4: Unconstrained Problems, Search methods**,** Constrained Problems

Unit 5: Lagrange method, Kuhn-Tucker conditions, Random Variables**,** Distributions

Unit 6: Independent Random Variables, Marginal and Conditional distributions, Elements of stochastic processes

References:

- Kenneth Hoffman and Ray Kunze, "Linear Algebra", 2nd Edition, PHI, 1992
- Erwin Kreyszig, "Introductory Functional Analysis with Applications", John Wiley & Sons, 2004
- Irwin Miller and Marylees Miller, John E. Freund's "Mathematical Statistics", 6th Edn, PHI, 2002
- J. Medhi, "Stochastic Processes", New Age International, New Delhi. 1994
- A Papoulis, "Probability, Random Variables and Stochastic Processes", 3rd Edition, McGraw Hill, 2002
- John B Thomas, "An Introduction to Applied Probability and Random Processes", John Wiley, 2000
- Hillier F S and Liebermann G J, "Introduction to Operations Research", 7th Edition, McGraw Hill, 2001
- Simmons D M, "Non Linear Programming for Operations Research", PHI, 1975

Pulse Width Modulation for PE Converters (MTEEPS104C)

Unit 1: Introduction to PE converters, Modulation of one inverter phase leg, Modulation of single phase, VSI and 3 phase VSI.

Unit 2: Zero space vector placement modulation strategies, Losses-Discontinuous modulation, Modulation of CSI.

Unit 3: Over modulation of converters, programme modulation strategies.

Unit 4: Pulse width modulation for multilevel inverters, Implementation of modulation controller

Unit 5: Continuing developments in modulation as random PWM, PWM for voltage unbalance.

Unit 6: Effect of minimum pulse width and dead time.

References:

- D. Grahame Holmes, Thomas A. Lipo, "Pulse width modulation of Power Converter: Principles and Practice", John Wiley & Sons, 03-Oct-2003
- Bin Vew, "High Power Converter", Wiley Publication
- Marian K. Kazimicrczuk, "Pulse width modulated dc-dc power converter", Wiley Publication

Electric and Hybrid Vehicles (MTEEPS104D)

Unit 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

Unit 2: Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis.

Unit 3: Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis.

Unit 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.

Unit 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

Unit 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.

References:

- Sira -Ramirez, R. Silva Ortigoza, "Control Design Techniques in Power Electronics Devices", Springer.
- Siew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse, "Sliding mode control of switching Power Converters"

Research Methodology and IPR (MTEEPS105)

Unit 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

Unit 2: Effective literature studies approaches, analysis Plagiarism, Research ethics,

Unit 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

Unit 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.

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology.Patent information and databases.Geographical Indications.

Unit 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.

References:

- Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineeringstudents'"
- Wayne Goddard and Stuart Melville, "Research Methodology: AnIntroduction"
- Ranjit Kumar, 2 nd Edition , "Research Methodology: A Step by Step Guide forbeginners"
- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007.
- Mayall , "Industrial Design", McGraw Hill,1992.
- Niebel , "Product Design", McGraw Hill,1974.
- Asimov , "Introduction to Design", Prentice Hall,1962.

Power System Steady State Analysis Lab (MTEEPS107)

Experiment List

Simulate Swing Equation in Simulink (MATLAB)

1. Modeling of Synchronous Machine.
2. Modeling of Induction Machine.
3. Simulate simple circuits using Circuit Maker.
4. (A) Modeling of Synchronous Machine with PSS.

(B) Simulation of Synchronous Machine with FACTS device.

5. (A) Modeling of Synchronous Machine with FACTS device.

   (B) Simulation of Synchronous Machine with FACTS devices.
6. FACTS Controller designs with FACT devices for SMIB system

Renewable Energy Lab (MTEEPS108)

Experiment List

1 Power Curves

2 Build a Wind Farm

3 Test the Capabilities of the Hydrogen Fuel Cells and Capacitors

4 Effect of Temperature on Solar Panel Output

5 Variables Affecting Solar Panel Output

6 Effect of Load on Solar Panel Output

7 Wind Turbine Output: The Effect of Load

8 Test the Capabilities of Solar Panels and Wind Turbines

Semester II

Course Number	Subject	Scheme Of Studies Per Week			IA	EA	Total	Credits
		L	T	P				
MTEEPS201	Digital Protection of Power System	3	0	0	50	100	150	3
MTEEPS202	Power System Dynamics-II	3	0	0	50	100	150	3
Electives(Any One)								
MTEEPS203A	Restructured Power Systems	3	0	0	50	100	150	3
MTEEPS203B	Advanced Digital Signal Processing	3	0	0	50	100	150	3
MTEEPS203C	Dynamics of Electrical Machines	3	0	0	50	100	150	3
MTEEPS203D	Power Apparatus Design	3	0	0	50	100	150	3
Electives(Any One)								
MTEEPS204A	Advanced Micro-Controller Based Systems	3	0	0	50	100	150	3
MTEEPS204B	SCADA System and Applications	3	0	0	50	100	150	3
MTEEPS204C	Power Quality	3	0	0	50	100	150	3
MTEEPS204D	AI Techniques	3	0	0	50	100	150	3
MTEEPS205	Audit Course – 2 AUDIT 1 and 2 : English for Research Paper Writing AUDIT 1 and 2: Disaster Management AUDIT 1 and 2 : Sanskrit For Technical Knowledge AUDIT 1 and 2 : Value Education AUDIT 1 and 2 : Constitution Of India AUDIT 1 and 2 : Pedagogy Studies AUDIT 1 and 2: Stress Management by Yoga AUDIT 1 and 2: Personality Development through Life Enlightenment Skills	2	0	0	0	0	0	0
Practical/Viva Voce								
MTEEPS206	Power System Protection Lab	0	0	4	60	40	100	2
MTEEPS207	Application to Power System Lab	0	0	4	60	40	100	2
MTEEPS208	Mini Project with Seminar	2	0	0	60	40	100	2
Total		14	0	8	380	520	900	18

SEMESTER - II

Digital Protection of Power System (MTEEPS201)

Unit1: Evolution of digital relays from electromechanical relays**,** Performance and operational characteristics of digital protection.

Unit 2: Mathematical background to protection algorithms**,** Finite difference techniques

Unit 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

Unit 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

Unit 5: Sinusoidal wave based algorithms,Sample and first derivative (Mann and Morrison) algorithm, Fourier and Walsh based algorithms.

Unit 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.

References:

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

Power System Dynamics-II (MTEEPS202)

Unit 1: Basic Concepts of Dynamic Systems and Stability Definition, Small Signal Stability (Low Frequency Oscillations) of Unregulated and Regulated System.

Unit 2: Effect of Damper, Flux Linkage Variation and AVR

Unit 3: Large Signal Rotor Angle Stability, Dynamic Equivalents And Coherency, Direct Method of Stability Assessment, Stability Enhancing Techniques**,** Mitigation Using Power System Stabilizer.

Unit 4: Asynchronous Operation and Resynchronization**,** Multi-Machine Stability.

Unit 5: Dynamic Analysis of Voltage Stability, Voltage Collapse.

Unit 6: Frequency Stability, Automatic Generation Control, Primary and Secondary Control, Sub-Synchronous Resonance and Counter Measures

References:

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

Restructured Power Systems (MTEEPS203A)

Unit1: Fundamentals of restructured system, Market architecture, Load elasticity**,** Social welfare maximization.

Unit2: OPF: Role in vertically integrated systems and in restructured markets**,** congestion management.

Unit3: Optimal bidding, Risk assessment, Hedging, Transmission pricing**,** Tracing of power.

Unit4: Ancillary services, Standard market design, Distributed generation in restructured markets.

Unit5: Developments in India, IT applications in restructured markets.

Unit6: Working of restructured power systems, PJM, Recent trends in Restructuring.

References:

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

Advanced Digital Signal Processing (MTEEPS203B)

Unit 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.

Unit 2: Linear convolution using DFT, Computation of DFT Design of IIR digital filters from analog filters, Impulse invariance method, Bilinear transformation method.

Unit 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.

Unit 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.

Unit 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.

Unit 6: Optimum linear filters, Optimum signal estimation, Mean square error estimation, Optimum FIR and IIR Filters.

References:

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

Dynamics of Electrical Machines (MTEEPS203C)

Unit 1: Stability, Primitive 4 Winding Commutator Machine, Commutator Primitive Machine, Complete Voltage Equation of Primitive 4 Winding Commutator Machine.

Unit 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.

Unit 3: Three Phase Salient Pole Synchronous Machine**,** Parks Transformation, Steady State Analysis.

Unit 4: Large Signal Transient, Small Oscillation Equations in State Variable form**,** Dynamical Analysis of Interconnected Machines.

Unit 5: Large Signal Transient Analysis using Transformed Equations**,** DC Generator /DC Motor System.

Unit 6: Alternator /Synchronous Motor System.

References:

- D.P. Sengupta& J.B. Lynn," Electrical Machine Dynamics", The Macmillan Press Ltd. 1980
- R Krishnan "Electric Motor Drives, Modeling, Analysis, and Control", Pearson Education., 2001
- P.C. Kraus, "Analysis of Electrical Machines", McGraw Hill Book Company,1987
- Boldia& S.A. Nasar,,"Electrical Machine Dynamics", The Macmillan Press Ltd. 1992
- C.V. Jones, "The Unified Theory of Electrical Machines", Butterworth, London. 1967

Power Apparatus Design (MTEEPS203D)

Unit 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

Unit 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.

Unit 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.

Unit 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.

Unit 5: Design of stator and rotor winding, slot leakage flux, Leakage reactance, equivalent resistance of squirrel cage rotor, Magnetizing current, efficiency from design data.

Unit 6: Types of alternators, comparison, specific loadings, output co-efficient, design of main dimensions, Introduction to Computer Aided Electrical Machine Design Energy efficient machines.

References:

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

Advanced Micro-Controller Based Systems (MTEEPS204A)

Unit1: Basic Computer Organization, Accumulator based Processes-Architecture, Memory Organization-I/O Organization.

Unit2: Micro-Controllers-Intel 8051, Intel 8056- Registers, Memories, I/O Ports, Serial Communication**,** Timers, Interrupts, Programming.

Unit3: Intel 8051 – Assembly language programming, Addressing-Operations, Stack & Subroutines Interrupts-DMA.

Unit4: PIC 16F877- Architecture Programming, Interfacing Memory/ I/O Devices**,** Serial I/O and data communication.

Unit5: Digital Signal Processor (DSP), Architecture – Programming**,** Introduction to FPGA.

Unit 6: Microcontroller development for motor control applications, Stepper motor control using micro controller.

References:

- John.F.Wakerly: "Microcomputer Architecture and Programming", John Wiley and Sons 1981
- Ramesh S.Gaonker: "Microprocessor Architecture, Programming and Applications with the 8085", Penram International Publishing (India), 1994
- Raj Kamal: "The Concepts and Features of Microcontrollers", Wheeler Publishing, 2005
- Kenneth J. Ayala, "The 8051 microcontroller", Cengage Learning, 2004
- John Morton," The PIC microcontroller: your personal introductory course", Elsevier, 2005
- Dogan Ibrahim," Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC18F
- Series", Elsevier, 2008
- Microchip datasheets for PIC16F877

SCADA System and Applications (MTEEPS204B)

Unit 1: Introduction to SCADA, Data acquisition systems, Evolution of SCADA**,** Communication technologies

Unit 2: Monitoring and supervisory functions, SCADA applications in Utility Automation**,** Industries SCADA

Unit 3: Industries SCADA System Components, Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices(IED), Programmable Logic Controller (PLC)**,** Communication Network, SCADA Server, SCADA/HMI Systems

Unit 4: SCADA Architecture, Various SCADA architectures, advantages and disadvantages of each System, single unified standard architecture -IEC 61850.

Unit 5: SCADA Communication, various industrial communication technologies, wired and wireless methods and fiber optics, Open standard communication protocols

Unit 6: SCADA Applications: Utility applications, Transmission and Distribution sector operations, monitoring, analysis and improvement, Industries - oil, gas and water, Case studies, Implementation, Simulation Exercises

References:

- Stuart A. Boyer: "SCADA-Supervisory Control and Data Acquisition", Instrument Society of America Publications,USA,2004
- Gordon Clarke, Deon Reynders: "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes Publications, Oxford, UK,2004
- William T. Shaw, "Cybersecurity for SCADA systems", PennWell Books, 2006
- David Bailey, Edwin Wright, "Practical SCADA for industry", Newnes, 2003
- Michael Wiebe, "A guide to utility automation: AMR, SCADA, and IT systems for electric power", PennWell 1999

Power Quality (MTEEPS204C)

Unit1: 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.

Unit 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.

Unit 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.

Unit 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

Unit 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.

Unit 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

Reference:

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

AI Techniques (MTEEPS204D)

Unit-I: 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.

Unit-II: Fuzzy Logic**,** Knowledge Representation and Inference Mechanism**,** Defuzzification Methods

Unit-III: Fuzzy Neural Networks**,** some algorithms to learn the parameters of the network like GA

Unit-IV: System Identification using Fuzzy and Neural Network

Unit-V: Genetic algorithm**,** Reproduction cross over, mutation**,** Introduction to evolutionary program

Unit-VI: Applications of above mentioned techniques to practical problems

Reference:

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

Power System Protection Lab (MTEEPS206)

Experiment List

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 Parellel Feeder Protection

6 Principle of Reverse Power Protection

7 Differential Protection of Transformer

8 To the study time vs.voltage characteristcs of over voltage induction relay

Application to Power System Lab (MTEEPS207)

Experiment List

1. To compute the fault level, post-fault voltages and currents for different types of faults.
2. To plot Swing Curve for one Machine System
3. To Formulate Y_{BUS} Matrix By Singular Transformation.
4. Gauss Siedal Load flow analysis using Matlab Software.
5. Newton Raphson load flow analysis Matlab Software.
6. Load sharing between two interconnected power systems.
7. Load sharing between two interconnected power systems including transmission losses component.
8. Load-frequency dynamics of single area power system.

Mini Project and Seminar (MTEEPS208)

Semester III

Course Number	Subject	Scheme Of Studies Per Week			IA	EA	Total	Credits
		L	T	P				
MTEEPS301A	Power System Transients	3	0	0	50	100	150	3
MTEEPS301B	FACTS and Custom Power Devices	3	0	0	50	100	150	3
MTEEPS301C	Industrial Load Modeling and Control	3	0	0	50	100	150	3
MTEEPS301D	Dynamics Of Linear Systems	3	0	0	50	100	150	3
MTEEPS302A	Business Analytics	3	0	0	50	100	150	3
MTEEPS302B	Industrial Safety	3	0	0	50	100	150	3
MTEEPS302C	Operations Research	3	0	0	50	100	150	3
MTEEPS302D	Cost Management of Engineering Projects	3	0	0	50	100	150	3
MTEEPS302E	Composite Materials	3	0	0	50	100	150	3
MTEEPS302F	Waste to Energy	3	0	0	50	100	150	3
MTEEPS303	Dissertation-I /Industrial Project	0	0	20	60	40	100	10
Total		6	0	20	160	240	400	16

SEMESTER - III

Power System Transients (MTEEPS301A)

Unit 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

Unit 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.

Unit 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

Unit 4: Switching HVDC line travelling waves on transmission line, Circuits with distributed Parameters Wave Equation, Reflection, Refraction, Behavior of Travelling waves at the line Terminations, Lattice Diagrams – Attenuation and Distortion, Multi-conductor system, and Velocity wave

Unit 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

Unit 6: Protective devices, Protection of system against over voltages, lightning arresters, substation earthing

References:

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

FACTS and Custom Power Devices (MTEEPS301B)

Unit 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

Unit 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

Unit 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

Unit 4: SSR and its damping Unified Power Flow Controller, Circuit Arrangement, Operation and control of UPFC, Basic Principle of P and Q control, Independent real and reactive power flow control- Applications.

Unit 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

Unit 6: Voltage swells, sags, flicker, unbalance and mitigation of these problems by power line conditioners, IEEE standards on power quality.

References:

- K R Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age
- InternationalPublishers, 2007
- X P Zhang, C Rehtanz, B Pal, “Flexible AC Transmission Systems- Modelling and Control”, SpringerVerlag, Berlin, 2006
- N.G. Hingorani, L. Gyugyi, “Understanding FACTS: Concepts and Technology of Flexible
- ACTransmission Systems”, IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.
- K.S.Sureshkumar ,S.Ashok , “FACTS Controllers & Applications”, E-book edition, Nalanda DigitalLibrary, NIT Calicut,2003
- G T Heydt , “Power Quality”, McGraw-Hill Professional, 2007
- T J E Miller, “Static Reactive Power Compensation”, John Wiley and Sons, Newyork, 1982.

Industrial Load Modeling and Control (MTEEPS301C)

UNIT–I: Electric Energy Scenario-Demand Side Management-Industrial Load Management, Load Curves-Load Shaping Objectives, Methodologies-Barriers, Classification of Industrial, Loads, Continuous and Batch processes -Load Modeling.

UNIT–II: Electricity pricing – Dynamic and spot pricing –Models, Direct load control-Interruptible load control, Bottom up approach- scheduling- Formulation of load, Models, Optimization and control algorithms - Case studies

UNIT–III: Reactive power management in industries**,** controls-power quality impacts**,** application of filters Energy saving in industries

UNIT–IV: Cooling and heating loads, load profiling**,** Modeling- Cool storage**,** Types-Control strategies**,** Optimal operation**,** Problem formulation- Case studies

UNIT–V: Captive power units**,** Operating and control strategies**,** Power Pooling- Operation models**,** Energy banking**,** Industrial Cogeneration

UNIT–VI: Selection of Schemes Optimal Operating Strategies**,** Peak load saving**,** Constraints Problem formulation- Case study**,** Integrated Load management for Industries

TEXT BOOKS:

- C.O. Bjork " Industrial Load Management - Theory, Practice and Simulations", Elsevier, the
- Netherlands,1989
- C.W. Gellings and S.N. Talukdar,. Load management concepts. IEEE Press, New York, 1986, pp. 3-28
- Y. Manichaikul and F.C. Schweppe ," Physically based Industrial load", IEEE Trans. on PAS, April 1981
- H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Interscience Publication, USA, 1989.
- I.J.Nagarath and D.P.Kothari, .Modern Power System Engineering., Tata McGraw Hill publishers, NewDelhi, 1995
- IEEE Bronze Book- "Recommended Practice for Energy Conservation and cost effective planning in Industrial facilities", IEEE Inc, USA

Dynamics of Linear Systems (MTEEPS301D)

Unit-I: State variable representations of systems**,** transfer function and transfer function matrix**,** solutions of state equations

Unit-II: Observability and controllability**,** minimal realization of MIMO systems**,** analysis of linear time varying systems**,** the concepts of stability

Unit-III: Lyapunov stability analysis**,** Lyapunov function and its properties**,** controllability by state variable feedback

Unit-IV: Ackerman's Formula - stabilisation by output feedback**,** asymptotic observers for state measurement**,** observer design

Unit-V: State space representation of discrete systems**,** solution of state equations, controllability and observabilty stability analysis using Lyapunov method

Unit-VI: State feedback of linear discrete time systems**,** design of observers - MATLAB Exercises

References:

- Thomas Kailath, "Linear Systems", Prentice Hall Inc., Englewood Cliffs, N.J. 1980.
- K. Ogata, "State Space Analysis of Control Systems", Prentice Hall Inc., Englewood Cliffs, N.J., 1965.
- K. Ogata, "Modern Control Engineering, (second edition)" , Prentice Hall Inc., Englewood Cliffs, N.J., 1990
- M.Gopal, "Digital Control and State Variable Methods", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997
- C.T. Chen, "Linear System Theory and Design", New York: Holt Rinehart and Winston,1984
- R.C. Dorf, and R. T. "Bishop, Modern Control Systems", Addison Wesley Longman Inc., 1999.

Business Analytics (MTEEPS302A)

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

Unit-II: Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Unit-III: Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.

Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Unit-IV: Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Unit-V: Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Unit-VI: Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

References:

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

Industrial Safety (MTEEPS302B)

Unit-I: Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit-II: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III: Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-IV: Fault tracing: Fault tracing-concept and importance, decision treeconcept, 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.

Unit-V: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

References:

- Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.

- Maintenance Engineering, H. P. Garg, S. Chand and Company.
- Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
- Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Operations Research (MTEEPS302C)

Unit 1: Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit 2: Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Unit 3: Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit 4: Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit 5: Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

- H.A. Taha, Operations Research, An Introduction, PHI, 2008
- H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
- J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
- Hitler Libermann Operations Research: McGraw Hill Pub. 2009
- Pannerselvam, Operations Research: Prentice Hall of India 2010
- Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Cost Management of Engineering Projects (MTEEPS302D)

Unit 1: Introduction and Overview of the Strategic Cost Management Process 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.

Unit 2: 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

Unit 3: Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement

Unit 4: 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.

Unit 5: Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

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

Composite Materials (MTEEPS302E)

UNIT–I: 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.

UNIT – II: 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.

UNIT–III: 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.

UNIT–IV: Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V: 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.

TEXT BOOKS:

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

REFERENCES:

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

Waste to Energy (MTEEPS302F)

Unit-I: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Unit-II: Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-III: 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.

Unit-IV: Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-V: 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.

References:

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

Dissertation-I / Industrial Project (MTEEPS303)

Dissertation-I: will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.

End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions and must bring out individuals contribution. Continuous assessment of Dissertation – I and Dissertation – II at Mid Semester and End Semester will be monitored by the departmental committee.

Semester IV

Course Number	Subject	Scheme Of Studies Per Week			IA	EA	Total	Credits
		L	T	P				
MTEEPS401	Dissertation II	0	0	32	300	400	700	16
			Total		**300**	**400**	**700**	**16**

Dissertation II (MTEEPS401)

Dissertation – II: will be extension of the to work on the topic identified in Dissertation – I. Continuous assessment should be done of the work done by adopting the methodology decided involving numerical analysis/ conduct experiments, collection and analysis of data, etc. There will be presubmission seminar at the end of academic term. After the approval the student has to submit the detail report and external examiner is called for the viva-voce to assess along with guide.

Audit Courses (Common for all)

AUDIT 1 and 2 : English for Research Paper Writing

Syllabus

UNIT-1: Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

UNIT-2: Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check.

UNIT-3: 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.

UNIT-4: 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.

UNIT-5: useful phrases, how to ensure paper is as good as it could possibly be the first- time Submission.

Suggested Studies:

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

AUDIT 1 and 2: Disaster Management

Syllabus

UNIT-1: Introduction

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT-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.

UNIT-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.

UNIT-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.

UNIT-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.

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.

Suggested Studies:

- R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.

- Sahni, Pardeep Et.Al. (Eds.),” Disaster Mitigation Experiences And Reflections”, Prentice Hall Of India, New Delhi.
- Goel S. L. , Disaster Administration And Management Text And Case Studies” ,Deep &Deep Publication Pvt. Ltd., New Delhi.

AUDIT 1 and 2 : Sanskrit for Technical Knowledge

Syllabus

UNIT-1: Alphabets in Sanskrit.

UNIT-2: Past/Present/Future Tense.

UNIT-3: Simple Sentences Order.

UNIT-4: Introduction of roots.

UNIT-5: Technical information about Sanskrit Literature, Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested Studies:

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

AUDIT 1 and 2 : Value Education

Syllabus

UNIT-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 judgments

UNIT-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

UNIT-3: Personality and Behavior Development - Soul and Scientific attitude.

 Punctuality, Love and Kindness.

 Avoid fault Thinking.

 Free from anger, Dignity of labor.

 Universal brotherhood and religious tolerance.

UNIT-4: Positive Thinking. Integrity and discipline. Positive Thinking. Integrity and discipline.

 True friendship.

 Happiness Vs suffering, love for truth.

 Aware of self-destructive habits.

 Association and Cooperation.

 Doing best for saving nature

UNIT-5: 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.

Suggested Studies:

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

AUDIT 1 and 2 : Constitution of India

Syllabus

UNIT-1: History of Making of the Indian Constitution:

History Drafting Committee, (Composition & Working).

Philosophy of the Indian Constitution: Preamble Salient Features.

UNIT-2: 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.

UNIT-3: 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

UNIT-3: 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

UNIT-5: 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.

Suggested Studies:

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

AUDIT 1 and 2: Pedagogy Studies

Syllabus

UNIT-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.

UNIT-2: Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.

 Curriculum, Teacher education

UNIT-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

UNIT-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

UNIT-5: Research gaps and future directions

 Research design

 Contexts

 Pedagogy

 Teacher education

 Curriculum and assessment

 Dissemination and research impact

Suggested Studies:

- Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
- Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
- Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
- 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.
- Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
- Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
- www.pratham.org/images/resource%20working%20paper%202.pdf.

AUDIT 1 and 2: Stress Management by Yoga

Syllabus

UNIT-1: Definitions of Eight parts of yog (Ashtanga).

UNIT-2: Yam and Niyam: Do`s and Don't's in life.

UNIT-3: Ahinsa, satya, astheya, bramhacharya and aparigraha

ii) Shaucha, santosh, tapa, swadhyay, ishwar pranidhan.

UNIT-4: Asan and Pranayam

I) Various yog poses and their benefits for mind & body

UNIT-5: Regularization of breathing techniques and its effects-Types of pranayam.

Suggested Studies:

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur.
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata.

AUDIT 1 and 2: Personality Development through Life Enlightenment Skills

Syllabus

UNIT-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)

UNIT-2: Approach to day to day work and duties.

 Shrimad BhagwadGeeta: 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.

UNIT-3: Statements of basic knowledge.

 Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68

 Chapter 12 -Verses 13, 14, 15, 16, 17, 18

UNIT-4: Personality of Role model. Shrimad BhagwadGeeta:

 Chapter2-Verses 17,

 Chapter 3-Verses 36, 37, 42,

 Chapter 4-Verses 18, 38, 39

 Chapter18 – Verses 37, 38, 63

Suggested Studies:

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