UNIVERSITY INSTITUTE OF ENGINEERING & TECHNOLOGY
KURUKSHETRA UNIVERSITY, KURUKSHETRA

('A+' Grade, NAAC Accredited)

SCHEME OF EXAMINATIONS FOR MASTER OF TECHNOLOGY IN ELECTRICAL ENGINEERING (w. e. f. 2018-19)

SEMESTER-I										
Sr. No.	Course Code	SUBJECT	L	T	P	Total	Minor Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	MTEL-101	Advanced Power System Analysis	3	-	-	3	40	60	3	3
2	MTEL-103	Advanced Instrumentation & Control	3	-	-	3	40	60	3	3
3	*	Program Elective-I	3	-	-	3	40	60	3	3
4	**	Program Elective-II	3	-	-	3	40	60	3	3
5	MTEL-117	Instrumentation & Control Lab	-	-	4	4	40	60	2	3
6	MTEL-119	Advanced Power System Lab-I	-	-	4	4	40	60	2	3
7	MTRM-111	Research Methodology and IPR	2	-	-	2	40	60	2	3
8	***	Audit Course-I	2	-	-	2	100	-	-	-
		Total	**16**		**8**	**24**	**280**	**420**	**18**	

SEMESTER-I

* PROGRAM ELECTIVE – I		
1.	MTEL-105	Renewable Energy Resources
2.	MTEL-107	Power Electronics Applications in Renewable Energy
3.	MTEL-109	Smart Grid
** PROGRAM ELECTIVE - II		
1.	MTEL-111	Bio-Medical Signal & Image Processing
2.	MTEL-113	Advanced Digital Signal Processing
3.	MTEL-115	Bio-Medical Instrumentation

*** AUDIT COURSE – I		
1.	MTAD-101	English for Research Paper Writing
2.	MTAD-103	Disaster Management
3.	MTAD-105	Sanskrit for Technical Knowledge
4.	MTAD-107	Value Education

Note: 1.The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

2. *** Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

SEMESTER-II

Sr. No.	Course Code	Subject	L	T	P	Total	Minor Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	MTEL-102	Advanced Power System Protection	3	-	-	3	40	60	3	3
2	MTEL-104	Intelligent Control	3	-	-	3	40	60	3	3
3	*	Program Elective-III	3	-	-	3	40	60	3	3
4	**	Program Elective-IV	3	-	-	3	40	60	3	3
5	MTEL-118	Modeling & Simulation Lab	-	-	4	4	40	60	2	3
6	MTEL-120	Advanced Power System Lab-II	-	-	4	4	40	60	2	3
7	#MTEL-122	Mini Project	-	-	4	4	100	-	2	3
8	***	Audit Course-II	2	-	-	-	100	-	-	-
		Total	**14**		**12**	**26**	**340**	**360**	**18**	

*PROGRAM ELECTIVE - III		
1.	MTEL-106	HVDC Transmission & FACTS Devices
2.	MTEL-108	Transients in Power System
3.	MTEL-110	Advanced Power Distribution & Automation

**PROGRAM ELECTIVE – IV		
1.	MTEL-112	Digital Control System
2.	MTEL-114	Advanced Microprocessors
3.	MTEL-116	Reliability Engineering

*** AUDIT COURSE–II		
1.	MTAD-102	Constitution of India
2.	MTAD-104	Pedagogy Studies
3.	MTAD-106	Stress Management by Yoga
4.	MTAD-108	Personality Development through Life Enlightenment Skills

Note 1: The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

Note 2: *** Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

#Note3: Mini project: During this course the student will be able to understand the contemporary/emerging technologies for various processes and systems. During the semester, the students are required to search/gather the material/ information on a specific topic, comprehend it and present/discuss the same in the class. He/she will be acquainted to share knowledge effectively in oral (seminar) and written form (formulate documents) in the form of report. The student will be evaluated on the basis of viva/ seminar (40 marks) and report (60 marks).

SEMESTER-III

Sr. No.	Course Code	Subject	L	T	P	Total	Minor* Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	*	Program Elective-V	3	-	-	3	40	60	3	3
2	**	Open Elective	3	-	-	3	40	60	3	3
3	MTEL-207	Dissertation Part-I	-	-	20	20	100	-	10	--
		Total	**6**		**20**	**26**	**180**	**120**	**16**	

* PROGRAM ELECTIVE - V		
1.	MTEL-201	Distributed Generation
2.	MTEL-203	Advanced Electric Drives & Control
3.	MTEL-205	Power System Restructuring & Deregulation

** OPEN ELECTIVE		
1.	MTOE-201	Business Analytics
2.	MTOE-203	Industrial Safety
3.	MTOE-205	Operation Research
4.	MTOE-207	Cost Management of Engineering Projects
5.	MTOE-209	Composite Materials
6.	MTOE-211	Waste to Energy

SEMESTER-IV

Sr. No.	Course Code		L	T	P	Total	Minor Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	MTEL-202	Dissertation Part-II	-	-	32	-	100	200	16	--
						Total	**100**	**200**	**16**	

Total Credits – 68

Note 1: At the end of the second semester each student is required to do his/her Dissertation work in the identified area in consent of the Guide/Supervisor. Synopsis for the Dissertation Part-I is to be submitted within three weeks of the beginning of the Third Semester.

Note 2: Each admitted student is required to submit the report of his/her Dissertation Part-I as per the schedule mentioned in Academic calendar for the corresponding academic session otherwise the Dissertation Part-II cannot be continued at any level.

Note 3: Each admitted student is required to submit his/her final Dissertation Part-II as per the schedule mentioned in Academic calendar for the corresponding academic session only after the publication of two papers in a journal/International/National conference of repute like IEEE, Springer, Elsevier, ACM etc.

Note 4: The course of program/open elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

MTEL-101	Advanced Power System Analysis						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time(Hrs)
3	0	0	3	60	40	100	3
Program Objective (PO)	To enable students to analyse power system networks, various faults, load flow study, security and contingency analysis.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	Understand matrices related to power system and its formation with different methods.						
CO2	Understand how to analyze various types of faults in power system						
CO3	Study various methods of load flow and their advantages and disadvantages						
CO4	Understand need of power system security, state estimation and contingency analysis						

UNIT1

Network Modelling: System graph, loop, cut set and Incidence matrices, Primitive network and matrix, Formation of various network matrices by singular transformation.

Bus Impedance Algorithm: Singular transformation, direct inspection, Building Block algorithm for bus impedance matrix, Addition of links, addition of branches, (considering mutual coupling).

UNIT2

Balanced and unbalanced network elements: Representation of three phase network elements, representation under balanced and unbalanced excitation, transformation matrices, symmetrical components, sequence impedances, unbalanced elements and three phase power invariance.

Short circuit studies: Network representations for single line to ground fault, line to line fault, LL-G fault, and 3-phase faults, Short circuit calculations for various types of faults in matrix form.

UNIT3

Load flow studies: Load flow and its importance. Classification of buses, load flow techniques, Iterative solutions and computer flow charts using Gauss-Seidel and Newton-Raphson methods, Decoupled and fast decoupled methods, Representation of regulating and off nominal ratio transformers and modification of Ybus.

UNIT4

Power system security: Introduction to Power system security, Addition and removal of multiple lines, network reduction for contingency analysis, current injection, shift destitution factor, single outage contingency analysis.

State estimation in power systems: data acquisition system, Method of least-squares, State estimation by weighted least square technique.

Suggested Books:

1. Stagg G W, El-Abaid A H, "Computer methods in Power system analysis", McGraw Hill.
2. Singh L P, "Advanced Power System Analysis and Dynamics", New Age, Int. Publication.
3. Ramana N V, "Power System Analysis", Pearson Education.
4. Nagsarkar T K, Sukhija M S, "Power System Analysis", Oxford University Press.
5. Uma Rao K, "Computer Techniques and Models in Power System", IK Publications.
6. Grainger J J, Stevenson W D, "Power System Analysis", McGraw Hill.
7. Allen Wood, Bruce Wollenberg, "Power Generation operation & control", John Wiley & Sons.
8. Nagrath I J, Kothari D P, "Power System Engineering" McGraw Hill, New York.
9. Pai M A, "Computer Techniques in Power System Analysis", 2nd Edition, TMH-New Delhi.

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2	MTEL-103	Advanced Instrumentation & Control	3	-	-	3	40	60	3	3
3	*	Program Elective-I	3	-	-	3	40	60	3	3
4	**	Program Elective-II	3	-	-	3	40	60	3	3
5	MTEL-117	Instrumentation & Control Lab	-	-	4	4	40	60	2	3
6	MTEL-119	Advanced Power System Lab-I	-	-	4	4	40	60	2	3
7	MTRM-111	Research Methodology and IPR	2	-	-	2	40	60	2	3
8	***	Audit Course-I	2	-	-	2	100	-	-	-
		Total	16		8	24	280	420	18	

SEMESTER-I

* PROGRAM ELECTIVE – I		
1.	MTEL-105	Renewable Energy Resources
2.	MTEL-107	Power Electronics Applications in Renewable Energy
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SEMESTER-II

Sr. No.	Course Code	Subject	L	T	P	Total	Minor Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	MTEL-102	Advanced Power System Protection	3	-	-	3	40	60	3	3
2	MTEL-104	Intelligent Control	3	-	-	3	40	60	3	3
3	*	Program Elective-III	3	-	-	3	40	60	3	3
4	**	Program Elective-IV	3	-	-	3	40	60	3	3
5	MTEL-118	Modeling & Simulation Lab	-	-	4	4	40	60	2	3
6	MTEL-120	Advanced Power System Lab-II	-	-	4	4	40	60	2	3
7	#MTEL-122	Mini Project	-	-	4	4	100	-	2	3
8	***	Audit Course-II	2	-	-	-	100	-	-	-
		Total	14		12	26	340	360	18	

*PROGRAM ELECTIVE - III		
1.	MTEL-106	HVDC Transmission & FACTS Devices
2.	MTEL-108	Transients in Power System
3.	MTEL-110	Advanced Power Distribution & Automation

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Note 1:.The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

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SEMESTER-III

Sr. No.	Course Code	Subject	L	T	P	Total	Minor* Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	*	Program Elective-V	3	-	-	3	40	60	3	3
2	**	Open Elective	3	-	-	3	40	60	3	3
3	MTEL-207	Dissertation Part-I	-	-	20	20	100	-	10	--
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3.	MTOE-205	Operation Research
4.	MTOE-207	Cost Management of Engineering Projects
5.	MTOE-209	Composite Materials
6.	MTOE-211	Waste to Energy

SEMESTER-IV

Sr. No.	Course Code		L	T	P	Total	Minor Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	MTEL-202	Dissertation Part-II	-	-	32	-	100	200	16	--
						Total	**100**	**200**	**16**	

Total Credits – 68

Note 1: At the end of the second semester each student is required to do his/her Dissertation work in the identified area in consent of the Guide/Supervisor. Synopsis for the Dissertation Part-I is to be submitted within three weeks of the beginning of the Third Semester.

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MTEL-101	Advanced Power System Analysis						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time(Hrs)
3	0	0	3	60	40	100	3
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Course Outcomes (CO)							
After completion of course students will be able to							
CO1	Understand matrices related to power system and its formation with different methods.						
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UNIT1

Network Modelling: System graph, loop, cut set and incidence matrices, Primitive network and matrix, Formation of various network matrices by singular transformation.

Bus Impedance Algorithm: Singular transformation, direct inspection, Building Block algorithm for bus impedance matrix, Addition of links, addition of branches, (considering mutual coupling).

UNIT2

Balanced and unbalanced network elements: Representation of three phase network elements, representation under balanced and unbalanced excitation, transformation matrices, symmetrical components, sequence impedances, unbalanced elements and three phase power invariance.

Short circuit studies: Network representations for single line to ground fault, line to line fault, LL-G fault, and 3-phase faults, Short circuit calculations for various types of faults in matrix form.

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Load flow studies: Load flow and its importance. Classification of buses, load flow techniques, Iterative solutions and computer flow charts using Gauss-Seidel and Newton-Raphson methods, Decoupled and fast decoupled methods, Representation of regulating and off nominal ratio transformers and modification of Y_{bus}.

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8. Nagrath I J, Kothari D P, "Power System Engineering" McGraw Hill, New York.
9. Pai M A, "Computer Techniques in Power System Analysis", 2nd Edition, TMH-New Delhi.

MTEL-103	Advanced Instrumentation & Control						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time(Hrs)
3	0	0	3	60	40	100	3
Program Objective (PO)	This course will look at different types of Instruments with their controls.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	Understand different types of Instruments with their applications.						
CO2	Understand basics of smart Sensor with their advantages ,disadvantages and applications						
CO3	To emphasize and analysis of Virtual Instruments.						
CO4	To study different types of VI structures						

Unit 1

Transducers: Introduction, Characteristics and Classifications of electrical transducers, measurement of displacement, Force, pressure, speed, temperature and intensity of light using different electrical transducers, advantages, disadvantages and applications of transducers

Unit 2

Smart Sensors: Introduction, architecture of smart sensor, optical sensor, microelectronic sensor, chemical, Bio Sensor and Physical Sensor, piezo-resistive pressure sensor, fibre optic temperature sensor, light sensor, advantages, disadvantages and applications of smart sensors.

Unit 3

Virtual Instrumentation: Introduction, architecture of VI, Evaluation and architecture of VI, conventional Virtual Instrumentation, Advantage of Lab View, Software Environment, Creating and Saving VI, front Panel and block diagram Tool Bar, Palettes, front panel control and indicators, block diagram: Terminals, Nodes, Functions, Sub VI, Data Flow Program.

Unit 4

VI Structures: Control structures, selection structures, case structures, Sequence structures, formula node, array, single and multi-dimensional array, auto indexing, clusters, creating clusters control and indicators, data plotting.

Suggested Books:

1. Johnson G W, "Lab VIEW Graphical Programming", Second edition, McGraw Hill.

2. Kring J & Travis J, "LabVIEW for everyone", Prentice Hall, New Jersey.

3. James K, "PC Interfacing and Data Acquisition", Elsevier.

4. Jerome J, "Virtual Instrumentation using Lab View", Prentice Hall, India.

MTEL-105	Renewable Energy Resources						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time(Hrs)
3	0	0	3	60	40	100	3
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of renewable energy resources and different factors related to them.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about renewable energy resources and solar power system.						
CO2	To acquaint students with the phenomenon of wind power system and its applications with grid.						
CO3	To impart knowledge to students about geothermal and ocean power system.						
CO4	To let student understand fuel cell, hydrogen and hybrid energy system.						

Unit 1

ENERGY RESOURCES: Renewable energy sources, distributed energy systems and dispersed generation, atmospheric aspects of electric energy generation, impact of renewable energy generation on environment
SOLAR ENERGY: Solar Radiation and its Measurement, Solar Thermal Energy Collectors: different types of collectors and their performance analysis, Solar Thermal Energy Conversion System: solar water heater, solar distillation, slat thermal power plant and various applications of solar system, Solar Photovoltaic System: solar cell, VI characteristics, solar electricity and grid and off-grid solar system.

Unit 2

WIND ENERGY: Wind turbines and rotors, Wind Energy Extraction, Wind Characteristics, Power Density Duration Curve, Design of Wind Turbine Rotor, Design of Regulating System for Rotor, Wind Power Generation Curve, Sub-systems of a Horizontal Axis Wind Turbine Generator, Modes of Wind Power Generation, Estimation of Wind Energy Potential, Selection of Optimum Wind Energy Generator (WEG), Grid Interfacing of a Wind Farm, Methods of Grid Connection, Grid System and Properties, Capacity of Wind Farms for Penetration into Grid, Control System for Wind Farms, Economics of Wind Farms

Unit 3

GEOTHERMAL ENERGY: Structure of the Earth's Interior, Plate Tectonic Major Test, Geothermal Sites, Geothermal Field, Geothermal Gradients, Geothermal Resources, Geothermal Power Generation, Geothermal Electric Power Plant, Geothermal-Preheat Hybrid with Conventional Plant
OCEAN ENERGY: Development of a Tidal Power Scheme, Grid Interfacing of Tidal Power, Wave Energy, Mathematical Analysis of Wave Energy, Empirical Formulae on Wave Energy, Wave Energy Conversion, Principle of Wave Energy plant, Wave Energy Conversion Machines.

Unit 4

FUEL CELLS: Principle of Operation of Fuel Cell, Fuel Processor, Fuel Cell Types, Energy Output of a Fuel Cell, Efficiency, and EMF of a Fuel Cell, Operating Characteristics of Fuel Cells, Thermal Efficiency of Fuel Cell
HYDROGEN ENERGY SYSTEM: Hydrogen Production, Hydrogen Storage, Development of Hydrogen Cartridge, Gas Hydrate
HYBRID ENERGY SYSTEMS: Hybrid Systems AND ITS Types, Electric and Hybrid Electric Vehicles, Hydrogen-Powered-Electric Vehicles.
Suggested Books:

1. Kothari DP, Singal KC, Ranjan Rakesh, "Renewable energy sources and emerging technologies, 2nd ed, Prentice Hall (India)
2. Rai G D, "Non-Conventional Sources of Energy, Khanna Publishers.
3. Bansal N K, Kleemann M, Heliss M, "Renewable energy sources and conversion technology", McGraw Hill Education.
4. Abbasi S A, Abbasi N, "Renewable energy sources and their environmental impact", PHI.
5. Mittal KM, "Renewable energy Systems", Wheelar Publishing.
6. Mukherjee D, "Renewable energy Systems", New Age International.

MTEL-107	Power Electronics Applications in Renewable Energy						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time(Hrs)
3	0	0	3	60	40	100	3
Program Objective (PO)	The main objective of the course is to impart the students with the application of power system in renewable energy resources.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about power electronics devices and DC-DC converters.						
CO2	To acquaint students with the modern power electronics converters.						
CO3	To impart knowledge to students about power electronics interface devices for solar energy.						
CO4	To let student understand wind energy interfacing devices.						

Unit1

Review of Power Devices: SCR, BJT, MOSFET, IGBT, GTO, Safe operating Limits, Selection of devices for various applications.

Phase controlled Converters: (1-φ&3-φ) thyristor fed half controlled, fully controlled and Dual converters with inductive and motor load.

DC to DC converters: Analysis of various conduction modes of Buck, Boost, Buck-Boost.

Unit2

Modern Power Electronic Converters: Basic concepts of VSI, single phase half bridge, full bridge and three phase bridge inverters, PWM modulation strategies, Sinusoidal PWM, Space vector modulation, Selective Harmonic Elimination method, other inverter switching schemes, blanking time, Current source inverters.

Unit3

Design of Power Electronics Interfaces for Solar PV: Solar PV technologies, MPPT, Design of DC-DC converters for MPPT, MPPT algorithms, Implementation of MPPT control through DSP controllers. Topologies for grid connected and standalone applications: single phase and three phase systems, Single stage and multistage, isolated and non-isolated.

Unit4

Power Electronics Interfaces for WES: Topologies of WES, design considerations for wind energy Switch rectifier/inverter system, Power Converters for Doubly Fed Induction Generators (DFIG) in Wind Turbines.

Power Electronics interfaces for Fuel Cells: Types of fuel cells, Proton Exchange Membrane (PEM) fuel cell: features and operational characteristics, Design of DC-DC converters for PEM fuel cell, MPPT in Fuel Cell.

Suggested Books:

1. Mohan N, Undel and T M, Robbins W P, "Power Electronics, Converters, Applications & Design", Wiley India Pvt. Ltd.
2. Bose B K, "Modern Power Electronics and AC Drives", Pearson Education.
3. Joseph Vithayathil,"Power Electronics", Tata McGraw Hil.
4. Amirnaser Yezdani, and Reza Iravani, "Voltage Source Converters in Power Systems: Modelling, Control and Applications", IEEE John Wiley Publications.
5. Solanki C S, "Solar Photo Voltaic", PHI learning Pvt Ltd.

MTEL-109	Smart Grid						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of smart Grid and its advantages over conventional grid						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about Smart Grids and Appreciate the difference between smart grid & conventional grid						
CO2	To acquaint students with the phenomenon of smart metering concepts to industrial and commercial installations						
CO3	To impart knowledge to students about Formulate solutions in the areas of smart substations, distributed generation and wide area measurements						
CO4	To let student understand microgrid and related issues..						

UNIT-1

Introduction to Smart Grid, Evolution of Electric Grid Concept of Smart Grid, Definitions Need of Smart Grid, Concept of Robust & Self-Healing Grid, Present development & International policies in Smart Grid. Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources Power Quality Conditioners for Smart Grid

UNIT-2

Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS) Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Smart Substations, Substation Automation, Feeder Automation. Cyber Security for Smart Grid

UNIT-3

Geographic Information System(GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System(WAMS), Phase Measurement Unit(PMU)

UNIT-4

Concept of micro-grid, need & applications of micro-grid, formation of micro-grid, Issues of interconnection, protection & control of Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel-cells, micro-turbines Captive power plants, Integration of renewable energy sources

Suggested Books:

1. Keyhani A, "Design of smart power grid renewable energy systems", Wiley IEEE.
2. Berger L T, Iniewski K, "Smart Grid: Applications, Communications and Security", Wiley.
3. Gellings C W., "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press.
4. Ekanayake J B, Jenkins N, Liyanage K, Yokoyama A, "Smart Grid: Technology and Applications", Wiley.
5. Borlase S, "Smart Grid: Infrastructure, Technology and solutions", CRC Press.
6. Phadke A G, "Synchronized Phasor Measurement and their Applications", Springer.

MTEL-111	Bio-Medical Signal & Image Processing						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time(Hrs)
3	0	0	3	60	40	100	3
Program Objective (PO)	This course will look at Biomedical signal and Image for understanding and their processing assessing						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	Understand different types of biomedical signal and Identify and analyse different biomedical signals.						
CO2	Understand basics of Image processing and its methods						
CO3	To emphasize and analysis of Clustering and Classification						
CO4	To study different types of bio signals and their processing						

Unit-1

Signals and Biomedical Signal Processing: Introduction and overview, Analog, discrete and digital signals, Processing and transformation of signals, Signal processing for feature extraction, Characteristics of digital Images, Fourier transform: Properties of One-Dimensional Fourier Transform, Discrete Fourier Transform.

Unit-2

Image Processing: Image filtering Enhancement and Restoration, Point processing, Mask processing: linear filtering in Space domain, Frequency-domain filtering, Smoothing and sharping filters in frequency domain, Wavelet transform, FFT to STFT, One-Dimensional Continuous and discrete Wavelet Transform, Image processing methods.

Unit-3

Clustering and Classification: Clustering versus Classification, Feature extraction, Biomedical and. Biological features, Signal and Image processing features, K-means: A Simple Clustering Method, study of different types of Classifiers for signal processing..

Unit-4

Processing of Biomedical Signals: Electric activities of Cell, Electric data acquisition, Electrocardiogram: Signal of Cardiovascular system, Processing and feature extraction of ECG, Electroencephalogram, Signal of the brain, Processing and feature extraction of EEG, Electromyogram: Signal of muscles, Processing and feature extraction of EMG. Frequency and wavelet-domain analysis.

Suggested Books:

1.KayvanNajarian& Robert Splinter, "Introduction to Biomedical signal and Image Processing", CRC Press
2.MetinAkay "Time Frequency & Wavelets in Biomedical Signal Processing", Wiley-IEEE Press.
3. Amine Nait-Ali, "Advanced Biomedical Signal Processing", Springer.

MTEL-113	Advanced Digital Signal Processing						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time(Hrs)
3	0	0	3	60	40	100	3
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of LTI system and designing of different types of Filters.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about LTI system and DFT.						
CO2	To acquaint students with the study and design of FIR filters.						
CO3	To impart knowledge to students about study and design of IIR filters.						
CO4	To let student understand the concept and design of adaptive digital filters and power spectrum estimation.						

UNIT-1

Introduction of DSP: Introduction to Signal Processing, Discrete Linear Systems, superposition Principle, UNIT-Sample response, stability & causality Criterion.

Fourier Transform & inverse Fourier transform: Frequency domain design of digital filters, Fourier transform, use of Fourier transform in Signal processing. The inverse fourier transform, sampling continuous function to generate a sequence, Reconstruction of continuous -time signals from Discrete-time sequences.

UNIT-2

Digital Filter Structure & Implementation: Linearity, time invariance & causality, the discrete convolution, the transfer function, stability tests, steady state response, Amplitude & Phase Characteristics, stabilization procedure, Ideal LP Filter, Physical reliability & specifications. FIR Filters, Truncation windowing & Delays, design example, IIR Filters: Review of design of analog filters & analog frequency transformation. Digital frequency transformation. Design of LP filters using impulse invariance method, bilinear transformation, Phase equalizer, digital all pass filters.

UNIT-3

Implementation of Filters: Realization block diagrams, Cascade & parallel realization, effect of infinite-word length, transfer function of degree 1&2, Sensitivity comparisons, effects of finite precision arithmetic on Digital filters.

UNIT-4

DFT & FFT & Z transform with Applications: Discrete Fourier transform, properties of DFT, Circular Convolution, Fast Fourier Transform, Realizations of DFT. The Z-transform, the system function of a digital filter, Digital Filter implementation from the system function, the inverse Z- transform, properties & applications, Special computation of finite sequences, sequence of infinite length & continuous time signals, computation of Fourier series & time sequences from spectra.

Suggested Books:

1. J G Proakis, "Digital Signal Processing using Matlab", Pearson Education.
2. Alam V. Oppenheim and Ronald W. Schafer, "Digital Signal Processing" Pearson Education.
3. Rabiner & Gold, "Major Test& application of digital Signal Processing", Pearson Education
4. Roman kuc, "Introduction to Digital Signal Processing," Tata McGraw Hill Edition.
5. Richard G. Lyons, "Understanding Digital Signal Processing", Pearson Education.
6. Paulo S. R. Diniz, Eduardo A. B. da Silva, Sergio L. Netto, "Digital Signal Processing: System Analysis and Design", Springer.
7. Manolakis G Demitries, "Applied Digital Signal Processing", Cambridge Univ. Press.

MTEL-115	Bio-Medical Instrumentation						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time(Hrs)
3	0	0	3	60	40	100	3
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of different types of Biomedical Instruments with their controls.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	Understand the different types of biomedical transducer for signal measurement and recording.						
CO2	Understand basics of blood pressure, blood flow and respiratory system measurements.						
CO3	Understand the muscoskeletal and nervous system and their measurement.						
CO4	To emphasize and analysis of recent trends in biomedical Engg and safety measurement.						

Unit-1

Characteristics of Transducers and Electrodes for Biological Measurement: Introduction to human body, block diagram, classification, various physiological events and suitable transducer for their recording, bioelectric potentials.

Cardiac system: Cardiac musculature, Electro cardiography, ECG recording, phonocardiography, holter recording ECG lead system, Heart rate meter, vector cardiography, pacemakers,

Unit-2

Blood pressure and Blood flow measurement; Invasive and non-invasive methods of blood pressure, characteristics of blood flow and heart sound, Cardiac output measurement, Plethysmography.

Respiratory system: Mechanics or breathing, parameters of respiration, Respiratory system measurements, respiratory therapy instruments.

Unit-3

Muscoskeletal Systems; EMG, Clinical applications, Muscles stimulator, Instrumentation for measuring Nervous function; EEG signal, frequency band classification, Lead systems, EEG recording, Clinical applications of EEG signal, X-ray CT scan, MRI, PET.

Clinical Laboratory Instrumentation; Test on blood cell, Blood cell counter, Blood glucose monitors, auto analyzer, pulse-oximeter.

Unit-4

Recent Trends in Biomedical Engg. Patient care and monitoring, Non-invasive diagnostic instrumentation, biotelemetry, telemedicine, prosthetic devices, lie detector test, Application of lasers and ultrasonic in biomedical field.

Troubleshooting and Electrical safety of Biomedical instruments; Physiological effect of current and safety measurement.

Suggested Books:

1.W T Wester, J G Tompkins, "Design of Microprocessor based Medical Instrumentation", Englewood cliffs

2.Tatsuo, Togato & Toshiya, "Biomedical transducers and instruments", CRC Press

3. Joseph P Bronzino, "The Biomedical engineering handbook", CRC Press

MTEL-117	Instrumentation & Control Lab						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time(Hrs)
0	0	4	2	60	40	100	3
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of how to create, simulate and measure the different applications in VI.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about mathematical, Boolean operations, half adder.						
CO2	Understand how to create the VI for decimal to binary conversion, array function, sequence structure. Also studying the properties and options of graphs/charts.						
CO3	To impart knowledge about measurement of temperature, strain and power using VI.						
CO4	Understand to create model for speed control of DC motor, analysis of PID controller.						

Following experiments (at least 10) are required to be performed in MATLAB/ETAP/LabView or equivalent:

1. Find addition, subtraction, multiplication and division of two numeric inputs
2. Perform various Boolean operations (AND, OR, NAND, NOR, XOR).
3. Add two binary bits and find the sum and carry (half adder).
4. Create a Vito find the decimal equivalent of a binary number using sub VI.
5. Create VI for studying array functions.
6. Create VI for studying sequence structure.
7. Create VI for studying properties and options of graphs/charts.
8. Measurement of Temperature using Virtual instrumentation.
9. Measurement of Strain using Virtual instrumentation.
10. ImplementationofVI to control the speed of a DC motor.
11. RealTime Power measurement and analysis using Virtual instrumentation.
12. Creating Models, Simulation and Analysis of PID Controller.
13. Study and Implementation of Displacement Transducers.

MTEL-119	Advanced Power System Lab-I						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time(Hrs)
0	0	4	2	60	40	100	3
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of programing for various types of power system appliances.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about a program to develop Bus Admittance Matrix, power flow studies using Newton-Raphson and Gauss-Siedel method.						
CO2	Understand how to determine the generalized constants A, B, C, D of a long transmission line and voltage & current for three phase faults ona2-buspowersystem						
CO3	To impart knowledge about simulation and analysis of a single phase & three phase power system and generation, transmission & distribution in power system.						
CO4	To impart knowledge about simulation and analysis of different fault condition and contingency concept in a power system.						

Following experiments are required to be performed in MATLAB/ETAP/LabView or equivalent.

1. Write a program to develop Bus Admittance Matrix YBUS.
2. Write a program for the Power Flow Studies using N-R(Newton-Raphson) method.
3. Write a program for the power flow analysis of system using Gauss-Siedel Technique.
4. Determination of the generalized constants A, B, C, D of a long transmission line.
5. Determination of the voltage and current for three phase faults on a 2-bus power system.
6. Simulation and Analysis of a single phase & three phase power system.
7. Simulation & Analysis of generation, transmission & distribution in power system.
8. Simulation & Analysis of different fault condition in power system.
9. Simulation and Analysis of 9-bus power system.
10. Simulation and Analysis of contingency concept in a power system.

MTRM-111	Research Methodology and IPR						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
2	0	0	2	60	40	100	3 Hrs.
Program Objective (PO)	*To enable students to Research Methodology and IPR for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.*						
Course Outcomes (CO)							
CO1	Understand research problem formulation.						
CO2	Analyze research related information						
CO3	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.						
CO4	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.						

Unit 1

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit 2

Effective literature studies approaches, analysis, Plagiarism, Research ethics, Effective technical writing, how to write report, Paper.Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit 3

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 4

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

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'.
2. C.R. Kothari, "Research Methodology: Methods & Techniques, 2nd edition or above, New Age Publishers.
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2 nd Edition , "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.

MTEL-102	Advanced Power System Protection						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time(Hrs)
3	0	0	3	60	40	100	3
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of advanced protection system in modern power system.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about need of protection system and various issues of CT and PT						
CO2	To acquaint students with the comparators and relays.						
CO3	To impart knowledge to students about distance protection and protection of feeders, generators and motors.						
CO4	To let student understand protection of transformers, buses and modern protection system.						

Unit1

Introduction: Need for protective systems, Zones of protection, classification of protective relays, electromechanical, solid state and digital relays, comparisons between different types of relays.
Current transformers and potential transformers: construction, operating principle and their performance

Unit2

Comparators: general equation of comparators, Analysis for amplitude comparator, analysis for phase comparator, duality between amplitude and phase comparators.
Over current relays, differential relays, operating and restraining characteristics, distance relays, impedance relays, reactance relays, and mho relay quadrilateral relays, elliptical relays, comparison with conventional relays.

Unit3

Distance protection: Principle of distance relaying, time grading of distance relays, schemes of distance protection, distance protection by impedance, reactance and mho relays, Effect of power swings on the performance of distance relays.
Pilot relaying schemes: Pilot wire protection, carrier current protection.
Protection of Generators and Motors: Types of faults, Stator and rotor protection against various types of faults.

Unit4

Protection of Transformers: Types of faults, differential protection schemes, harmonic restraint relay, over flux protection, Earthing transformer protection.
Bus Zone Protection: Types of Bus-bar faults, differential current protection frame leakage protection.
Microprocessor based protective relays: Overcurrent relay, impedance relay, reactance relay, mho relay, microprocessor based distance relaying.
Application of artificial intelligence and wavelet transform in protective relays

Suggested Books:

1. TSM Rao, "Power System Protection--Static Relays", Tata McGraw Hill Education Pvt. Ltd.
2. B. Bhalja, R P Maheshwari and N G Chothani, "Protection and Switchgear", Oxford University Press.
3. Ravinder Nath & Chander, "Power System Protection and Switchgear', New Age International Publishers.
4. Badri Ram & Vishwakarma, "Power system protection and switch gear" McGraw Hill Education(India)
5. C L Wadhwa, "Electrical Power Systems", New Age International Publishers.
6. Protective Relays --Their Major Test and Practice Vol. I & II by W. Van Warrington.
7. Advanced power system analysis and dynamics by L P Singh: Wiley Eastern N. Delhi.
8. Digital Protection: Protective relay from Electro Mechanical to Microprocessor, L P Singh: Wiley Eastern.
9. Switchgear and protection by S S Rao: Khanna Pub

MTEL-104	Intelligent Control						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time(Hrs)
3	0	0	3	60	40	100	3 Hrs.
Program Objective (PO)	This course will look at different types of intelligent controls.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	Understand reasoning and apply the ANN models to different problems.						
CO2	Understand reasoning and apply the learning scheme to different problems.						
CO3	Understand reasoning and apply the Fuzzy system to different problems.						
CO4	Understand reasoning and apply the Genetic & PSO algorithm to different problems.						

Unit-1

ANN Models & Architecture:

Biological foundations, ANN models, Types of activation function, Introduction to network architecture, multilayer feed forward network (MLFFN), Kohonen self-organizing map, radial basis Function network (RBFN), recurring neural network.

Unit-2

Learning Processes:

Supervised and unsupervised learning, error-correction learning, Hebbian learning, Boltzman learning, single layer and multilayer perception model, least mean square algorithm, back propagation algorithm, Application in forecasting and pattern recognition and other engineering problems.

Unit-3

Fuzzy Control System:

Fuzzy sets, fuzzy set operations, properties, membership functions, fuzzy to crisp conversion, measures of fuzziness, fuzzification and defuzzification methods, application in engineering problems. Simple fuzzy logic controllers with examples, special forms of fuzzy logic models, classical fuzzy control problems.

Unit-4

Genetic & PSO Algorithm:

Genetic Algorithm: Types of reproduction operators, crossover & mutation Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP, Simulated Annealing Algorithm, Particle Swarm Optimization (PSO) - Graph Grammer Approach - Example Problems

Suggested Books:

1. M. T. Hagon, Howard B. Demuth and Mark Beale, "Neural Network Design", PWS Publishing.

2. Jacek M Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, Bombay.

3. Wasserman, "Neural Computing: Major Test and Practice", Van Nastr and Reinhold.

4. Freeman "Neural Networks-Algorithms, application and programming techniques", Pearson Education.

MTEL-106	HVDC Transmission & FACTS Devices						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time(Hrs)
3	0	0	3	60	40	100	3
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of HVDC and FACTS devices.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about HVDC transmission system.						
CO2	To acquaint students with the interaction of AC and DC system and various links.						
CO3	To impart knowledge to students about facts devices.						
CO4	To let student understand compensation system and control techniques.						

Unit 1

HVDC Transmission: Development of HVDC Technology, Selection of converter configuration. Rectifier and Inverter operation. Control of HVDC converters and Systems.

Harmonics in HVDC Systems, Harmonic elimination, AC and DC filters.

Unit 2

Interaction between HVAC and DC systems – Voltage interaction, over voltages on AC/DC side, Harmonic instability problems and DC power modulation.

Multi-terminal DC links and systems; series, parallel and series parallel systems, their operation and control.

Unit 3

Introduction of Facts Concepts: Basic of flexible alternating current transmission system (FACTS) controllers, shunt, series, combined and other controllers, HVDC or FACTS, static VAR compensator (SVC) and static synchronous compensator (STATCOM), Static Synchronous Series Compensator (SSSC), Thyristor Controlled Series, Capacitor (TCSC). Solid State Contactors (SSC) and TSSC.

Unit 4

Combined Compensators: Introduction, Unified power flow controller (UPFC), conventional power control capabilities, real and reactive power flow control, comparison of UPFC to series compensators, control structure, dynamic performance. Interline power flow controller (IPFC) basic operating principles, control structure, application considerations.

Suggested Books:

1. Hingorani N.G, "Understanding FACTS (Concepts and Technology of Flexible AC Transmission System)", Standard Publishers.
2. Song Y.H. and Johns A.T., "Flexible AC Transmission Systems", IEEE Press.
3. Ghosh A. and Ledwich G., "Power Quality Enhancement using Custom Power Devices", Kluwer Academic Publishers.
4. Mathur R.M. and Verma R.K., "Thyristor based FACTS controllers for Electrical Transmission Systems", IEEE Press.
5. Bollen M.H.J., "Understanding Power Quality and Voltage Sag", IEEE Press.
6. Padiyar K.R., "FACTS Controllers in Power Transmission and Distribution", New Age International Publisher.
7. Miller T.J.E., "Reactive Power Control in Electric Systems", John Wiley.
8. Kamakshaiah S, Kamaraju V, "HVDC Transmission", McGraw Hill Education.

MTEL-108	Transients in Power System						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of transients in power system.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about different types of factors effecting power quality.						
CO2	To acquaint students with the transients and lightning.						
CO3	To impart knowledge to harmonics.						
CO4	To let student understand about distributed generation and various issues related to power quality.						

UNIT-1

What is Power Quality, Power Quality is Equal to Voltage Quality, Why are we concerned about Power Quality, Voltage Imbalance, Waveform Distortion, Voltage Fluctuation, Power Frequency Variations, Power Quality Terms, Sources of Sags and Interruption, Estimating Voltage Sag Performance, Area of Vulnerability, Equipment Sensitivity of Voltage Sags, Transmission Systems Sag Performance Evaluation, Utility Distribution System Sag Performance Evaluation.

UNIT-2

Sources of Transient Overvoltage's: Capacitor Switching, Restrike during Capacitor Deenergizing, Lightning, Ferro - resonance, Other Switching Transients. Principles of Overvoltage Protection.

Devices for Overvoltage Protection: Surge Arresters and Transient Voltage Surge Suppressor, Isolation Transformers, Utility System Lightning Protection, Shielding, Line Arresters, Low Side Surges, Cable Protection, Scout Arrester Scheme, Computer Tools for Transient Analysis.

UNIT-3

Fundamentals of Harmonics: Harmonic Distortion, Voltage vs Current Distortion, Harmonics vs Transients, Power System Quantities Under Non Sinusoidal Conditions, Active, Reactive and Apparent Power, Power Factor: Displacement and True, Harmonic Phase Sequences, Triplen Harmonics.

Harmonic Sources from Commercial Loads: Single Phase Power Supplies, Fluorescent Lighting, Adjustable Speed Drives for HVAC and Elevators.

Effects of Harmonic Distortion: Impact on Capacitors, Impact on Transformers, Impact on Motors, Impact on Telecommunications, Impact on Energy and Demand Metering.

UNIT-4

Distributed Generation and Power Quality: Resurgence of DG, Perspectives on DG Benefits, Perspectives on Interconnection, DG Technologies, Fuel Cells, Wind Turbines, Photovoltaic Systems, Interface to the Utility System, Synchronous Machines, Asynchronous Machines, Electronic Power Inverters, Power Quality Issues, Voltage Regulation, Harmonics, Voltage Sags, Operating Conflicts, Voltage Regulation Issues, Islanding, Transformer Connections.

Suggested Books:

1. R C Dugan, M F McGranaghan, S Santoso, H. Wayne Beaty, "Electrical Power System Quality", McGraw Hill.
2. Akihiro Ametani, Naoto Nagaoka, Yoshihiro Baba, Teruo Ohno, "Power System Transients: Theory and Applications", CRC Press.
3. L.V. Bewley, "Traveling waves in Transmission Systems", Dover.
4. R. Rudenberg, "Electric Stroke waves in Power Systems", Harvard University Press, Cambridge, Massachusetts.
5. Allan Greenwood, "Electric Transients in Power Systems", Wiley Interscience.
6. CS Indulkar and DP Kothari, "Power System Transients, Statistical Approach", PHI Pvt Ltd., New Delhi.
7. VA Venikov, "Transient phenomena in Electrical Power Systems", Pergamon Press, London.
8. Klaus Ragaller, "Surges in High Voltage Networks", Plenum Press, New York.
9. Pritindra Chowdhari, "Electromagnetic transients in Power System", John Wiley and Sons Inc.
10. Naidu M S and Kamaraju V, "High Voltage Engineering", TMH Publishing Company Ltd., New Delhi.

MTEL-110	Advanced Power Distribution & Automation						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time(Hrs)
3	0	0	3	60	40	100	3 Hrs.
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of electricity distribution and automation.						
Course Outcomes (CO)							
After completion of course students will be abie to							
CO1	To impart knowledge about distribuiion automation.						
CO2	To acquaint students with the control and intelligent system in distribution automation.						
CO3	To impart knowledge to students about renewable energy resources and distribution management.						
CO4	To let student understand communication system implementation in distribution system.						

UNIT-1

Introduction: General Concept, Distribution of Power, Power Loads, Connected Loads.
Load Forecasting: Concept of Statistics, Regression Analysis, Correlation Theory, Factor in Power System Loading, Unloading the System, Forecast of System peak.

UNIT-2

System Planning: Planning Process, Basic Principle in system planning, System Development, Overview of Distributed generation, Different types of mapping: Global positioning System GPS, Automated mapping AM/Facility Management FM.
Introductory Methods in Power System Planning: Per Unit Calculation, Matrix Algebra, Symmetrical Components, Overview of Load Flow, Automated Planning: software needs, Data, solution techniques (Gauss Iterative method, Gauss seidel iterative method, Newton Raphson iterative method, Improved newton Raphson method) Effect of Abnormal Loads.

UNIT-3

Brief introduction of Distribution Automation, Role of PLC & SCADA in substation and distribution automation, Consumer information Service (CIS), Geographical information system GIS, Automatic meter Reading (AMR), Automation System.

UNIT-4

Metering System: Different types of Meter, Metering system component, Ferraris Meters, Solid state meters, Advance meter Infrastructure Systems (AMI).
Overview of Net metering, Meter current Rating, Prepaid Electricity meters, Meter selection and Location, testing methods.

Suggested Books:

1. A. S Pabla, "Electric Power Distribution", McGraw Hill Education.
2. James A. Momoh, "Electric Power Distribution Automation Protection and Control", CRC Press.
3. James N-Green and R Wilson, "Control and Automation of electric Power Distribution Systems", CRC Press.
4. Turan Gonen,"Electric Power Distribution System Engineering", CRC Press.
5. Abdelhay A. Sallam, "Electric Distribution Systems",Wiley-IEEEPress.

MTEL-112	Digital Control System						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	0	0	3	60	40	100	3 Hrs.
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of digital control system.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about signal processing in digital control system.						
CO2	To acquaint students with the control devices and systems.						
CO3	To impart knowledge to students about state variables, controllability and observability.						
CO4	To let student understand the various concepts of digital observers.						

Unit-1

Signal Processing in Digital Control: Basic digital control scheme, principle of signal conversion, basic discrete-time signal, time-domain model for discrete-time systems, z-transform, transfer function models, jury stability criterion, sample and hold systems, sample spectra and aliasing

Unit-2

Models of Digital Control Devices and Systems: Introduction, z-domain description of sampled continuous-time plants, z-domain description of systems with dead-time, implementation of digital controllers, digital PID controllers, digital temperature control system, stepping motors and their control, PLC

Unit-3.

Analysis using State Variable Methods: State variable representation-concepts, modeling, transformation, state diagrams, Jordan canonical form, Eigen values and Eigenvectors,

Solution of state equations, concepts of controllability and Observability.

Unit-4

Digital Observers: State regulator design-full order and reduced order state observer, design of state observers, compensator design by separation principle, state feedback with integral control , deadbeat control by state feedback and deadbeat observers

Suggested Books:

1. Ogata K," Discrete time Control Systems", Pearson Education.

2. Nagrath and Gopal, "Control System Engineering", New Age International.

3. Kuo B C, "Digital Control Systems", Oxford University Press.

4. Goapl, "Digital Control & State Variable Method", McGraw Hill Education.

MTEL-114	Advanced Microprocessors						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	0	0	3	60	40	100	3 Hrs.
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of advanced microprocessor.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about 8086 microprocessors.						
CO2	To acquaint students with the interfacing converters etc.						
CO3	To impart knowledge to students about microcontrollers.						
CO4	To let student about application of microprocessor and various controllers related to it.						

UNIT-1

Architecture of 8086 microprocessor, Memory Addressing, Bus Timings for MN/MX mode, interrupt structure. Memory Interfacing and Addressed encoding techniques for 8086 microprocessor

UNIT-2

Addressing modes, Instruction set and application programs, Assembler Directives, Programming Techniques using TASM, Interfacing D/A and A/D converters using programmable I/O devices, Interfacing Stepper motor. Architecture of INTEL X86 Family: CPU block diagrams, Pin diagrams and internal descriptions of 80286, 386, 486 and Pentium Processor, Instruction formats.

UNIT-3

Introduction to micro controllers, Architecture of 8051microcontroller, basic Instruction set, programming, serial data communication, inter facing with D/A and A/D converters.

UNIT-4

Application of Microprocessors, A Microcomputer-based Industrial Process-control System, Hardware for Control Systems and Temperature Controller, Overview of Smart-Scale Operation.

Suggested Books:

1. Hall D V, "Microprocessors & Interfacing", McGraw Hill Education.
2. Brey B, "The Intel Processors", Pearson Education.
3.Gibson, "Microprocessors",, Prentice Hall of India.
4. Jean Loup Baer, "Microprocessor Architecture", Cambridge University Press.
5. Ayala K J, "Micro Controller", Penram International

MTEL-116	Reliability Engineering						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	0	0	3	60	40	100	3 Hrs.
Program Objective (PO)	The main objective of the course is to impart the students with the concept of Reliability Engineering and its application in Engineering.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To emphasize and analysis of basic of reliability engineering.						
CO2	To understand the concept of Fault tree analysis in reliability.						
CO3	To understand the concept of Maintainability Analysis in reliability.						
CO4	To study the concept of Artificial Intelligence in reliability engineering.						

Unit-1

Review of basic concepts in Reliability Engg., Reliability function, different reliability models, etc. Reliability evaluation techniques for complex systems; Tie set and cut set approaches, different reliability measures, Reliability allocation/apportionment, reliability improvement, redundancy optimization techniques.

Unit-2

Fault tree analysis: fault tree construction, simplification and evaluation, importance measures, modularization, applications, advantages and disadvantages of fault tree techniques.

Unit-3

Maintainability Analysis: measures of system performance, types of maintenance, reliability centred maintenance, reliability and availability, evaluation of engine ring systems using Markov models.

Unit-4

Applications of fuzzy Major Test and neural networks to Reliability Engineering. Reliability testing, design for reliability and maintainability. Typical reliability case studies.

Suggested Books:

1. R. Rama Kumar, "Engineering Reliability", Prentice Hall.
2. K B Mishra, "Reliability Analysis & Prediction".
3. K B Mishra, "New trends in System Reliability Evaluation".
4. M L Shooman, "Probabilistic reliability–an engineering approach", R E Krieger Pub.
5. K K Aggarwal, "Reliability Engineering".
6. Roy & Billington, "Reliability Engineering".
7. Balagurswami, "Reliability Engineering", McGraw Hill Education.

MTEL-118	Modeling & Simulation Lab						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time(Hrs)
0	0	4	2	60	40	100	3
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of modelling and simulation of different types of applications.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about to preform Thevenin's ,Norton's,& Superposition theorem and Avg. & R. M. S. value of R L C different R, L and C circuit.						
CO2	To impart knowledge about to preform half and full wave rectifier with different R, L and C load for both single and three phase.						
CO3	To impart knowledge about to preform different types of power electronics component mainly inverter and chopper.						
CO4	To impart knowledge about to preform speed and torque control of DC and AC motors.						

Following experiments (at least 10) are required to be performed in MATLAB/ETAP/LabView or equivalent.

1. To verify Thevenin's, Norton's & Superposition theorem.
2. To find Average & RMS value of (V-I) of RLC series & parallel; series parallel RC-RL circuit.
3. To perform1-ϕ (half & full) wave rectifier with (R, R-L & R-C) load.
4. To perform 3-ϕ (half & full) wave rectifier with (R, R-L & R-C) load.
5. To find Average RMS.&T.H.D. of 1-ϕ (half & full) wave inverter with (R & R-L) load.
6. To find Avg., R.M.S.&T.H.D. of 3-ϕ (half & full) wave inverter with (R & R-L) load.
7. To perform current source inverter (C.S.I.) & PWM inverter.
8. To perform step down (BUCK)& step up (BOOST) chopper.
9. To perform Type (A, B, C & D) chopper.
10. To perform Field & Armature control of separately excited DC motor.
11. To perform Field & Armature control of DC series & DC shunt motor.
12. To perform 3-ϕ Induction Motor with constant & variable torque.
13. To perform speed control of 3-ϕ Synchronous motor with constant & variable torque.

MTEL-120	Advanced Power System Lab-II						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
0	0	4	2	60	40	100	3
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of programing for various types of power system appliances.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge the simulation& analysis of the generator and transformer protection.						
CO2	To impart knowledge the simulation& analysis of power quality improvement, different types of load.						
CO3	To impart knowledge the simulation& analysis of PV cell.						
CO4	To impart knowledge the simulation& analysis of different non-conventional plant biomass gasifier and wind turbine.						

Following experiments are required to be performed in MATLAB/ETAP/LabView or equivalent.

1. Simulation & Analysis of the generator protection.
2. Simulation & Analysis of the transformer protection.
3. Simulation & Analysis of power quality improvement.
4. Simulation & Analysis of different types of relays in power system.
5. To perform the simulation of Photo-Electric Effect.
6. To perform the simulation to construct the PV cell to show the V-I & P-V characteristics curve of it.
7. ToperformthesimulationofPhotovoltaicpowerconversionforsingleand3-phase load on account with MPPT.
8. To perform the construction of a Simulink model of Biomass Gasifier.
9. To study mathematical modelling of DFIG based Wind Turbine and its impact on connection with grid.
10. To perform the simulation of Permanent Magnet Synchronous Generator (PMSG) based wind energy conversion system.
11. To perform the simulation of PV-Grid inter connection using MPPT technique with the partial shading effect.

MTEL-201	DISTRIBUTED GENERATION						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time(Hrs)
3	0	0	3	60	40	100	3
Program Objective (PO)	To understand renewable energy sources. To gain understanding of the working of off-grid and grid-connected renewable energy generation schemes.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To understand the planning and operational issues related to Distributed Generation.						
CO2	Acquire Knowledge about Distributed Generation Learn Micro-Grids						
CO3	understand renewable energy sources						
CO4	Understanding of the working of off-grid and grid-connected renewable energy generation schemes.						

UNIT-1

Need for Distributed generation. Renewable sources in distributed generation and current scenario in Distributed Generation. Introduction to micro-grids. Types of micro-grids: autonomous and non-autonomous grids Sizing of micro-grids. Modelling & analysis of Micro-grids with multiple DGs. Micro-grids with power electronic interfacing units.

UNIT-2

Planning of DGs. Sitting and sizing of DGs optimal placement of DG sources in distribution systems. Grid integration of DGs Different types of interfaces, Inverter based DGs and rotating machine based interfaces. Aggregation of multiple DG units.

UNIT-3

Technical impacts of DGs. Transmission systems Distribution Systems De-Regulation Impact of DGs upon protective relaying. Impact of DGs upon transient and dynamic stability of existing distribution systems, Steady-state and Dynamic analysis...

UNIT-4

Economic and control aspects of DGs Market facts Issues and challenges Limitations of DGs, Voltage control techniques. Reactive power control, Harmonics Power quality issues, Reliability of DG based systems.

Suggested reading:

1. H. Lee Willis, Walter G. Scott, "Distributed Power Generation – Planning and Evaluation", Marcel Decker Press.

2. M Godoy Simoes, Felix A. Farret, "Renewable Energy Systems – Design and Analysis with Induction Generators", CRC press.

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

MTEL-203	ADVANCED ELECTRIC DRIVES & CONTROL						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time(Hrs)
3	0	0	3	60	40	100	3
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of electric drives & control in electric system.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To study basic electric drives, types of loads, classes of motor duty.						
CO2	To study different types of DC drives, stability analysis, modern control techniques.						
CO3	To study mathematical modelling of induction motor drives, introduction to Cyclo-converter fed induction motor drive.						
CO4	To study different types of synchronous motor drives used in mills.						

UNIT 1

Introduction: Definition, Part of the electric drive, Types of loads, steady state & transient stability of Drive, state of art of power electronics and drives, thermal model of motor for heating and cooling, classes of motor duty, determination of motor rating.

UNIT 2

D.C. Drives: Review of braking and speed control of D.C. motors, multi-quadrant operation, loss minimization in adjustable speed drives. Mathematical modelling of dc drives, stability analysis, modern control techniques: variable structure, adaptive control, Chopper-Controlled DC Drives.

UNIT 3

Induction motor drives: Review of braking and speed control of induction motors, constant V/F, constant air gap flux, controlled voltage, controlled current and controlled slip operation. Mathematical modelling of induction motor drives, transient response and stability analysis Introduction to Cyclo-converter fed induction motor drive. Pulse Width Modulation for Electric Power Converters

UNIT 4

Synchronous motor drives: Adjustable frequency operation, voltage fed drive, current fed self-controlled drive. Application of electric drives in steel mills, paper mills, textile mills and machine tools etc. A. C. motor drives in transportation system and traction.

References:

1. Dubey G K, "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi.
2. S K Pillai, "A First Course on Electrical Drives", New Age International (P) Ltd., New Delhi.
3. Krishan R, "Electric Motor Drives: Modeling Analysis and Control", PHI Pvt Ltd. New Delhi-2001.
4. Bose B K, "Power Electronics and Variable Frequency Drives: Technology and Applications", IEEE Press, 1997.
5. Bose B K , "Modern Power Electronics and AC Drives", Pearson Educational, Delhi,

MTEL-205	Power System Restructuring & Deregulation						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time(Hrs)
3	0	0	3	60	40	100	3 Hrs.
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of restructuring and deregulation.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about restructuring and its various issues related to it.						
CO2	To acquaint students with the deregulation and market models.						
CO3	To impart knowledge to students about transmission pricing.						
CO4	To let student understand in detail about congestion management and experiences of various nations.						

Unit-1

Introduction: Basic concept and definitions, privatization, restructuring, transmission open access, wheeling, deregulation, components of deregulated system, advantages of competitive system.
Power System Restructuring: An overview of the restructured power system, Difference between integrated power system and restructured power system, Explanation with suitable practical examples.

Unit-2

Deregulation of Power Sector: Separation of owner ship and operation, Deregulated models, pool model, pool and bilateral trades model, multilateral trade model.
Competitive electricity market: Independent System Operator activities in pool market, Wholesale electricity market characteristics, central auction, single auction power pool, double auction power pool, market clearing and pricing, Market Power and its Mitigation Techniques, Bilateral trading, Ancillary services.

Unit-3

Transmission Pricing: Marginal pricing of Electricity, nodal pricing, zonal pricing, embedded cost, Postage stamp method, Contract Path method, Boundary flow method MW-mile method, MVA-mile method, Comparison of different methods.

Unit-4

Congestion Management: Congestion management in normal operation, explanation with suitable example, total transfer capability (TTC), Available transfer capability (ATC), Different Experiences in deregulation: England and Wales, Norway, China, California, New Zealand and Indian power system.

Suggested Books:

1.LoiLei Lai, "Power System Restructuring and Deregulation", John Wiley & Sons Ltd.
2.K Bhattacharya, M H J Bollen and J C Doolder, " Operation of Restructured Power Systems", Kluwer Academic Publishers.
3.Lonn Philipson and H Lee Willis, "Understanding Electric Utilities and Deregulation", Marcel Dekker Inc, New York.
4.Yong-Hua Song, Xi-Fan Wang, "Operation of market-oriented power systems" ,Springer, Germany.

MTOE-201	Business Analytics						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	0	0	3	60	40	100	3 Hrs.
Program Objective (PO)	The main objective of this course is to give the student a comprehensive understanding of business analytics methods.						
Course Outcomes (CO)							
CO1	*Able to have knowledge of various business analysis techniques.*						
CO2	*Learn the requirement specification and transforming the requirement into different models.*						
CO3	*Learn the requirement representation and managing requirement assests.*						
CO4	*Learn the Recent Trends in Embedded and collaborative business*						

Unit 1

Business Analysis: Overview of Business Analysis, Overview of Requirements. Role of the Business Analyst.

Stakeholders: the project team, management, and the front line, Handling, Stakeholder Conflicts.

Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

Unit 2

Forming Requirements: Overview of Requirements Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.

Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

Unit 3

Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements.

Managing Requirements Assets: Change Control, Requirements Tools

Unit 4

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

References:

1. Business Analysis by James Cadle et al.
2. Project Management: The Managerial Process by Erik Larson and, Clifford Gray

MTOE-203	Industrial Safety						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3 Hrs.
Program Objective (PO)	*To enable students to aware about the industrial safety.*						
Course Outcomes (CO)							
CO1	*Understand the industrial safety.*						
CO2	*Analyze fundamental of maintenance engineering.*						
CO3	*Understand the wear and corrosion and fault tracing.*						
CO4	*Understanding that when to do periodic inceptions and apply the preventing maintenance.*						

Unit-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, washrooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

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

Unit-2

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

Unit-3

Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-4

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

Reference:

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.

MTOE-205	Operations Research						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	0	0	3	60	40	100	3 Hrs.
Program Objective (PO)	To enable students to aware about the dynamic programming to solve problems of discreet and continuous variables and model the real world problem and simulate it.						
Course Outcomes (CO)							
CO1	*Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.*						
CO2	*Students should able to apply the concept of non-linear programming*						
CO3	*Students should able to carry out sensitivity analysis*						
CO4	*Student should able to model the real world problem and simulate it.*						

Unit -1

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

Unit -2

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

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

Unit- 3

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

Unit -4

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

References:

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

MTOE-207	Cost Management of Engineering Projects						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	0	0	3	60	40	100	3 Hrs.
Program Objective (PO)	*To enable students to make aware about the cost management for the engineering project and apply cost models the real world projects.*						
Course Outcomes (CO)							
CO1	*Students should able to learn the strategic cost management process.*						
CO2	*Students should able to types of project and project team types*						
CO3	*Students should able to carry out Cost Behavior and Profit Planning analysis.*						
CO4	*Student should able to learn the quantitative techniques for cost management.*						

Unit-1

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit-2

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Unit-3

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit-4

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

References:

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. Atkinson, 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.

MTOE-209	Composite Materials						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3 Hrs.
Program Objective (PO)	*To enable students to aware about the composite materials and their properties.*						
Course Outcomes (CO)							
CO1	*Students should able to learn the Classification and characteristics of Composite materials.*						
CO2	*Students should able reinforcements Composite materials.*						
CO3	*Students should able to carry out the preparation of compounds.*						
CO4	*Student should able to do the analysis of the composite materials.*						

UNIT–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.

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. Iso-strain and Iso-stress conditions.

UNIT – 2

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–3

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

UNIT – 4

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

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.
3. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

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.

MTOE-211	Waste to Energy						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3 Hrs.
Program Objective (PO)	*To enable students to aware about the generation of energy from the waste.*						
Course Outcomes (CO)							
CO1	*Students should able to learn the Classification of waste as a fuel.*						
CO2	*Students should able to learn the Manufacture of charcoal.*						
CO3	*Students should able to carry out the designing of gasifiers and biomass stoves.*						
CO4	*Student should able to learn the Biogas plant technology.*						

Unit-1

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

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

Unit-2

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit-3

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

Unit-4

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References:

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.

MTAD-101	English For Research Paper Writing						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
2	0	0	0	-	100	100	3 Hrs.
Program Objective (PO)	*Student will able to understand the basic rules of research paper writing.*						
Course Outcomes (CO)							
CO1	*Understand that how to improve your writing skills and level of readability*						
CO2	*Learn about what to write in each section*						
CO3	*Understand the skills needed when writing a Title*						
CO4	*Ensure the good quality of paper at very first-time submission*						

Unit 1

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

Unit 2

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

Unit 3

Review of the Literature Methods, Results. Discussion, Conclusions, the Final Check. key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

Unit 4

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

References:

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'sbook.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

MTAD-103	Disaster Management						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
2	0	0	0	-	100	100	3 Hrs.
Program Objective (PO)	*Develop an understanding of disaster risk reduction and management*						
Course Outcomes (CO)							
CO1	*Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.*						
CO2	*Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.*						
CO3	*Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.*						
CO4	*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*						

Unit 1

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

Unit 2

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills. Outbreaks Of Disease And Epidemics, War And Conflicts.

Unit 3

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 Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Unit 4

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. Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation in India.

References:

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

MTAD-105	Sanskrit for Technical Knowledge						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
2	0	0	0	-	100	100	3 Hrs.
Program Objective (PO)	*Students will be able to Understanding basic Sanskrit language and Ancient Sanskrit literature about science & technology can be understood and Being a logical language will help to develop logic in students*						
Course Outcomes (CO)							
CO1	*To get a working knowledge in illustrious Sanskrit, the scientific language in the world*						
CO2	*Learning of Sanskrit to improve brain functioning*						
CO3	*Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power*						
CO4	*The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature*						

Unit –1

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences.

Unit – 2

Order, Introduction of roots,Technical information about Sanskrit Literature

Unit –3

Technical concepts of Engineering: Electrical, Mechanical

Unit –4

Technical concepts of Engineering: Architecture, Mathematics

References

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

MTAD-107	Value Education						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
2	0	0	0	-	100	100	3 Hrs.
Program Objective (PO)	*Understand value of education and self- development, Imbibe good values in students and Let the should know about the importance of character*						
Course Outcomes (CO)							
CO1	*Knowledge of self-development*						
CO2	*Learn the importance of Human values*						
CO3	*Developing the overall personality*						
CO4	*Know about the importance of character*						

Unit 1

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements.

Unit 2

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity Power of faith, National Unity. Patriotism.Love for nature,Discipline

Unit 3

Personality and Behavior Development - Soul and Scientific attitude. 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

Unit 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

References

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

MTAD-102	Constitution of India						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
2	0	0	0	-	100	100	3 Hrs.
Program Objective (PO)	*Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective and 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.*						
Course Outcomes (CO)							
CO1	*Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.*						
CO2	*Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.*						
CO3	*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.*						
CO4	*Discuss the passage of the Hindu Code Bill of 1956.*						

Unit I

History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working) Philosophy of the Indian Constitution: Preamble Salient Features

Unit 2

Contours of Constitutional Rights & Duties: Fundamental Rights , Right to Equality , Right to Freedom , Right against Exploitation , Right to Freedom of Religion, Cultural and Educational Rights , Right to Constitutional Remedies , Directive Principles of State Policy , Fundamental Duties.

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive , President, Governor , Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications. Powers and Functions

Unit 3

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Panchayati raj: Introduction, PRI: ZilaPanchayat, Elected officials and their roles, CEO ZilaPanchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Unit 4

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.

References

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.

MTAD-104	Pedagogy Studies						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
2	0	0	0	-	100	100	3 Hrs.
Program Objective (PO)	*Review existing evidence on the review topic to inform programme design and policy making undertaken by the DFID, other agencies and researchers and Identify critical evidence gaps to guide the development.*						
Course Outcomes (CO)							
CO1	*What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?*						
CO2	*What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?*						
CO3	*How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?*						
CO4	*What is the importance of identifying research gaps?*						

Unit 1

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology , Theories of learning, Curriculum, Teacher education., Conceptual framework, Research questions. Overview of methodology and Searching. Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. , Curriculum, Teacher education.

Unit 2

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

Unit 3

Professional development: alignment with classroom practices and follow-up support, Peer support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes,

Unit 4

Research gaps and future directions: Research design, Contexts , Pedagogy, Teacher education Curriculum and assessment, Dissemination and research impact.

References

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.

MTAD-106	Stress Management by Yoga						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	0	0	0	-	100	100	3 Hrs.
Program Objective (PO)	To achieve overall health of body and mind and to overcome stress						
Course Outcomes (CO)							
CO1	*Develop healthy mind in a healthy body thus improving social health.*						
CO2	*Improve efficiency*						
CO3	*Learn the Yog asan*						
CO4	*Learn the pranayama*						

Unit – 1

Definitions of Eight parts of yog (Ashtanga).

Unit- 2

Yam and Niyam, Do`s and Don't's in life; Ahinsa, satya, astheya, bramhacharya and aparigraha; Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

Unit- 3

Asan and Pranayam, Various yog poses and their benefits for mind & body,

Unit- 4

Regularization of breathing techniques and its effects-Types of pranayam.

References

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

MTAD-108	Personality Development through Life Enlightenment Skills						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
2	0	0	0	-	100	100	3 Hrs.
Program Objective (PO)	To learn to achieve the highest goal happily To become a person with stable mind, pleasing personality and determination To awaken wisdom in students						
Course Outcomes (CO)							
CO1	*Students become aware about leadership.*						
CO2	*Students will learn how to perform his/her duties in day to day work.*						
CO3	*Understand the team building and conflict*						
CO4	*Student will learn how to become role model for the society.*						

Unit - 1

Neetisatakam-Holistic development of personality: Verses: 19, 20, 21, 22 (wisdom); Verses: 29, 31, 32 (pride & heroism); Verses: 26, 28, 63, 65 (virtue); Verses: 52, 53, 59 (don'ts); Verses: 71, 73, 75, 78 (do's).

Unit - 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.

Unit - 3

Statements of basic knowledge; Shrimad Bhagwad Geeta: Chapter-2: Verses: 56, 62, 68; Chapter-12: Verses: 13, 14, 15, 16, 17, 18.

Unit - 4

Personality of Role model; Shrimad Bhagwad Geeta: Chapter-2: Verses: 17; Chapter-3: Verses: 36, 37, 42: Chapter-4: Verses: 18, 38, 39; Chapter-18: Verses: 37, 38, 63.

References:

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

Dissertation Part – I and Dissertation Part - II

	Dissertation Part-I (MTEL-207) and Dissertation Part-II (MTEL-202)
	Course Outcomes (CO)
CO1	Ability to synthesize knowledge and skills previously gained and applied to an in depth study and execution of new technical problem.
CO2	Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
CO3	Ability to present the findings of their technical solution in a written report.
CO4	Presenting the work in International/ National conference or reputed journals.

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following:

Relevance to social needs of society
Relevance to value addition to existing facilities in the institute
Relevance to industry need
Problems of national importance
Research and development in various domain

The student should complete the following:

Literature survey Problem Definition
Motivation for study and Objectives
Preliminary design / feasibility / modular approaches
Implementation and Verification
Report and presentation

The dissertation part- II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

Experimental verification / Proof of concept
The viva-voce examination will be based on the above report and work.

Guidelines for Dissertation Part – I and Dissertation Part - II

As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two parts i.e. Part– I: July to December and Part- II: January to June.

The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.

After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives.

The referred literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing Engineering and any other related domain. In case of Industry sponsored projects, the relevant application notes, white papers, product catalogues should be referred and reported.

Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.

Part–I deliverables: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper, proof of concept/functionality, part results, and record of continuous progress.

Part–I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend repeating the Part-I work.

During Part– II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.

Part–II deliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software, and record of continuous progress.

Part-II evaluation: Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the Part-I work.