Study Scheme & Syllabus of

Master of Technology Power Engineering/

M. Tech. Power Engineering

Batch 2018 onwards

By

Board of Study Electrical Engineering

Department of Academics

IK Gujral Punjab Technical University

I.K. Gujral Punjab Technical University
M. Tech Power Engineering

Master of Technology in Power Engineering/

(M. Tech Power Engineering)

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		
MTPE-101-18	Core 1 Theory	Power System Analysis	3	0	0	40	60	100	3
MTPE-102-18	Core 2 Theory	Renewable Energy Systems	3	0	0	40	60	100	3
MTPE-103X-18	Elective -I	Professional Elective-I	3	0	0	40	60	100	3
MTPE-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
MTPE-105-18	Practical/ Laboratory 1	Power Systems Lab	0	0	4	60	40	100	2
MTPE-106-18	Practical/ Laboratory 2	Renewable Energy 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**

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Professional Elective/Audit	Course Code	Course Name	L	T	P	Marks Distribution		Total Marks	Credits
						Internal	External		
PE1	MTPE-103A-18	Engineering Optimization	3	0	0	40	60	100	3
	MTPE-103B-18	High Voltage Engineering	3	0	0	40	60	100	3
	MTPE-103C-18	Static VAR Controllers and Harmonic Filtering	3	0	0	40	60	100	3
	MTPE-103D-18	High Power Converters	3	0	0	40	60	100	3
PE2	MTPE-104A-18	Electrical Power Distribution System	3	0	0	40	60	100	3
	MTPE-104B-18	Power System Dynamics	3	0	0	40	60	100	3
	MTPE-104C-18	Electric and Hybrid Vehicles	3	0	0	40	60	100	3
	MTPE-104D-18	Industrial Load Modeling and Control	3	0	0	40	60	100	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

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Second Semester

Course Code	Course Type	Course Name	L	T	P	Marks Distribution Internal	 External	Total Marks	Credits
MTPE-201-18	Core 1 Theory	Non-Conventional Electrical Energy Systems	3	0	0	40	60	100	3
MTPE-202-18	Core 2 Theory	Mathematical Methods for Power Engineering	3	0	0	40	60	100	3
MTPE-203X-18	Elective -I	Professional Elective-III	3	0	0	40	60	100	3
MTPE-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
MTPE-205-18	Practical/ Laboratory 1	Renewable Energy Lab	0	0	4	60	40	100	2
MTPE-206X-18	Practical/ Laboratory 2	Lab Elective 4	0	0	4	60	40	100	2
MTA-10Y-18	Audit-II	Audit Course-II	2	0	0	00	00	Satisfactory/ Non-satisfactory	Non-Credit
	Total		**14**	**0**	**12**	**340**	**360**	**700**	**18**

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Professional Elective/Audit	Course Code	Course Name	L	T	P	Marks Distribution Internal	External	Total Marks	Credits
PE3	MTPE-203A-18	Power Quality	3	0	0	40	60	100	3
	MTPE-203B-18	Artificial Intelligence Techniques	3	0	0	40	60	100	3
	MTPE-203C-18	Advanced Digital Signal Processing	3	0	0	40	60	100	3
	MTPE-203D-18	Energy Conversion Processes	3	0	0	40	60	100	3
PE4	MTPE-204A-18	Restructured Power Systems	3	0	0	40	60	100	3
	MTPE-204B-18	Power Apparatus Design	3	0	0	40	60	100	3
	MTPE-204C-18	Smart Grids	3	0	0	40	60	100	3
	MTPE-204D-18	Advanced Micro controller Based Systems	3	0	0	40	60	100	3
Lab4	MTPE-206A-18	Power Electronics Applications to Power Systems	0	0	4	60	40	100	2
	MTPE-206B-18	Smart Grids Lab	0	0	4	60	40	100	2
	MTPE-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	2	0	0	00	00	Satisfactory/	Non-

		Development through Life Enlightenment Skills						Non-satisfactory	Credit

Third Semester

Course Code	Course Type	Course Name	L	T	P	Marks Distribution Internal	External	Total Marks	Credits
MTPE-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
MTPE-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 Internal	External	Total Marks	Credits
PE5	MTPE-301A-18	HVDC	3	0	0	40	60	100	3
	MTPE-301B-18	FACTS and Custom Power Devices	3	0	0	40	60	100	3
	MTPE-301C-18	SCADA Systems and Applications	3	0	0	40	60	100	3
	MTPE-301D-18	Reliability Analysis & Protection	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		
MTPE-401-18	Major Project	Phase-II Dissertation	0	0	32	60	40	100	**16**

Total Marks of M. Tech Program: 1800

Total Credits of M. Tech Program: 68

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MTPE-101-18 **POWER SYSTEM ANALYSIS** **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

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MTPE-102-18 **RENEWABLE ENERGY SYSTEMS** **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, Distributed vs Central Station Generation, Sources of Energy such as Micro-turbines, Internal Combustion Engines.	8
2	Introduction to Solar Energy, Wind Energy, Combined Heat and Power, Hydro Energy, Tidal Energy, Wave Energy, Geothermal Energy, Biomass and Fuel Cells.	8
3	Power Electronic Interface with the Grid.	6
4	Impact of Distributed Generation on the Power System, Power Quality Disturbances.	8
5	Transmission System Operation, Protection of Distributed Generators	8
6	Economics of Distributed Generation, Case Studies.	6

Suggested reading

1. Ranjan Rakesh, Kothari D.P, Singal K.C, "Renewable Energy Sources and Emerging Technologies", 2nd Ed. Prentice Hall of India, 2011
2. Math H. Bollen, Fainan Hassan, "Integration of Distributed Generation in the Power System", July 2011, Wiley-IEEE Press
3. Loi Lei Lai, Tze Fun Chan, "Distributed Generation: Induction and Permanent Magnet Generators", October 2007, Wiley- IEEE Press.
4. Roger A. Messenger, Jerry Ventre, "Photovoltaic System Engineering", 3rd Ed, 2010
5. James F. Manwell, Jon G. McGowan, Anthony L Rogers, "Wind energy explained: Theory Design and Application", John Wiley and Sons 2nd Ed, 2010

Course Outcomes:- Students will be able to:

1. Knowledge about renewable energy
2. Understand the working of distributed generation system in autonomous/grid connected modes
3. Know the Impact of Distributed Generation on Power System

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MTPE-103A-18 **ENGINEERING OPTIMIZATION** **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 need for optimization and different techniques involved and also constraints.
2. To know Linear/Non-linear Programming.
3. To understand the importance of optimization to solve Engineering problems
4. To know genetic algorithm for Engineering Optimization

Syllabus

Units	Contents	Hours
1	Concepts of optimization: Engineering applications Statement of optimization Problem, Classification - type and size of the problem Classical Optimization Techniques: Single and multi variable problems- Types of Constraints Semi definite case-saddle point	8
2	Linear programming: Standard form-Geometry of LP problems-Theorem of LP Relation to convexity - formulation of LP problems - simplex method and algorithm Matrix form- two phase method. Duality dual simplex method- LU Decomposition	8
3	Sensitivity analysis. Artificial variables and complementary solutions-QP Engineering Applications: Minimum cost flow problem Network problems-transportation, assignment & allocation, scheduling Karmarkar method-unbalanced and routing problems.	8
4	Nonlinear programming: Non linearity concepts-convex and concave functions non-linear programming-gradient and Hessian. Unconstrained optimization First & Second order necessary conditions- Minimization & Maximization Local & Global convergence- Speed of convergence	6
5	Basic decent methods: Fibonacci & Golden section search – Gradient methods – Newton Method-Lagrange multiplier method - Kuhn-tucker conditions Quasi-Newton method- separable convex programming- Frank and Wolfe method, Engineering applications Nonlinear programming-Constrained optimization: Characteristics of constraints -Direct methods- SLP, SQP-Indirect methods. Transformation techniques-penalty function-Lagrange multiplier methods checking convergence- Engineering applications	8
6	Dynamic programming: Multistage decision process- Concept of sub optimization and principle of optimality Computational procedure- Engineering applications. Genetic algorithms-Simulated Annealing Methods - Optimization programming, tools and Software packages	6

Suggested reading

1. David G Luenberger, "Linear and Non Linear Programming", 2nd Ed, Addison-Wesley Pub.Co.,Massachusetts, 2003

2. W.L.Winston, "Operation Research-Applications & Algorithms",2nd Ed., PWS-KENT Pub.Co.,Boston, 2007

3. S.S. Rao, "Engineering Optimization", 3rd Ed.,New Age International (P) Ltd,New Delhi, 2007

4. W.F. Stocker, "Design of Thermal Systems", 3rd Ed., McGraw Hill, New York. 1990

5. G.B. Dantzig, "Linear Programming and Extensions" Princeton University Press, N.J., 1963.

6. L.C.W. Dixton, "Non Linear Optimisation: theory and algorithms" Birkhauser, Boston, 1980

Course Outcomes:

1: Apply optimization techniques to typical engineering problems

2: Learn the concepts and techniques of nonlinear and unconstrained optimization

3: Acquire knowledge on direct and indirect methods for constrained optimization

4: Learn the application of dynamic programming and genetic algorithms for engineering Optimization

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MTPE-103B-18 **HIGH VOLTAGE ENGINEERING** **L T P**

Internal Marks: 40 **3 0 0**

External Marks: 60

Total Marks: 100

Course Objectives:- Students will be able to:
To get introduced to high voltage engineering
To understand different high voltage measurements and the necessary instruments

Syllabus

Unit	Content	Hours
1	Voltage doubler - cascade circuits electrostatic machines	6
2	Generation of Impulse voltages and current single stage and multistage Circuits wave shaping-tripping and control of impulse generators	8
3	Generation of switching surge voltage and impulse current Measurement of high voltages and currents DC,AC and impulse voltages and currents DSO-electrostatic and peak Voltmeters sphere gaps-factors affecting measurements-potential dividers (capacitive and resistive) ries impedance ammeters-rogowski coils-hall effect generators Digital techniques in HV measurements	8
4	Measurement of electric field, Sources of EMI Principles of EMC, Filtering, Shielding Grounding techniques	8
5	Introduction to relevant national and international standards Layout and clearances as well as shielding and grounding of HV lab	8
6	Safety regulations for high voltage tests, Calibration of HV measuring instruments. Indian Standards for HV clearances. Recent trends in HV Engineering	8

Suggested reading

1. M. S. Naidu, V. Kamaraju, "High Voltage Engineering", McGraw-Hill, 1995.

2. M. Khalifa, "High Voltage Engineering: Theory and Practice", Dekker, 1990
3. H. M. Ryan, "High Voltage Engineering and Testing", Peter Peregrinus, 1994

4. Wadhwa C L."High Voltage Engineering", Wiley Eastern Limited, NewDelhi,1994
5. Ott, H.W.,"Noise Reduction Techniques in Electronic Systems", John Wiley, New York, 1989

Course Outcomes:-

Students will be able to:

1. Knowledge about the need for high voltage generation

2. Acquaint with the different methods for generating high voltage AC/DC and impulse voltages and current

3. Knowledge about the measurement techniques for high voltage AC/DC and impulse voltages and currents

4. To learn sources of EMI and its mitigation techniques

5. Safety precautions to be taken while designing an HV lab

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MTPE-103C-18 STATIC VAR CONTROLLER AND HARMONIC FILTERING

	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 various static converters
2. Understand the static converter control strategies
3. Understand the active and reactive power compensation and their control
4. Understand harmonic filtering and its control design

Units	Content	Hours
1	Fundamentals of Load Compensation. Steady-State Reactive Power Control in Electric Transmission Systems. Reactive Power Compensation and Dynamic Performance of Transmission Systems.	6
2	Power Quality Issues: Sags, Swells, Unbalance, Flicker, istortion. Current Harmonics. Sources of Harmonics in Distribution Systems and effects .	6
3	Static Reactive Power Compensators and their control. Shunt Compensators. SVCs of Thyristor Switched and Thyristor Controlled types and their control, STATCOMs and their control. Series Compensators of thyristor Switched and Controlled Type and their Control. SSSC and its Control, Sub-Synchronous Resonance and damping. Use of STATCOMs and SSSCs for Transient and Dynamic Stability Improvement in Power System.	10
4	Converters for Static Compensation. Single Phase and Three Phase Converters and Standard Modulation Strategies (Programmed Harmonic Elimination and SPWM). GTO Inverters. Multi-Pulse Converters and Interface Magnetics. Multi-Level Inverters of Diode Clamped Type and Flying Capacitor Type	8
5	Passive Harmonic Filtering. Single Phase Shunt Current Injection Type Filter and its Control. Three Phase Three-wire Shunt Active Filtering and their control using p-q theory and d-q modeling. Three phase four wire shunt active filters. Hybrid Filtering using Shunt Active Filters. Dynamic Voltage Restorer and its control. Power Quality Conditioner	8
6	Series Active Filtering in Harmonic Cancellation Mode. Series Active Filtering in Harmonic Isolation Mode.	4

Suggested reading

1.Ned Mohan et.al, "Power Electronics", John Wiley and Sons,2006.

2.G. Massobrio, P. Antognet," Semiconductor Device Modeling with Spice", McGraw-Hill, Inc.,1988.

3. B. J. Baliga," Power Semiconductor Devices", Thomson, 2004

4. V. Benda, J. Gowar, D. A. Grant," Power Semiconductor Devices. Theory and Applications", John Wiley& Sons1994.

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. To introduce the student to various single phase and three-phase Static VAR Compensation schemes and their controls
3. To develop analytical modeling skills needed for modeling and analysis of such Static VAR

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MTPE-103D-18 **HIGH POWER CONVERTERS** **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 requirements of high power rated converters
2. Understand the different topologies involved for these converters
3. Able to understand the design of protection circuits for these converters

Syllabus

Units	Content	Hours
1	Power electronic systems An overview of PSDs, multipulse diode rectifier, multipulse SCR rectifier.	6
2	Phase shifting transformers, multilevel voltage source inverters: two level voltage source inverter, cascaded H bridge multilevel inverter.	8
3	Diode clamped multilevel inverters, flying capacitor multilevel inverter	6
4	PWM current source inverters, DC to DC switch mode converters	6
5	AC voltage controllers: Cyclo-converters, matrix converter, Power conditioners and UPS.	8
6	Design aspects of converters, protection of devices and circuits	6

Suggested reading

1. N. Mohan, T. M. Undeland and W. P. Robbins, “Power Electronics: Converter, Applications and Design”, John Wiley and Sons, 1989

2. M.H. Rashid, “Power Electronics”, Prentice Hall of India, 1994

3. B. K .Bose, “Power Electronics and A.C. Drives”, Prentice Hall, 1986

4. Bin Wu, “High power converters and drives”, IEEE press, Wiley Enter science

Course Outcomes:-

Students will be able to:

1. Learn the characteristics of PSDs such as SCRs, GTOs, IGBTs and use them in practical systems

2. Knowledge of working of multi-level VSIs, DC-DC switched mode converters, cyclo-converters and PWM techniques and the ability to use them properly

3. Acquire knowledge of power conditioners and their applications

4. Ability to design power circuit and protection circuit of PSDs and converters

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MTPE-104A-18 ELECTRICAL POWER DISTRIBUTION SYSTEM L T P

Internal Marks: 40 3 0 0

External Marks: 60

Total Marks: 100

Course Objectives:-Students will be able to:
1. Learning about power distribution system
2. Learning of SCADA System
3. Understanding Distribution Automation

Syllabus

Unit	Content	Hours
1	Distribution of Power, Management, Power Loads, Load Forecasting Short-term & Long-term, Power System Loading, Technological Forecasting.	8
2	Advantages of Distribution Management System (D.M.S.), Distribution Automation: Definition, Restoration / Reconfiguration of Distribution Network, Different Methods and Constraints, Power Factor Correction.	8
3	Interconnection of Distribution, Control & Communication Systems, Remote Metering, Automatic Meter Reading and its implementation.	8
4	SCADA: Introduction, Block Diagram, SCADA Applied To Distribution Automation, Common Functions of SCADA, Advantages of Distribution Automation through SCADA.	8
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.	6
6	Maintenance of Automated Distribution Systems, Difficulties in Implementing Distribution, Automation in Actual Practice, Urban/Rural Distribution, Energy Management, AI techniques applied to Distribution Automation.	6

Suggested reading

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

Course Outcomes:-Students will be able to:

1. Knowledge of power distribution system
2. Study of Distribution automation and its application in practice
3. To learn SCADA system

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MTPE-104B-18 **POWER SYSTEM DYNAMICS** **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 equations	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

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MTPE-104C-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

Unit	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	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
4	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
5	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.

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MTPE-104D-18 INDUSTRIAL LOAD MODELING AND CONTROL 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 energy demand scenario
2. To understand the modeling of load and its ease to study load demand industrially
3. To know Electricity pricing models
4. Study Reactive power management in Industries

Syllabus

Units	Content	Hours
1	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.	6
2	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.	8
3	Reactive power management in industries-controls-power quality impacts application of filters Energy saving in industries	6
4	Cooling and heating loads- load profiling- Modeling. Cool storage-Types- Control strategies. Optimal operation-Problem formulation- Case studies.	8
5	Captive power units- Operating and control strategies- Power Pooling-Operation models. Energy banking-Industrial Cogeneration	8
6	Selection of Schemes Optimal Operating Strategies. Peak load saving-Constraints-Problem formulation- Case study. Integrated Load management for Industries	8

Suggested reading

1. C.O. Bjork “Industrial Load Management - Theory, Practice and Simulations", Elsevier, the

Netherlands,1989.

2. C.W. Gellings and S.N. Talukdar, “Load management concepts,” IEEE Press, New York, 1986, pp. 3-28.

3. Y. Manichaikul and F.C. Schweppe ," Physically based Industrial load", IEEE Trans. on PAS,

April 1981.

4. H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Interscience Publication, USA, 1989.

5. I.J.Nagarath and D.P.Kothari, .Modern Power System Engineering., Tata McGraw Hill publishers, New Delhi, 1995.

6. IEEE Bronze Book- "Recommended Practice for Energy Conservation and cost effective planningin Industrial facilities", IEEE Inc, USA.

Course Outcomes:

Students will be able to:

1. Knowledge about load control techniques in industries and its application.

2. Different types of industrial processes and optimize the process using tools like LINDO and LINGO.

3. Apply load management to reduce demand of electricity during peak time.

4. Apply different energy saving opportunities in industries.

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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. Asimov , "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
7. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

8. Mayall, “Industrial Design”, McGraw Hill, 1992.
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.

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MTPE-105-18 **POWER SYSTEMS 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 power quality problems using SIMULINK
2. To understand the optimization techniques with tool box.
3. To understand the Design of passive and active filters
4. Development of simulink model for excitation system using MATLAB.

Syllabus

Sr. No.	**List of Experiments**
1	Simulation and analysis of Governor System for impulse, unit step, and ramp inputs using SIMULINK.
2	Simulation and response analysis of Excitation system for impulse, unit step, and ramp inputs using SIMULINK.
3	SIMULINK modelling of power electronic 3 phase, 6 pulse converter using PWM technique.
4	Development of any five classical optimization techniques.
5	Design of passive and active filters using SIMULINK.
6	Simulation and analysis of Governor System for impulse, unit step, and ramp inputs using SIMULINK.
7	Simulation of power quality problems (like Sag/Swell, interruption, transients, harmonics, flickers etc.) using SIMULINK.

Course Outcomes:- Students will be able to

1. Analyze the passive and active filters using models
2. Simulink models considering excitation systems

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MTPE-106-18 **RENEWABLE ENERGY 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 curves for energy sources
2. Effect of variable parameters on solar panels
3. Relation of wind output and load.

Syllabus

Sr. No.	**List of Experiments**
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

Course Outcomes:- Students will be able to

1. Various power curves considering different renewable sources
2. Analyze the effect of variations of parameters on solar panels
3. Analyze the wind power

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MTAC-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

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MTAC-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

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MTAC-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

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MTAC-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

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MTPE-201-18 NON CONVENTIONAL ELECTRICAL ENERGY 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 important concepts of energy generation through non-conventional ways
2. Understand different sources like:- Hydro ,Solar , Biomass, Wind, Tidal
3. Learn about Fusion

Syllabus

Units	Content	Hours
1	Solar energy principles and applications. Efficiency of solar thermal and PV systems. Storage and enrichment. Shadow effect	4
2	Biomass: generation characterization. Biogas: aerobic and anaerobic bio-conversion processes. Microbial reactions purification. Properties of biogas	4
3	Tidal and wind energy potential and conversion efficiency	4
4	Fusion: Basic concepts. Fusion reaction physics. Thermonuclear fusion reaction criteria. Confinement schemes. Inertial and magnetic confinement fusion. Current status Geothermal: Geothermal regions. Geothermal sources. Dry rock and hot aquifer analysis Geothermal energy conversion technologies. OTEC.	6
5	Mini/micro hydro power: classification of hydropower schemes. Classification of water turbine. Turbine theory. Essential components of hydroelectric system. System efficiency	4
6	Integrated operation of non-conventional energy sources/Islanding preventive schemes	4

Suggested reading

1. J.Twidell and T.Weir, “Renewable Energy Resources”, Taylor and Francis Group 2007
2. G.N.Tiwari and MK Ghosal, “Renewable Energy Resources Basic Principles and Application”, Narosa Publishing House 2005.
3. J.A.Duffie and WA Beckman, “Solar Engineering and Thermal Processes”, 2nd Edition John Wiley and sons. 2001.
4. G.N.Tiwari, “Solar Energy”, Narosa Publishing House, 2002.
5. R.A.Gross, “Fusion Energy”, John Wiley and Sons, 1984.

Course Outcomes: Students will be able to

1. Have knowledge about Hydro, Wind, Biomass, Tidal sources
2. Learn about Dry rock and Hot Aquifier Analysis
3. Acquire the knowledge about fusion

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MTPE-202-18 **MATHEMATICAL METHODS FOR POWER ENGINEERING** **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 relevance of mathematical methods to solve engineering problems.
2. To understand how to apply these methods for a given engineering problem.

Syllabus

Units	Content	Hours
1	Vector spaces, Linear transformations, Matrix representation of linear transformation	4
2	Eigen values and Eigen vectors of linear operator	6
3	Linear Programming Problems, Simplex Method Duality, Non Linear Programming problems	6
4	Unconstrained Problems, Search methods, Constrained Problems	6
5	Lagrange method, Kuhn-Tucker conditions, Random Variables Distributions	6
6	Independent Random Variables, Marginal and Conditional distributions Elements of stochastic processes	6

Suggested reading

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

Course Outcomes: - Students will be able to:

1. Knowledge about vector spaces, linear transformation, eigenvalues and eigenvectors of linear operators
2. To learn about linear programming problems and understanding the simplex method for solving linear programming problems in various fields of science and technology

3. Acquire knowledge about nonlinear programming and various techniques used for solving constrained and unconstrained nonlinear programming problems
4. Understanding the concept of random variables, functions of random variable and their probability distribution
5. Understand stochastic processes and their classification

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MTPE-203A-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

Units	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.	5
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.	6
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.	6
5	Hamilton-Jacobi-Bellman equation - model reference adaptive (MRAS) - Design hypothesis.	8
6	Introduction to design method based on the use of Liapunov function. Design and simulation of variable structure adaptive model following control.	6

Suggested reading

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. 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.

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MTPE-203B-18 ARTIFICIAL INTELLIGENCE TECHNIQUES L T P
Internal Marks: 40 3 0 0
External Marks: 60
Total Marks: 100

Course Objectives: - Students will be able to:
1. Understand fuzzy logic, ANN
2.Understand 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	4
2	Fuzzy Logic, Knowledge Representation and Inference Mechanism. Defuzzification Methods	6
3	Fuzzy Neural Networks and some algorithms to learn the parameters of the network like GA	4
4	System Identification using Fuzzy and Neural Network	4
5	Genetic algorithm: Reproduction. Cross over. Mutation. Introduction to evolutionary program	4
6	Applications of above mentioned techniques to practical problems.	4

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. Identify fuzzy and neural network
4. Acquire the knowledge of GA

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MTPE-203C-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

Units	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	6
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

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MTPE-203D-18 **ENERGY CONVERSION PROCESSES** **L T P**
Internal Marks: 40 **3 0 0**
External Marks: 60
Total Marks: 100

Course Objectives: - Students will be able to:
1.Analysis of different energy system like solar
2.Understand design aspects of MHD generators
3.Understand Fuel cell & their applications

Syllabus

Units	Content	Hours
1	Basic science of energy conversion. Indirect verses direct conversion	4
2	Physics of semiconductor junctions for photovoltaic and photo-Electro chemical conversion of solar energy. Fabrication and evaluation of various solar cells in photovoltaic power generation systems	4
3	Technology and physics of thermo-electric generations. Thermal-electric materials and optimization studies	4
4	Basic concepts and design considerations of MHD generators Cycle analysis of MHD systems	6
5	Thermonic power conversion and plasma diodes. Thermo dynamics and Performance of fuel cells and their applications.	4
6	Advanced topics in Energy Conversion Process	4

Suggested reading

1. S. S. L. Chang, "Energy Conversion", Prentice Hall, 1963. 16
2. S. W. Angrist, "Direct Energy Conversion", Pearson, 1982
3. R. J. Rosa, "Magneto hydrodynamic Energy Conversion", Springer, 1987
4. V. S. Bagotsky, "Fuel Cell Problems and Solutions", John Wiley & Sons, 2009

Course Outcomes: Students will be able to

1. Have knowledge about Physics of semiconductor junctions for photovoltaic and photo-electro chemical conversion
2. Carry out Cycle analysis of MHD systems
3. Know Different thermo-electric processes of electric materials and their efficient use

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MTPE-204A-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.

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MTPE-204B-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 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, continous and intermittent rating	
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	6
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	6
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.Ability to model and design all types of rotation machines including special machines

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MTPE-204C-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.Understand concept of smart grid and its advantages over conventional grid
2.Know smart metering techniques
3.Learn wide area measurement techniques
4.Understand the problems associated with integration of distributed generation & its solution through smart grid.

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	4
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	6
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.	6
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	4
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 Powerline (BPL). IP based protocols	4

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. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, "Smart Grid: Technology and Applications", Wiley 2012
4. StuartBorlase,"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

I.K. Gujral Punjab Technical University
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MTPE-204D-18 ADVANCED MICROCONTROLLER BASED 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 architecture of advance microcontrollers
2.To understand the applications of these controllers
3.To get some introduction to FPGA.

Syllabus

Unit	Content	Hours
1	Basic Computer Organization. Accumulator based processes-Architecture-Memory Organization-I/O Organization	6
2	Micro-Controllers-Intel 8051, Intel 8056- Registers, Memories. I/O Ports, Serial Communication. Timers, Interrupts, Programming.	8
3	Intel 8051 – Assembly language programming-Addressing-Operations-Stack & Subroutines, Interrupts-DMA.	6
4	PIC 16F877- Architecture Programming. Interfacing Memory/ I/O Devices, Serial I/O and data communication	8
5	Digital Signal Processor (DSP)- Architecture –Programming, Introduction to FPGA	8
6	Microcontroller development for motor control applications. Stepper motor control using micro controller.	8

Suggested reading

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

Course Outcomes: Students will be able to:

1. To learn how to program a processor in assembly language and develop an advanced processor based system
2. To learn configuring and using different peripherals in a digital system
3. To compile and debug a Program
4. To generate an executable file and use it

I.K. Gujral Punjab Technical University
M. Tech Power Engineering

MTPE-205 -18 **RENEWABLE ENERGY LAB** **L T P**
Internal Marks: 60 **0 0 4**
External Marks: 40
Total Marks: 100

Course Objectives:-Students will be able : 1.To make the student familiar about the fundamentals of renewable energy 2.To make the student aware about how to derive the electric energy from solar energy 3.To understand the energy conversion process	
Syllabus	
Sr. No.	**List of Experiments**
1	Build a Power Curves a wind farm
2	Test the Capabilities of the Hydrogen Fuel Cells and Capacitors
3	Effect of Temperature on Solar Panel Output
4	Variables Affecting Solar Panel Output
5	Effect of Load on Solar Panel Output
6	Wind Turbine Output: The Effect of Load
7	Test the Capabilities of Solar Panels and Wind Turbines

Course Outcome: - Student will be able

1. To understand the energy conversion process
2. Student aware about how to derive the electric energy from solar energy

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MTPE-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 develop the various prototype models for working analysis of SCRs, IGBTs and MOSFETs.
2. To develop and analyse the small DC-DC/DC-AC converter models.
3. To complete the analysis of various energy conversion circuits under different loading conditions.

Syllabus

Sr. No.	List of Experiments
1.	Development of various configurations of power modules using SCRs, IGBTs, power transistors and power MOSFETs.
2.	Practical converter design considerations- Snubber design, gate and base drive circuits.
3.	DC to DC converters of various configurations using SCRs, IGBTs, power transistors and power MOSFETs.
4.	DC to AC converters of various configurations using SCRs, IGBTs, power transistors and power MOSFETs.
5.	AC to AC converters of various configurations using SCRs, IGBTs, power transistors and power MOSFETs.
6.	Practical implementation of control techniques for voltage control, speed control and harmonic minimization.

Course Outcome: - Student will be able to:

1. Operate upon various conversion circuits for different types of applications.
2. Analyse the various output waveforms under different loading patterns.

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MTPE-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

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

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MTPE-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 write programs for AI techniques
2.Application of AI in power system.

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. Write programs using AI techniques
2. Learn AI oriented power applications

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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.

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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.
2.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?

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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 pranayam	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

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MTA-108-18 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

	L	T	P
Internal Marks: 00	**2**	**0**	**0**

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.

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MTPE-301A-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 powerflow 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.

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MTPE-301B-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 InternationalPublishers, 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 ACTransmission Systems", IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.
4. K.S.Sureshkumar ,S.Ashok , "FACTS Controllers & Applications", E-book edition, Nalanda DigitalLibrary, 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.

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MTPE-301C-18 **SCADA SYSTEMS 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. To understand what is meant by SCADA and its functions.
2. To know SCADA communication.
3. To get an insight into its application.

Syllabus

Unit	Content	Hours
1	Introduction to SCADA: Data acquisition systems, Evolution of SCADA, Communication technologies	6
2	Monitoring and supervisory functions, SCADA applications in Utility Automation, Industries SCADA	8
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	6
4	SCADA Architecture: Various SCADA architectures, advantages and disadvantages of each system - single unified standard architecture -IEC 61850.	6
5	SCADA Communication: various industrial communication technologies -wired and wireless methods and fiber optics. open standard communication protocols.	6
6	SCADA Applications: Utility applications- Transmission and Distribution sector- operations, monitoring, analysis and improvement. Industries - oil, gas and water, Case studies, Implementation, Simulation Exercises	8

Suggested reading

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

Course Outcomes:- Student will be able to

1. Describe the basic tasks of Supervisory Control Systems (SCADA) as well as their typical applications
2. Acquire knowledge about SCADA architecture, various advantages and disadvantages of each system
3. Knowledge about single unified standard architecture IEC 61850
4. Describe the basic tasks of Supervisory Control Systems (SCADA) as well as their typical applications
5. Acquire knowledge about SCADA architecture, various advantages and disadvantages of each system
6. Knowledge about single unified standard architecture IEC 61850
7. To learn about SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server
8. Learn and understand about SCADA applications in transmission and distribution sector, industries etc

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MTPE-301D-18 RELIABILITY ANALYSIS & PROTECTION L T P
Internal Marks: 40 3 0 0
External Marks: 60
Total Marks: 100

Course Objectives:

Students will be able to:

1. Understand proper planning and analysis of reliability
2. Learn different methods to estimate different electric quantities

Syllabus

Unit	Content	Hours
1	Long and short term planning. Load forecasting, characteristics of loads. Methodology of forecasting, energy forecasting. Peak demand forecasting, total forecasting. Annual and monthly peak demand forecasting.	4
2	Reliability concepts, exponential distributions. Meantime to failure, series and parallel system, MARKOV process. Recursive technique. Generator system reliability analysis. Probability models for generators unit and loads. Reliability analysis of isolated and interconnected system, generator system cost analysis, corporate model. Energy transfer and off peak loading.	8
3	Transmission system reliability model analysis: Monte Carlo simulation. Average interruption rate. LOLP method, frequency and duration method.	4
4	Two plant single load system. Two plant two load system. Load forecasting uncertainly interconnections benefits.	6
5	Introduction to system modes of failure. The loss of load approach. Frequency& duration approach.spare value assessment. Multiple bridge equivalents	4
6	Distribution system reliability analysis. Calculation of indices SAIFI. SAIDI, CAIDI, etc.	4

Suggested reading

1. Sullivan, R.L., “Power System Planning”, Heber Hill.

2. Roy Billington, “Power System Reliability Evaluation”, Gordan& Breach Scain Publishers.

Course Outcomes

Students will be able to

1. Have knowledge of different methods to estimate different electrical quantities
2. Acquire skills in planning and building reliable power system.
3. Manage skills required in the field of power system engineering are enhanced.

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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. 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	9
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	10

	Model, Cash Budget Model	
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:-

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.

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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, 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.	8
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	8

	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	

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

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

I.K. Gujral Punjab Technical University
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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. Pannerselvam, 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.

I.K. Gujral Punjab Technical University
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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 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.	10
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

I.K. Gujral Punjab Technical University
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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 winding method – Compression moulding – Reaction injection moulding. Properties and applications.	8
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

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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 combustors, Design, construction and operation - Operation of all the above biomass combustors.	8
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

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY

Estd. Under Punjab Technical University Act, 1996
(Punjab Act No. 1 of 1997)

Ref. No. : IKGPTU/Reg/NF/ 157 *Dated :* 04.04.2019

NOTIFICATION

Sub: **Distribution of marks for evaluation of M.Tech and M.Sc. Dissertation.**

As approved by the Vice Chancellor, the Distribution of marks for evaluation of Master of Technology (M.Tech) and Master of Science (M.Sc) Dissertation Phase I and II shall be as under:

For Master of Technology (M.Tech) for Batch 2018 onwards

(I) The composition of Departmental Research Committee (DRC) for M.Tech /ME evaluation:

- Head of Department (HOD) — Chairman
- Director/Principal Nominee — Member
- One faculty member as Department PG Coordinator (Nominated by HOD) — Member
- Supervisor(s) — Member(s)

(II) Dissertation Phase I — Credits (10)

(A) Internal Marks to be awarded by the Departmental Research Committee (DRC) for Dissertation Phase I:

1.	Presentation-I (a. Subject Matter, b. Knowledge of Research Area, c. Literature Review, d. Response to Questions asked)	20
2.	Presentation-II (a. Tentative Title, b. Objectives, c. Methodology, d. Problem Statement, d. Research Gap, e. Response to Questions asked)	20
3.	Report	20
	Total Internal Marks	**60**

(B) External Marks to be awarded by External Expert for Dissertation Phase I:

All members will award the remaining Forty (40) marks assigned to the viva-voce examination as per the following. HOD will approve the name of External Expert.

1.	Presentation Structure	10
2.	Response to Questions asked during presentation	10
3.	Usefulness/Contribution of the work to the field	10
4.	Evaluation of Report by External Expert	10
	Total External Marks	**40**

(III) Dissertation Phase II Credits (16)

(A) Internal Marks to be awarded by the Departmental Research Committee (DRC) for Dissertation Phase II:

1.	Presentation-I (a. Final Title, b. Methodology (Simulation Tool(s)), c. Performance evaluation regarding the implementation techniques, d. Response to Questions asked)	20
2.	Presentation-II (a. Objectives achieved, b. Relevance of Research Work, c. Response to Questions asked)	20
3.	M. Tech Dissertation (Plagiarism Check)	20
	Total Internal Marks	**60**

The Supervisor will submit a List of three External Examiner Experts of relevant field to the HOD for the final approval. The HOD will take approval of one Examiner from the Competent Authority. The appointment letter of External Examiner will be issued by the concerned HOD. The final result will be forwarded to the Controller of Examination of the University for notification.

(B) External Marks to be awarded by External Expert for Dissertation Phase II:

All members will award the remaining Forty (40) marks assigned to the viva-voce examination as per the following:

1.	Presentation Structure (including M. Tech.(Dissertation)	10
2.	Response to Questions asked during presentation	10
3.	Usefulness/Contribution of the work to the field	10
4.	Publication of paper(s) to Journal of repute	10
	Total External Marks	**40**

(IV) **Duties of DRC:**

Responsible to conduct the whole process in right direction and improve the overall research work of M. Tech Dissertation Phase-I and Phase-II.

Note: Decision of DRC will be final in all relevant cases.

For Master of Science (M. Sc.) for Batch 2018 onwards

<table>
<tr><td></td><td colspan="4">Internal Assessment</td><td></td><td></td></tr>
<tr><td rowspan="2">Departmental Presentation</td><td colspan="2">Communication and presentation</td><td colspan="2">Response to queries</td><td>Maximum Marks</td><td>Evaluated by</td></tr>
<tr><td colspan="2">20</td><td colspan="2">30</td><td>50</td><td>Committee Member:
1.Head
2.Supervisor
3.One of Faculty Member</td></tr>
<tr><td rowspan="2">Dissertation</td><td>Plagiarism</td><td>Subject Matter</td><td>Usage of Language</td><td>Publication/Presentation in Conference</td><td rowspan="2">150</td><td rowspan="2"></td></tr>
<tr><td>25</td><td>70</td><td>25</td><td>30</td></tr>
<tr><td></td><td colspan="4">External Assessment</td><td></td><td></td></tr>
<tr><td rowspan="2">External Examiner</td><td colspan="4">Subject Matter</td><td rowspan="2">50</td><td rowspan="2"></td></tr>
<tr><td colspan="4">50</td></tr>
<tr><td rowspan="2">Viva Voce</td><td colspan="2">Communication and Presentation</td><td colspan="2">Response to queries</td><td rowspan="2">50</td><td rowspan="2">Committee Member:
1.Head
2.External Expert
3.Supervisor
4. Director (MC) nominee</td></tr>
<tr><td colspan="2">20</td><td colspan="2">30</td></tr>
<tr><td colspan="5">Total</td><td>300</td><td></td></tr>
</table>

Evaluation Process:

1. The subject matter evaluation can further be defined on the basis of Title, Review of literature/Motivation, Objectives, Methodology, Results and discussions, and Conclusion.
2. The usage of language and the subject matter shall be evaluated by the supervisor. Out of 300 marks, 95 marks are to be evaluated by the concerned supervisor.
3. Total 15% Plagiarism is admissible for submission of the dissertation. For (0-5)% of plagiarism, candidate should be awarded 25 marks. For >5%-10% candidate should be awarded 15 marks and for the range of > 10% to < 15%, candidate should be awarded 5 marks.

4. For publication candidate should be awarded full 30 marks and for presenting the work related to dissertation, candidate should be awarded 25 marks.

(Dr. S.S. Walia)
Registrar

Endst. No. IKGPTU/REG/NF/ 158-161 Dated: 04.04.2019

A copy is forwarded to the following officers for information please.

1. I/c Secretariat, O/o Vice Chancellor: For information of Vice Chancellor
2. All HODs (Non-Teaching)
3. Director (Main Campus): To inform all HODs (Teaching) and Incharge, IKGPTU Campuses
4. Deputy Controller (ITS): for uploading on official website

(Dr. S. S. Walia)
Registrar