Faculty of Engineering & Technology

Syllabus

For

Master of Technology (M. Tech.)

Electrical Engineering

(Program Code: ET0151EE)

(2019-20)

(Approved by the Academic Council vide Resolution No. 34.26 dated 20.06.2019)

INDEX

1. Program Educational Objectives (PEOs):

1. To provide students with a foundation in engineering areas required to formulate, solve and analyse engineering problems. **(Fundamental Knowledge)**
2. To analyse real life problems; apply the knowledge gained from modern design methodologies to address issues in a manner i.e., technically sound, economically feasible and socially acceptable. **(Professional Skill & Society).**
3. To inculcate ethical attitude, effective communication skills, teamwork in their profession and adapt to current trends by engaging in lifelong learning needed for a successful professional career. **(Ethics & Lifelong Learning)**

2. Post Graduate Attributes (PGAs)

The post graduate attributes in M. Tech. are the summation of the expected course learning outcomes mentioned in the end of each course. Some of them are stated below:

PGA1: **Discipline-specific Knowledge:** Capability of demonstrating comprehensive knowledge of MCA program and understanding of core branch so that it forms a foundation for a Post Graduate program of study.

PGA2: Research-related skills: To develop a sense of inquiry and capability for asking relevant and intelligent questions, problem identification, synthesizing and articulating; ability to recognize and establish cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyze, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation.

PGA3: **Critical Thinking & Analytical Reasoning:** Ability to employ critical thinking in understanding the concepts relevant to the various branches of technical courses. Analytical reasoning refers to the ability to look at information, be it qualitative or quantitative in nature, and discern patterns within the information.

PGA4: **Problem Solving:** Capability to solve problems by using research-based knowledge and research methods including innovative thinking, design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PGA5: **Usage of Modern Tools (Information/digital literacy)& Self-directed learning:** To create, select, and apply appropriate techniques, resources, and modern science and IT tools including prediction and modeling to complex science activities with an understanding of the limitations. Self – directed learning is to provide ability to work independently and do in-depth study of various problems and requirements of society.

PGA6: Communication skills:

i. Ability to communicate various concepts of technical education effectively using practical approach and their geometrical visualizations.
ii. Ability to use courses as a precise language of communication in other branches of human knowledge.
iii. Ability to resolve unsolved problems and requirements of industries and societies.
iv. Ability to show the importance of their technical knowledge as precursor to various scientific developments since the beginning of the civilization.

PGA7. Leadership Readiness/Qualities and Employability Options: Capability for mapping out the tasks in a team or an organization, self-motivating and inspiring team members to engage with the team objectives/vision and using management skills to follow the mapped path to the destination in a smooth and efficient way. This program will also help students to enhance their employability through self employment (Entrepreneur) or by opting jobs in various sectors like industries, Government offices, PSUs, corporate etc.

PGA8. Multicultural Competence: Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.

PGA9: Moral and ethical awareness/reasoning: Ability to identify unethical behavior such as falsification or misrepresentation of data and adopting objective, unbiased and truthful actions in all aspects of their program.

PGA10: Lifelong learning: Life-long learning provides the ability to think, acquire knowledge and skills through logical reasoning and to inculcate the habit of self-learning.

3. Programme Outcomes (POs)

Students post graduating with the M. Tech degree should be able to acquire with following **POs**

PO1. Apply knowledge, skills, and current tools, recent computing technologies of Engineering innovatively to different applications

PO2. Enhance thinking skills to design and conduct experiments, as well as to analyze and interpret data and address the research gaps to produce solutions with the help of tools, technology and products.

PO3. Understand the contemporary research, security issues in the different areas of engineering.

PO4. An ability to identify, analyze, design, develop, implement and integrate based systems.

PO5. Enhance critical thinking by acquiring the skills in modern techniques, methodologies and tools to be innovative and creative.

PO6. An ability to communicate effectively, express /present ideas in an impressive and professional manner, both in written and verbal forms.

PO7. An ability to work in multidisciplinary and multicultural environment, become entrepreneur.

PO8. An ability to understand leadership and entrepreneurship qualities.

PO9. An ability to understand health, ethical, legal, financial, and professional responsibilities.

PO10. To recognizes the need for self-motivation and ability to engage in lifelong learning through continuing education, research and professional development.

Mapping of Graduate Attributes (PGAs) and Programme Outcomes (POs):

PO/PGA	PGA1	PGA2	PGA3	PGA4	PGA5	PGA6	PGA7	PGA8	PGA9	PGA10
PO1	■									
PO2		■								
PO3			■							
PO4				■						
PO5					■					
PO6						■				
PO7							■			
PO8								■		
PO9									■	
PO10										■

4. **Program Specific Outcomes (PSOs) :**

PSO1: Engage in sustainable development and to demonstrate engineering skills for effective interpretation and decision to solve real world problems.

PSO2: To make a strong combination of technical and leadership qualities for successful professional career in industry or in entrepreneurship.

5. Course-Wise Learning Objectives, Structures and Outcomes (CLOSOs)

MASTER OF TECHNOLOGY

Semester I

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

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

Semester II

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

Semester III

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

Semester IV

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

Syllabus

Semester – I

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

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

Advanced Power System Analysis (MTEEPS101)

COURSE OBJECTIVE

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

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

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

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

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

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

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

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES

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

CO1: Calculate voltage phasor at all buses
CO2: Study various methods of load flow and their advantages and disadvantages
CO3: Rank various contingencies according to their severity in terms of bus voltage and line loading
CO4: Study voltage instability phenomenon

CO5: Estimate the bus voltage phasor given various quantities viz. power flow, voltages, taps, CB status etc

CO6: Understand how to analyze various types of faults in power system

Mapping between Objectives and Outcomes
Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L4**	**H**	**M**	**-**	**M**	**L**	**M**	**L**	**-**	**-**	**M**	**M**	**H**
CO2	**L2**	**M**	**M**	**M**	**L**	**M**	**L**	**-**	**M**	**-**	**L**	**M**	**H**
CO3	**L4**	**M**	**L**	**L**	**-**	**M**	**M**	**M**	**L**	**-**	**M**	**H**	**H**
CO4	**L2**	**M**	**L**	**M**	**-**	**M**	**L**	**M**	**L**	**-**	**L**	**M**	**M**
CO5	**L4**	**M**	**H**	**L**	**M**	**L**	**L**	**L**	**-**	**-**	**H**	**H**	**H**
CO6	**L4**	**M**	**M**	**-**	**M**	**M**	**M**	**-**	**M**	**-**	**H**	**H**	**H**

H- High, M- Moderate, L- Low, '-' for No correlation

Power System Dynamics-I (MTEEPS102)

COURSE OBJECTIVE

1. To introduce the basic concepts of power system dynamics.
2. To introduce the dynamic behavior of the system and its effect on the stability of the power system.
3. To cover the modeling of different machines.

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

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

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

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

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

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

TEXT BOOKS:

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

COURSE OUTCOMES

At the end of the course, the student will be able to:

CO1: Analyse the modeling of synchronous machine in details

CO2: Carry out simulation of power system dynamics using MATLAB-SIMULINK.

CO3: Carry out stability analysis with and without power system stabilizer (PSS)

CO4: Understand the load modeling in power system

CO5: Study the effect of excitation system and voltage stability of the power system.

CO6: Explain the multi machine stability and asynchronous operation.

Mapping between Objectives and Outcomes
Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L4**	**H**	**-**	**M**	**-**	**L**	**-**	**-**	**-**	**-**	**M**	**M**	**M**
CO2	**L6**	**M**	**H**	**H**	**M**	**H**	**-**	**-**	**-**	**-**	**H**	**M**	**H**
CO3	**L4**	**M**	**H**	**L**	**M**	**H**	**-**	**-**	**-**	**-**	**H**	**H**	**H**
CO4	**L2**	**M**	**L**	**-**	**M**	**M**	**-**	**-**	**-**	**-**	**M**	**H**	**H**
CO5	**L2**	**H**	**L**	**L**	**M**	**L**	**-**	**-**	**-**	**-**	**L**	**M**	**M**
CO6	**L2**	**M**	**L**	**L**	**-**	**L**	**-**	**-**	**-**	**-**	**L**	**M**	**M**

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Renewable Energy System (MTEEPS103A)

COURSE OBJECTIVE

1. To expose the students to real time working principles of distributed generation systems with renewable energy sources.
2. To gain understanding of sizing, economics, dynamics of off-grid and grid-connected renewable energy based distributed generation schemes.

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

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

Unit 3: Power Electronic Interface with the Grid

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

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

Unit 6: Economics of Distributed Generation, Case Studies

References:

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

COURSE OUTCOMES
At the end of the course, students will be able to:

CO1: Understand the renewable sources in distributed generation (DG)

CO2: Understand sitting, sizing, optimal placement & grid integration of DG sources in distribution and transmission systems.

CO3: Explain the economics, reliability aspects of DGs.

CO4: Apply modeling techniques to micro grid with multiple DGs and study the transients.

CO5: Analyze the steady state and dynamic performance in control of DG systems.

Mapping between Objectives and Outcomes
Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L2**	**H**	**M**	**M**	**H**	**L**	**-**	**-**	**-**	**-**	**M**	**H**	**H**
CO2	**L2**	**M**	**M**	**H**	**L**	**M**	**-**	**-**	**-**	**-**	**H**	**H**	**H**
CO3	**L2**	**M**	**L**	**L**	**H**	**M**	**-**	**-**	**-**	**-**	**H**	**M**	**M**
CO4	**L3**	**M**	**L**	**L**	**M**	**M**	**-**	**-**	**-**	**-**	**M**	**H**	**H**
CO5	**L4**	**M**	**M**	**L**	**M**	**L**	**-**	**-**	**-**	**-**	**M**	**H**	**H**

H- High, M- Moderate, L- Low, '-' for No correlation

Smart Grids (MTEEPS103B)

COURSE OBJECTIVE

1. To understand concept of smart grid and its advantages over conventional grid
2. To know smart metering technique
3. To learn wide area measurement techniques
4. To understanding the problems associated with integration of distributed generation and its solution through smart grid

Unit 1: Introduction to Smart Grid, Evolution of Electric Grid, Concept of Smart Grid, Definitions Need of Smart Grid, Concept of Robust & Self Healing Grid Present development & International policies in Smart Grid

Unit 2: Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation**,** Smart Substations, Substation Automation, Feeder Automation .

Unit 3: Geographic Information System(GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System(WAMS)**,** Phase Measurement Unit(PMU)

Unit 4: Concept of micro-grid, need & applications of micro-grid, formation of micro-grid, Issues of interconnection, protection & control of micro-grid, Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel-cells, micro-turbines**,** Captive power plants, Integration of renewable energy sources.

Unit 5: Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

Unit 6: Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area, Network (NAN), Wide Area Network (WAN), Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Basics of CLOUD Computing & Cyber Security for Smart Grid, Broadband over Power line (BPL), IP based protocols----------

References:

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

COURSE OUTCOMES

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

CO1: To study the power quality problems associated with integration of renewable energy sources in smart grid.

CO2: Formulate solutions in the areas of smart substations, distributed generation and wide area measurements.

CO3: Come up with smart grid solutions using modern communication technologies

CO4: To apply smart metering concepts to industrial and commercial installations.

CO5: Appreciate the difference between smart grid & conventional grid.

Mapping between Objectives and Outcomes
Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L2**	**H**	**M**	**-**	**H**	**L**	**M**	**H**	**H**	**H**	**L**	**H**	**H**
CO2	**L6**	**M**	**-**	**H**	**L**	**M**	**-**	**L**	**M**	**L**	**-**	**H**	**H**
CO3	**L3**	**M**	**L**	**H**	**-**	**H**	**H**	**H**	**L**	**M**	**-**	**H**	**H**
CO4	**L3**	**H**	**L**	**L**	**M**	**-**	**L**	**-**	**M**	**-**	**-**	**H**	**H**
CO5	**L4**	**M**	**-**	**L**	**M**	**L**	**L**	**H**	**M**	**-**	**L**	**M**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

High Power Converters (MTEEPS103C)

COURSE OBJECTIVE

1. To introduce the students to different type of Power Electronics converters.
2. To know about various design aspects as well as protection schemes of the converters.

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

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

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

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

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

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

References:

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

COURSE OUTCOMES

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

CO1: Understand the characteristics of different semiconductor devices and their applications in different converters.

CO2: Gain knowledge about different AC voltage controllers and their control.

CO3: Design gate drive circuits and protective circuits for semiconductor devices

.

CO4: Know about the requirement and working phenomenon of power conditioners and UPS.

CO5: Know about different topologies of multi-level inverters and also PWM techniques used in VSI and CSI.

Mapping between Objectives and Outcomes
Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L4**	**H**	**M**	**-**	**M**	**L**	**M**	**L**	**H**	**L**	**L**	**H**	**H**
CO2	**L4**	**-**	**M**	**H**	**L**	**M**	**L**	**-**	**M**	**L**	**-**	**M**	**M**
CO3	**L6**	**M**	**L**	**-**	**H**	**-**	**H**	**M**	**L**	**M**	**-**	**H**	**H**
CO4	**L4**	**M**	**L**	**L**	**M**	**M**	**L**	**-**	**L**	**L**	**-**	**M**	**M**
CO5	**L4**	**-**	**M**	**L**	**-**	**L**	**M**	**L**	**-**	**L**	**M**	**H**	**H**

H- High, M- Moderate, L- Low, '-' for No correlation

Wind and Solar Systems (MTEEPS103D)

COURSE OBJECTIVE

1. To appreciate the importance of energy growth of the power generation from the renewable energy sources and participates in solving these problems.
2. To demonstrate the knowledge of the physics of wind power and solar power generation and all associated issues so as to solve practical problems.
3. To understand the factors involved in installation and commissioning of a Solar or Wind plant.
4. To learn the dynamics involved when interconnected with power system grid.

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

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

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

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

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

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

References:

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

COURSE OUTCOMES

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

CO1: Understand the development and current status of wind and solar system.
CO2: Know the characteristics of wind power generation and its integration with transmission and distributi.on network
CO3: Know abour Solar power systems and its applications.
CO4: PV power generation, Energy Storage device. Designing the solar systems for small installations.
CO5: Impacts on power systems dynamics, power systems interconnection.

Mapping between Objectives and Outcomes
Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L4**	**H**	**M**	**-**	**M**	**L**	**M**	**L**	**H**	**-**	**L**	**H**	**H**
CO2	**L2**	**M**	**H**	**-**	**L**	**M**	**-**	**L**	**M**	**L**	**-**	**H**	**H**
CO3	**L2**	**-**	**L**	**M**	**H**	**-**	**M**	**M**	**L**	**-**	**M**	**M**	**M**
CO4	**L6**	**H**	**L**	**L**	**M**	**M**	**-**	**-**	**L**	**-**	**-**	**H**	**H**
CO5	**L1**	**M**	**-**	**L**	**M**	**L**	**L**	**-**	**H**	**L**	**M**	**M**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

Electrical Power Distribution System (MTEEPS104A)

COURSE OBJECTIVE

1. To familiarize students with rudimentary concepts and design of modern power distribution system
2. To adopt Technologies for automation of distributed system.
3. To understand maintenance and protection of distribution system.

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

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

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

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

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

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

References:

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

COURSE OUTCOMES

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

CO1: Understand Introduction to SCADA and its application

CO2: Know the AI techniques applied to Distribution Automation.

CO3: To find the optimal placement of switching devices in distribution network to minimize losses and improve the performance

CO4: Provides an idea regarding distribution management system, interconnected power system and power system automation.

CO5: To study different aspects of distribution system maintenance and energy management.

Mapping between Objectives and Outcomes
Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L4**	**H**	**M**	**M**	**M**	**L**	**M**	**L**	**M**	**L**	**L**	**H**	**H**
CO2	**L2**	**M**	**M**	**M**	**L**	**M**	**L**	**H**	**M**	**L**	**-**	**H**	**H**
CO3	**L2**	**M**	**L**	**L**	**M**	**M**	**H**	**H**	**L**	**M**	**-**	**H**	**H**
CO4	**L2**	**H**	**L**	**L**	**M**	**M**	**L**	**L**	**H**	**-**	**M**	**M**	**M**
CO5	**L2**	**M**	**H**	**L**	**M**	**H**	**L**	**L**	**M**	**L**	**M**	**M**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

Mathematical Methods for Power Engineering (MTEEPS104B)

COURSE OBJECTIVE

1. To understand the relevance of mathematical methods to solve engineering problems.
2. To understand how to apply these methods for a given engineering problem.

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

Unit 2: Eigen values and Eigen vectors of linear operator

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

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

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

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

References:

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

COURSE OUTCOMES

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

CO1: Knowledge about vector spaces, linear transformation, eigenvalues and eigenvectors of linear operators.

CO2: To learn about linear programming problems and understanding the simplex method for solving linear programming problems in various fields of science and technology

CO3: Acquire knowledge about nonlinear programming and various techniques used for solving constrained and unconstrained nonlinear programming problems

CO4: Understanding the concept of random variables, functions of random variable and their probability distribution

CO5: Understand stochastic processes and their classification.

Mapping between Objectives and Outcomes
Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L3**	**H**	**M**	**M**	**H**	**L**	**M**	**L**	**H**	**-**	**L**	**M**	**L**
CO2	**L3,L4**	**M**	**-**	**H**	**L**	**M**	**L**	**-**	**M**	**L**	**-**	**M**	**H**
CO3	**L2**	**M**	**L**	**H**	**-**	**M**	**H**	**H**	**L**	**M**	**M**	**H**	**H**
CO4	**L4**	**M**	**-**	**L**	**M**	**M**	**-**	**H**	**L**	**M**	**-**	**M**	**M**
CO5	**L4**	**-**	**M**	**L**	**M**	**L**	**M**	**L**	**L**	**L**	**M**	**M**	**M**

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Pulse Width Modulation for PE Converters (MTEEPS104C)

COURSE OBJECTIVE

1. To understand Necessity and Importance of PWM techniques
2 To understand Implementation of PWM controllers

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

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

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

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

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

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

References:

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

COURSE OUTCOMES

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

CO1: To study development in modulation scheme and its application for unbalanced voltage system.

CO2: To provide the students a deep insight in to the power electronics converters and its modulation techniques.

CO3: To study the necessity of providing minimum pulse width and its effect.

CO4: To study development in modulation scheme and its application for multilevel inverters.

CO5: To study Implementation of modulation controller.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L2**	**H**	**M**	**M**	**H**	**L**	**M**	**M**	**M**	**L**	**-**	**M**	**M**
CO2	**L2**	**M**	**M**	**H**	**-**	**M**	**L**	**L**	**M**	**-**	**H**	**H**	**H**
CO3	**L2**	**M**	**-**	**H**	**H**	**-**	**H**	**L**	**-**	**H**	**-**	**M**	**M**
CO4	**L6**	**H**	**H**	**-**	**M**	**M**	**L**	**-**	**L**	**H**	**H**	**H**	**H**
CO5	**L2**	**H**	**M**	**-**	**M**	**M**	**L**	**-**	**L**	**-**	**H**	**M**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

Electric and Hybrid Vehicles (MTEEPS104D)

COURSE OBJECTIVE

1. To understand upcoming technology of hybrid system
2. To understand different aspects of drives application
3. To Learn about the electric Traction

Unit 1: History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Impact of modern drive-trains on energy supplies, Basics of vehicle performance, vehicle power source characterization Transmission characteristics, Mathematical models to describe vehicle performance

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

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

Unit 4: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Introduction Motor drives configuration and control of Permanent Magnet Motor drives Configuration and control of Switch Reluctance, Motor drives, drive system efficiency.

Unit 5: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics Selecting the energy storage technology, Communications, supporting subsystems

Unit 6: Introduction to energy management and their strategies used in hybrid and electric vehicle, Classification of different energy management strategies Comparison of different energy management strategies Implementation issues of energy strategies.

References:

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

COURSE OUTCOMES

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

CO1: Learn the basic concepts, mathematical models and social/environmental importance of hybrid and electric vehicles

CO2: Learn about energy management in hybrid and electric vehicle

CO3: Understand and learn about different drive applications

CO4: Learn fundamental concepts of hybrid tractions, hybrid drive-train topologies and hybrid drive-train topologies.

CO5: Learn electric machine and the internal combustion engine (ICE),

Mapping between Objectives and Outcomes
Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L2**	**-**	**M**	**M**	**H**	**-**	**L**	**-**	**H**	**L**	**H**	**H**	**H**
CO2	**L4**	**H**	**M**	**-**	**M**	**M**	**L**	**M**	**M**	**-**	**-**	**H**	**H**
CO3	**L4**	**-**	**L**	**H**	**-**	**L**	**H**	**H**	**-**	**M**	**H**	**M**	**M**
CO4	**L2**	**M**	**H**	**-**	**M**	**M**	**L**	**-**	**L**	**L**	**L**	**H**	**H**
CO5	**L2**	**M**	**H**	**-**	**M**	**-**	**L**	**M**	**L**	**-**	**L**	**H**	**H**

H- High, M- Moderate, L- Low, '-' for No correlation

Research Methodology and IPR (MTEEPS105)

COURSE OBJECTIVE

1. To understand research problem formulation.
2. To analyze research related information
3. To follow research ethics
4. To understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.

Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

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

Unit 3: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

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

Unit 6: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc.Traditional knowledge Case Studies, IPR and IITs.

References:

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

COURSE OUTCOMES

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

CO1: Understand research problem formulation. Analyze research related information & Follow research ethics.

CO2: Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.

CO3: 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.

CO4: Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Mapping between Objectives and Outcomes
Mapping of Course Outcomes onto Program Outcomes

Course Outcomes	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L1**	M	M	H	M	L	L	M	L	M	L	**M**	**M**
CO2	**L3**	M	M	M	L	M	-	L	M	M	M	**M**	**M**
CO3	**L2**	H	H	L	M	M	M	L	-	M	-	**L**	**L**
CO4	**L3,L4**	M	M	L	L	M	-	-	-	M	L	**M**	**M**

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Power System Steady State Analysis Lab (MTEEPS107)

COURSE OBJECTIVE

1. To learn basic principles of simulation, modeling of power system for study of various phenomena using software/hardware
2. To learn basic principles of simulation, modeling of control system for study of various phenomena using software/hardware
3. To model load flow problems and find various sulutions to it.

Experiment List

Simulate Swing Equation in Simulink (MATLAB)

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

(B) Simulation of Synchronous Machine with FACTS device.

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

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

COURSE OUTCOMES

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

CO1: Do the simulation
CO2: Do modeling of power system.
CO3: Do modeling of control system, and power electronics devices
CO4: Apply the lab knowledge for their thesis work as well.
CO5: Modelling of FACTS devices

Mapping between Objectives and Outcomes
Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L3**	**M**	**M**	**-**	**M**	**L**	**L**	**M**	**H**	**L**	**M**	**M**	**M**
CO2	**L3**	**M**	**H**	**M**	**M**	**-**	**L**	**M**	**M**	**L**	**M**	**H**	**H**
CO3	**L3**	**L**	**-**	**H**	**L**	**L**	**H**	**M**	**-**	**H**	**-**	**H**	**H**

CO4	**L2,L3**	**-**	**H**	**L**	**-**	**M**	**-**	**M**	**L**	**-**	**L**	**M**	**M**
CO5	**L2**	**-**	**H**	**L**	**M**	**-**	**-**	**-**	**L**	**-**	**L**	**H**	**H**

H- High, M- Moderate, L- Low, '-' for No correlation

Renewable Energy Lab (MTEEPS108)

COURSE OBJECTIVE

1. Tto learn made conversant with the non conventional energy systems such as solar energy and its modeling.
2. To learn made conversant with the non conventional energy systems such as wind energy and its modeling using software/hardware
3. To Test the Capabilities of the Hydrogen Fuel Cells and Capacitors.

Experiment List

1 Power Curves
2 Build a Wind Farm
3 Test the Capabilities of the Hydrogen Fuel Cells and Capacitors
4 Effect of Temperature on Solar Panel Output
5 Variables Affecting Solar Panel Output
6 Effect of Load on Solar Panel Output
7 Wind Turbine Output: The Effect of Load
8 Test the Capabilities of Solar Panels and Wind Turbines

COURSE OUTCOMES

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

CO1: Build a Wind Farm
CO2: Test the Capabilities of the Hydrogen Fuel Cells and Capacitors
CO3: Modeling of solar plant and test its efficiency.
CO4: Know the effect of loads on solar power plant.
CO5: Test the Capabilities of Solar Panels and Wind Turbines.

Mapping between Objectives and Outcomes
Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L3**	**M**	**M**	**-**	**M**	**L**	**L**	**M**	**H**	**-**	**M**	**H**	**H**
CO2	**L3**	**M**	**-**	**H**	**M**	**-**	**L**	**M**	**M**	**L**	**M**	**H**	**H**
CO3	**L3**	**L**	**-**	**H**	**L**	**-**	**H**	**M**	**-**	**M**	**-**	**H**	**H**
CO4	**L4**	**-**	**H**	**-**	**M**	**M**	**L**	**-**	**L**	**M**	**L**	**H**	**H**
CO5	**L4**	**-**	**H**	**M**	**-**	**M**	**L**	**-**	**L**	**M**	**L**	**H**	**H**

H- High, M- Moderate, L- Low, '-' for No correlation

Semester II

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

SEMESTER - II

Digital Protection of Power System (MTEEPS201)

COURSE OBJECTIVE

1. To study of numerical relays
2. To develop mathematical approach towards protection
3. To study of algorithms for numerical protection

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

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

Unit 3: Interpolation formulae, Forward, backward and central difference interpolation, Numerical differentiation, Curve fitting and smoothing, Least squares method, Fourier analysis, Fourier series and Fourier transform**,** Walsh function analysis

Unit 4: Basic elements of digital protection, Signal conditioning: transducers, surge protection, analog filtering, analog multiplexers**,** Conversion subsystem: the sampling theorem, signal aliasing, Error, sample and hold circuits, multiplexers, analog to digital conversion, Digital filtering concepts, The digital relay as a unit consisting of hardware and software

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

Unit 6: Fourier Algorithm: Full cycle window algorithm, fractional cycle window algorithm, Walsh function based algorithm, Least Squares based algorithms. Differential equation based algorithms. Traveling Wave based Techniques, Digital Differential Protection of Transformers, Digital Line Differential Protection, Recent Advances in Digital Protection of Power Systems.

References:

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

COURSE OUTCOMES

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

CO1: Learn the basic requirements of digital protection

CO2: Apply Mathematical approach towards protection

CO3: Learn the importance of Digital Relays.

CO4: Learn numerical protection on various power system elements.

CO5: Learn to develop various Protection algorithms

Mapping between Objectives and Outcomes
Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L2**	**M**	**-**	**M**	**L**	**H**	**-**	**H**	**M**	**L**	**-**	**L**	**L**
CO2	**L3**	**M**	**M**	**M**	**M**	**-**	**L**	**M**	**-**	**L**	**M**	**M**	**L**
CO3	**L2**	**L**	**M**	**H**	**-**	**L**	**H**	**H**	**L**	**H**	**-**	**M**	**M**
CO4	**L2**	**M**	**H**	**-**	**M**	**H**	**-**	**M**	**L**	**-**	**L**	**H**	**M**
CO5	**L2,L6**	**-**	**-**	**M**	**L**	**H**	**L**	**-**	**L**	**L**	**-**	**H**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

Power System Dynamics-II (MTEEPS202)

COURSE OBJECTIVE

1. To study of power system dynamics
2. To understand interpretation of power system dynamic phenomena
3. To study of various forms of stability

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

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

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

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

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

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

References:

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

COURSE OUTCOMES

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

CO1: analyze the rotor angle stability and design techniques to improve the stability of the system.
CO2: Study the effect of excitation system and voltage stability of the power system.
CO3: explain the multi machine stability and asynchronous operation.
CO4: Understand the modeling of automatic generation control of single area and multiarea system and sub
CO5: Analyze the small signal stability of the power system

Mapping between Objectives and Outcomes
Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L6**	**M**	**-**	**L**	**L**	**M**	**L**	**-**	**H**	**L**	**L**	**M**	**L**
CO2	**L2**	**M**	**L**	**M**	**-**	**M**	**L**	**M**	**M**	**L**	**-**	**L**	**L**
CO3	**L2**	**L**	**M**	**-**	**L**	**L**	**-**	**H**	**L**	**H**	**-**	**L**	**L**
CO4	**L2**	**M**	**H**	**L**	**M**	**L**	**L**	**M**	**L**	**-**	**L**	**H**	**M**
CO5	**L2**	**M**	**-**	**M**	**H**	**H**	**L**	**-**	**L**	**-**	**M**	**M**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

Restructured Power Systems (MTEEPS203A)

COURSE OBJECTIVE

1. To understand what is meant by restructuring of the electricity market.
2. To understand the need behind requirement for deregulation of the electricity market.
3. To understand the money, power & information flow in a deregulated power system.

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

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

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

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

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

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

References:

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

COURSE OUTCOMES

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

CO1: Describe the working and various other aspects of restructured power system.
CO2: Discuss the recent trends and applications in restructured markets.
CO3: Classify different market mechanisms and summarize the role of various entities in the market.
CO4: Identify the need of regulation and deregulation.
CO5: Describe the Technical and Non-technical issues in Deregulated Power Industry.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L2**	**M**	**-**	**H**	**H**	**M**	**M**	**L**	**H**	**L**	**-**	**M**	**L**
CO2	**L2**	**M**	**L**	**M**	**M**	**M**	**L**	**M**	**-**	**L**	**H**	**M**	**H**
CO3	**L4**	**L**	**M**	**-**	**L**	**L**	**M**	**L**	**L**	**H**	**-**	**H**	**H**
CO4	**L5**	**M**	**-**	**H**	**H**	**-**	**L**	**M**	**M**	**H**	**L**	**M**	**M**
CO5	**L2**	**M**	**M**	**-**	**L**	**M**	**L**	**M**	**-**	**L**	**-**	**M**	**H**

H- High, M- Moderate, L- Low, '-' for No correlation

Advanced Digital Signal Processing (MTEEPS203B)

COURSE OBJECTIVE

1. To understand the difference between discrete-time and continuous-time signals
2. To understand and apply Discrete Fourier Transforms (DFT)

Unit 1: Discrete time signals, Linear shift invariant systems, Stability and causality, Sampling of continuous time signals, Discrete time Fourier transform- Discrete Fourier series-Discrete Fourier Transform, Z transform-Properties of different transforms.

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

Unit 3: FIR filter design using window functions, Comparison of IIR and FIR digital filters, Basic IIR and FIR filter realization structures, Signal flow graph representations Quantization process and errors, Coefficient quantisation effects in IIR and FIR filters.

Unit 4: A/D conversion noise- Arithmetic round-off errors, Dynamic range scaling, Overflow oscillations and zero Input limit cycles in IIR filters**,** Linear Signal Models.

Unit 5: All pole, All zero and Pole-zero models, Power spectrum estimation- Spectral analysis of deterministic signals, Estimation of power spectrum of stationary random signals.

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

References:

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

COURSE OUTCOMES

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

CO1: Analyze and implement power spectrum estimation techniques.
CO2: Analyze, design and implement digital systems using the DFT and (FFT).
CO3: Design and analyze frequency-selective digital filters using various filtering methods.
CO4: Learn the Principles of adaptive filtering and implement algorithms of adaptation
CO5: Acquire the basics of multi rate digital signal processing.

Mapping between Objectives and Outcomes
Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L4**	**M**	**M**	**L**	**-**	**M**	**M**	**H**	**L**	**H**	**-**	**H**	**H**
CO2	**L4**	**M**	**L**	**-**	**L**	**L**	**L**	**-**	**M**	**L**	**M**	**H**	**H**
CO3	**L2,L6**	**L**	**-**	**M**	**L**	**-**	**H**	**L**	**L**	**-**	**-**	**H**	**M**
CO4	**L2**	**M**	**H**	**L**	**M**	**L**	**-**	**M**	**M**	**H**	**L**	**M**	**M**
CO5	**L2**	**M**	**-**	**L**	**L**	**L**	**L**	**H**	**L**	**-**	**H**	**L**	**L**

H- High, M- Moderate, L- Low, '-' for No correlation

Dynamics of Electrical Machines (MTEEPS203C)

COURSE OBJECTIVE

1.To learn about the performance characteristics of machine
2. To understand the dynamics of the machine
3. To understand how to determine stability of machine
4.To learn the synchronous machine

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

Unit 2: Torque Equation Analysis of Simple DC Machines using the Primitive Machine Equations, The Three Phase Induction Motor, Transformed Equations, Different Reference Frames for Induction, Motor Analysis Transfer**,** Function Formulation.

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

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

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

Unit 6: Alternator /Synchronous Motor System.

References:

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

COURSE OUTCOMES

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

CO1: Study the concept of synchronous machine system.
CO2: Study the machine dynamics and its stability analysis.
CO3: Understand the transient study using transformed equation and to study the DC generator and DC motor system

CO4: Study the torque dynamics of primitive modeled DC machine, induction motor dynamics, transformed equation and various reference frame theories of induction motor.

CO5: Analyze the concept of synchronous machine and its analysis.

.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L2**	**M**	**-**	**H**	**M**	**L**	**M**	**H**	**L**	**H**	**H**	**L**	**L**
CO2	**L2**	**M**	**L**	**-**	**L**	**M**	**L**	**H**	**-**	**L**	**-**	**L**	**L**
CO3	**L2**	**H**	**M**	**L**	**L**	**-**	**H**	**L**	**L**	**-**	**L**	**M**	**L**
CO4	**L2**	**-**	**H**	**L**	**M**	**L**	**L**	**-**	**M**	**H**	**L**	**M**	**L**
CO5	**L4**	**M**	**M**	**-**	**L**	**M**	**L**	**M**	**L**	**L**	**-**	**L**	**L**

H- High, M- Moderate, L- Low, '-' for No correlation

Power Apparatus Design (MTEEPS203D)

COURSE OBJECTIVE

1. To study the modeling analysis of rotating machine.
2. To understand the electromagnetic energy conversion
3. To know about rating of machines.

Unit 1: Principles of Design of Machines -Specific loadings, choice of magnetic and electric loadings, Real and apparent flux densities, temperature rise calculation, Separation of main dimension for DC machines Induction machines and synchronous machines, Design of Transformers-General considerations, output equation, emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling

Unit 2: Specific loadings, choice of magnetic and electric loadings Real and apparent flux - densities, temperature rise calculation, Separation of main dimension for DC machines, Induction machines and synchronous machines Heating and cooling of machines, types of ventilation, continuous and intermittent rating.

Unit 3: General considerations, output equation, emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling tubes, Calculation of losses, efficiency and regulation, Forces winding during short circuit.

Unit 4: General considerations, output equation, Choice of specific electric and magnetic loadings, efficiency, power factor, Number of slots in stator and rotor**,** Elimination of harmonic torques.

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

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

References:

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

COURSE OUTCOMES

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

CO1: Design Computer Aided Electrical Machine.

CO2: Model and design all types of rotating machines including special machines.

.

CO3: Model all rotating machines under both transient and steady state conditions with the dimensions and material used.

CO4: Apply the knowledge of the electrical apparatus in industry oriented applications.

CO5: Analyze and design a transformer with general considerations such as emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size etc.

Mapping between Objectives and Outcomes
Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L6**	**M**	**-**	**M**	**L**	**L**	**M**	**L**	**H**	**H**	**H**	**H**	**H**
CO2	**L6**	**M**	**L**	**M**	**L**	**-**	**L**	**L**	**M**	**L**	**-**	**H**	**M**
CO3	**L6**	**H**	**M**	**-**	**L**	**M**	**L**	**L**	**L**	**H**	**L**	**H**	**M**
CO4	**L3**	**M**	**H**	**L**	**M**	**L**	**-**	**M**	**M**	**-**	**L**	**H**	**H**
CO5	**L2,L6**	**M**	**-**	**L**	**L**	**-**	**L**	**H**	**-**	**L**	**M**	**M**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

Advanced Micro-Controller Based Systems (MTEEPS204A)

COURSE OBJECTIVE

1. To understand the architecture of advance microcontrollers
2. To understand the applications of these controllers
3. To get some introduction to FPGA

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

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

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

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

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

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

References:

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

COURSE OUTCOMES

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

CO1: Program a microcontroller or microprocessor using assembly language.

CO2: Configure and use different peripherals in a digital system

.

CO3: Understand the operation of different microcontrollers as well as DSP based systems

CO4: Understand the architecture and organization of a microcontroller or microprocessor

CO5: Compile and debug a program and generate an executable file and use it

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L6**	**M**	**H**	**-**	**L**	**H**	**-**	**M**	**L**	**M**	**M**	**H**	**L**
CO2	**L4**	**M**	**-**	**M**	**H**	**M**	**L**	**-**	**M**	**L**	**-**	**M**	**L**
CO3	**L2**	**H**	**-**	**L**	**L**	**-**	**M**	**L**	**L**	**M**	**-**	**L**	**L**
CO4	**L2**	**M**	**H**	**L**	**-**	**M**	**L**	**L**	**-**	**H**	**L**	**M**	**M**
CO5	**L3**	**M**	**-**	**L**	**L**	**L**	**-**	**M**	**M**	**-**	**-**	**M**	**L**

H- High, M- Moderate, L- Low, '-' for No correlation

SCADA System and Applications (MTEEPS204B)

COURSE OBJECTIVE

1. To understand what is meant by SCADA and its functions
2. To know SCADA communication
3. To get an insight into its application

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

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

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

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

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

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

References:

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

COURSE OUTCOMES

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

CO1: Analyze Various architectures of SCADA systems with their advantages and limitations

CO2: Underastand Basic knowledge on supervisory control and their applications

.

CO3: Knowledge on applications of SCADA systems on distribution sector and in various industries.

CO4: Overview on single unified standard architecture IEC 61850

CO5: Learn about remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L4**	**M**	**-**	**M**	**L**	**L**	**L**	**M**	**L**	**H**	**-**	**H**	**L**
CO2	**L2**	**M**	**L**	**-**	**-**	**M**	**L**	**-**	**M**	**L**	**-**	**L**	**L**
CO3	**L2**	**H**	**M**	**L**	**L**	**-**	**-**	**L**	**L**	**L**	**-**	**M**	**L**
CO4	**L2**	**M**	**H**	**-**	**M**	**M**	**L**	**-**	**M**	**-**	**L**	**H**	**M**
CO5	**L4**	**M**	**-**	**L**	**L**	**-**	**L**	**M**	**H**	**L**	**-**	**L**	**L**

H- High, M- Moderate, L- Low, '-' for No correlation

Power Quality (MTEEPS204C)

COURSE OBJECTIVE

1. To understand the different power quality issues to be addressed
2. To understand the recommended practices by various standard bodies like IEEE, IEC, etc on voltage & frequency, harmonics
3. To understand the STATIC VAR Compensators

Unit1: Introduction-power quality-voltage quality-overview of power quality phenomena, classification of power quality issues-power quality measures and standards-THD-TIF-DIN-C, message weights-flicker factor transient phenomena-occurrence of power quality problems, power acceptability curves-IEEE guides, standards and recommended practices.

Unit 2: Harmonics-individual and total harmonic distortion, RMS value of a harmonic waveform- Triplex harmonics-important harmonic introducing devices-SMPS-,Three phase power converters-arcing devices saturable devices-harmonic distortion of fluorescent lamps-effect of power system harmonics on power system equipment and loads.

Unit 3: Modeling of networks and components under non-sinusoidal conditions transmission and distribution systems, Shunt capacitors-transformers-electric machines-ground, systems loads that cause power quality problems, power quality problems created by drives and its impact on drive.

Unit 4: Power factor improvement- Passive Compensation, Passive Filtering , Harmonic Resonance Impedance Scan Analysis- Active Power Factor Corrected Single Phase Front End, Control Methods for Single Phase APFC, Three Phase APFC and Control Techniques, PFC, Based on Bilateral Single Phase and Three Phase Converter

Unit 5: Static VAR compensators-SVC and STATCOM Active Harmonic Filtering-Shunt Injection, Filter for single phase, three-phase three-wire and three-phase four wire systems, d-q domain control of three phase shunt active filters uninterruptible power supplies constant voltage, transformers, series active power filtering techniques for harmonic cancellation and isolation.

Unit 6: Dynamic Voltage Restorers for sag , swell and flicker problems. Grounding and wiring introduction, NEC grounding requirements-reasons for grounding typical grounding and wiring problems solutions to grounding and wiring problems

Reference:

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

COURSE OUTCOMES

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

CO1: Model power systems under non-sinusoidal condition for transient studies.

CO2: Design model reference adaptive systems for power quality problems

.

CO3: Understand importance of power quality with power quality issues & standards

CO4: Understand and analyze the solutions to mitigate power quality problems

CO5: Design variable structure control for power quality systems

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L6**	**M**	**L**	**-**	**H**	**L**	**-**	**M**	**L**	**M**	**-**	**M**	**L**
CO2	**L6**	**M**	**-**	**M**	**H**	**-**	**L**	**M**	**M**	**L**	**-**	**M**	**L**
CO3	**L2**	**-**	**M**	**L**	**M**	**L**	**-**	**L**	**L**	**L**	**-**	**L**	**L**
CO4	**L2**	**M**	**H**	**L**	**H**	**-**	**L**	**-**	**M**	**H**	**L**	**H**	**M**
CO5	**L6**	**M**	**L**	**L**	**-**	**L**	**L**	**H**	**-**	**L**	**-**	**H**	**H**

H- High, M- Moderate, L- Low, '-' for No correlation

AI Techniques (MTEEPS204D)

COURSE OBJECTIVE

1. To understand the fuzzy logic, ANN
2. To understand the GA & EP

Unit-I: Biological foundations to intelligent Systems**,** Artificial Neural Networks, Single layer and Multilayer Feed Forward NN**,** LMS and Back Propagation Algorithm**,** Feedback networks and Radial Basis Function Networks.

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

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

Unit-IV: System Identification using Fuzzy and Neural Network

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

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

Reference:

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

COURSE OUTCOMES

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

CO1: Explore different techniques to solve artificial intelligence problems by searching.
CO2: Envisage the need of quantifying uncertainty and probabilistic reasoning.
CO3: Demonstrate the fundamental principles of intelligent systems.
CO4: Conceive the concepts of knowledge representation and inference mechanism.
CO5: Apply the fuzzy reasoning rules and knowledge representation in real life problem solving.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L6**	**M**	**M**	**L**	**H**	**H**	**L**	**M**	**L**	**-**	**-**	**H**	**L**
CO2	**L2**	**M**	**H**	**M**	**L**	**M**	**L**	**H**	**L**	**L**	**M**	**M**	**M**
CO3	**L3**	**M**	**M**	**L**	**M**	**L**	**H**	**L**	**M**	**L**	**M**	**M**	**H**
CO4	**L2**	**M**	**H**	**H**	**L**	**M**	**L**	**L**	**L**	**-**	**M**	**L**	**L**
CO5	**L3**	**M**	**L**	**L**	**M**	**L**	**L**	**-**	**M**	**L**	**L**	**H**	**M**

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Power System Protection Lab (MTEEPS206)

COURSE OBJECTIVE

1. To understand the modelling of various relays using software.
2. To know about various protective schemes.

Experiment List

1 Introduction to Power System Protection
2 Impact of Induction Motor Starting on Power System
3 Modelling of Differential Relay using MATLAB
4 Radial Feeder Protection
5 Parellel Feeder Protection
6 Principle of Reverse Power Protection
7 Differential Protection of Transformer
8 To the study time vs.voltage characteristcs of over voltage induction relay

COURSE OUTCOMES

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

CO1: Introduction to Power System Protection.
CO2: Model Differential Relay using MATLAB
CO3: Demonstrate the fundamental principles of intelligent systems.
CO4: protective schemes for various equipments of power system.
CO5: Know about various relays and its applications.

Mapping between Objectives and Outcomes
Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L2**	**M**	**M**	**-**	**L**	**M**	**L**	**M**	**L**	**M**	**-**	**L**	**L**
CO2	**L3**	**M**	**L**	**M**	**L**	**M**	**L**	**H**	**L**	**L**	**-**	**M**	**L**
CO3	**L3**	**M**	**-**	**H**	**-**	**L**	**H**	**-**	**M**	**-**	**M**	**H**	**L**
CO4	**L2**	**M**	**H**	**-**	**L**	**M**	**-**	**L**	**H**	**-**	**M**	**L**	**L**
CO5	**L2**	**M**	**L**	**L**	**M**	**-**	**L**	**H**	**-**	**L**	**L**	**L**	**L**

H- High, M- Moderate, L- Low, '-' for No correlation

Application to Power System Lab (MTEEPS207)

COURSE OBJECTIVE

1. To train the students in solving and analyzing the advanced power system problems and research oriented problems using various hardware/software procured by various projects.

Experiment List

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

COURSE OUTCOMES

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

CO1: Solve power system problems using MATLAB..
CO2: Perform simulation studies using software packages
CO3: Use of Real Time Data and Instruments for analyzing the performance of Power Systems.
CO4: Disucss Load sharing in power systems.
CO5: Apply Load-frequency dynamics of single area power system.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L4**	**M**	**M**	**-**	**H**	**M**	**L**	**-**	**L**	**M**	**-**	**H**	**L**
CO2	**L3**	**M**	**-**	**M**	**L**	**-**	**L**	**H**	**-**	**L**	**M**	**H**	**L**
CO3	**L1,L3**	**-**	**M**	**L**	**-**	**L**	**H**	**L**	**M**	**L**	**-**	**H**	**M**
CO4	**L2**	**M**	**H**	**-**	**H**	**M**	**-**	**L**	**L**	**-**	**-**	**L**	**M**
CO5	**L3**	**M**	**-**	**M**	**-**	**-**	**L**	**H**	**-**	**L**	**-**	**H**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

Mini Project and Seminar (MTEEPS208)

COURSE OBJECTIVE

- To identification of the problem
- To use modern research tools/methods.
- To design and conduct experiments and identify the solution of the problem/s.

COURSE OUTCOMES

By the end of this course every student is expected to be able to

CO1: handle research problems and use modern research tools/methods.

CO2: analyze and review the existing literature on a research problem.

CO3: design and conduct experiments.

CO4: write dissertation and technical reports.

CO5: publish research papers.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L3	M	H	H	L	M	-	-	-	-	-	M	H
CO2	L4	M	M	H	L	M	M	-	-	-	L	H	H
CO3	L6	H	L	M	M	H	L	-	-	-	M	H	H
CO4	L3	H	-	M	H	H	H	-	-	-	L	M	M
CO5	L3	H	-	M	H	M	H	-	-	-	L	M	M

H- High, M- Moderate, L- Low, '-' for No correlation

Semester III

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

SEMESTER - III

Power System Transients (MTEEPS301A)

COURSE OBJECTIVE

1. To learn the reasons for occurrence of transients in a power system
2. To understand the change in parameters like voltage & frequency during transients
3. To know about the lightning phenomenon and its effect on power system

Unit 1: Fundamental circuit analysis of electrical transients, Laplace Transform method of solving simple Switching transients, Damping circuits -Abnormal switching transients, Three-phase circuits and transients, Computation of power system transients

Unit 2: Principle of digital computation – Matrix method of solution, Modal analysis- Z transform- Computation using EMTP, Lightning, switching and temporary over voltages, Lightning, Physical phenomena of lightning.

Unit 3: Interaction between lightning and power system, Influence of tower footing resistance and Earth Resistance, Switching: Short line or kilometric fault, Energizing transients - closing and, re-closing of lines, line dropping, load rejection – over voltages induced by faults

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

Unit 5: Insulation co-ordination: Principle of insulation co-ordination in Air Insulated substation (AIS) and Gas Insulated Substation (GIS) Coordination between insulation and protection level, Statistical approach

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

References:

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

COURSE OUTCOMES

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

CO1: Describe the formation and characteristics of travelling waves in transmission line

CO2: Model power apparatus under transient conditions.

.

CO3: Explain the various sources of electromagnetic transient.

CO4: Apply insulation co-ordination principles.

CO5: Understand Principle of digital computation.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L2**	**M**	**H**	**-**	**M**	**H**	**-**	**M**	**L**	**-**	**M**	**L**	**L**
CO2	**L6**	**M**	**-**	**M**	**-**	**M**	**L**	**-**	**M**	**L**	**M**	**M**	**L**
CO3	**L2**	**M**	**-**	**L**	**H**	**L**	**-**	**L**	**M**	**L**	**-**	**L**	**L**
CO4	**L3**	**M**	**H**	**-**	**H**	**-**	**L**	**L**	**-**	**M**	**-**	**M**	**L**
CO5	**L2**	**-**	**L**	**M**	**-**	**L**	**L**	**-**	**M**	**L**	**-**	**M**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

FACTS and Custom Power Devices (MTEEPS301B)

COURSE OBJECTIVE

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

Unit 1: Reactive power flow control in Power Systems, Control of dynamic power unbalances in Power System - Power flow control,Constraints of maximum transmission line loading, Benefits of FACTS Transmission line compensation, Uncompensated line - Shunt compensation, Series compensation Phase angle control, Reactive power compensation Shunt and Series compensation principles, Reactive compensation at transmission and distribution level

Unit 2: Static versus passive VAR compensator, Static shunt compensators: SVC and, STATCOM, Operation and control of TSC, TCR and STATCOM –Compensator control, Comparison between SVC and STATCOM

Unit 3: Static series compensation: TSSC, SSSC -Static voltage and phase angle regulators, TCVR and TCPAR Operation and Control, Applications, Static series compensation, GCSC, TSSC, TCSC and Static synchronous series compensators and their Control

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

Unit 5: Introduction to interline power flow controller, Modeling and analysis of FACTS, Controllers, Simulation of FACTS controllers Power quality problems in distribution systems, harmonics, loads that create harmonics, modeling, harmonic propagation, series and parallel resonances, mitigation of harmonics, passive filters, active filtering – shunt , series and hybrid and their control

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

References:

- K R Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age
- InternationalPublishers, 2007
- X P Zhang, C Rehtanz, B Pal, “Flexible AC Transmission Systems- Modelling and Control”, SpringerVerlag, Berlin, 2006
- N.G. Hingorani, L. Gyugyi, “Understanding FACTS: Concepts and Technology of Flexible

- ACTransmission Systems", IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.
- K.S.Sureshkumar ,S.Ashok , "FACTS Controllers & Applications", E-book edition, Nalanda DigitalLibrary, NIT Calicut,2003
- G T Heydt , "Power Quality", McGraw-Hill Professional, 2007
- T J E Miller, "Static Reactive Power Compensation", John Wiley and Sons, Newyork, 1982.

COURSE OUTCOMES

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

CO1: Describe the Reactive power flow control in Power Systems

CO2: Describe about various compensation methods.

.

CO3: Power quality operation and control methods.

CO4: Know about various FACTS devices and its applications.

CO5: Know about SSR and its damping Unified Power Flow Controller.

Mapping between Objectives and Outcomes
Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L2**	**M**	**L**	**L**	**H**	**H**	**L**	**M**	**M**	**M**	**L**	**L**	**L**
CO2	**L2**	**M**	**L**	**M**	**L**	**M**	**L**	**M**	**L**	**L**	**-**	**L**	**L**
CO3	**L2**	**M**	**M**	**L**	**L**	**L**	**H**	**L**	**M**	**H**	**-**	**M**	**L**
CO4	**L2,L3**	**M**	**H**	**L**	**H**	**M**	**L**	**M**	**L**	**H**	**-**	**M**	**M**
CO5	**L2**	**M**	**L**	**L**	**M**	**L**	**M**	**M**	**L**	**L**	**-**	**H**	**L**

H- High, M- Moderate, L- Low, '-' for No correlation

Industrial Load Modeling and Control (MTEEPS301C)

COURSE OBJECTIVE

1. To understand the energy demand scenario
2. To understand the modeling of load and its ease to study load demand industrially
3. To know Electricity pricing models
4. To study Reactive power management in Industries

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

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

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

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

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

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

TEXT BOOKS:

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

COURSE OUTCOMES

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

CO1: Present scenario of electrical energy.

CO2: Know about electric energy pricing methods.

.

CO3: Selection of Schemes Optimal Operating Strategies

CO4: Know about Energy banking, Industrial Cogeneration.

CO5: Optimal operation of load distribution.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L4**	**M**	**-**	**L**	**H**	**-**	**L**	**M**	**L**	**M**	**-**	**M**	**L**
CO2	**L3**	**-**	**L**	**M**	**-**	**M**	**L**	**H**	**L**	**L**	**M**	**M**	**M**
CO3	**L1**	**M**	**M**	**-**	**H**	**L**	**H**	**-**	**M**	**-**	**M**	**M**	**H**
CO4	**L2**	**M**	**M**	**L**	**M**	**M**	**L**	**-**	**L**	**M**	**-**	**M**	**H**
CO5	**L2**	**M**	**-**	**L**	**-**	**L**	**-**	**M**	**M**	**L**	**-**	**H**	**H**

H- High, M- Moderate, L- Low, '-' for No correlation

Dynamics of Linear Systems (MTEEPS301D)

COURSE OBJECTIVE

1. To understand the linear system and its functions
2. To understand the stability analysis of linear systems and implement the same in MATLAB

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

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

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

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

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

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

References:

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

COURSE OUTCOMES

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

CO1: Know State variable representations of systems.

CO2: Analyze linear time varying systems.

CO3: State space representation of discrete systems and provide solutions to it.

CO4: Know about State feedback of linear discrete time systems, design of observers with MATLAB Exercises.

CO5: Apply Ackerman's Formula - stabilisation by output feedback.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L2**	**M**	**H**	**-**	**L**	**H**	**-**	**H**	**L**	**H**	**-**	**L**	**L**
CO2	**L2**	**-**	**L**	**M**	**-**	**L**	**L**	**M**	**L**	**H**	**M**	**M**	**L**
CO3	**L3**	**H**	**-**	**H**	**L**	**-**	**M**	**L**	**-**	**-**	**L**	**L**	**L**
CO4	**L6**	**-**	**M**	**L**	**-**	**M**	**L**	**-**	**L**	**M**	**L**	**L**	**M**
CO5	**L3**	**M**	**L**	**-**	**M**	**L**	**-**	**M**	**-**	**L**	**-**	**M**	**L**

H- High, M- Moderate, L- Low, '-' for No correlation

Business Analytics (MTEEPS302A)

COURSE OBJECTIVE

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

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

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

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

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

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

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

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

References:

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

COURSE OUTCOMES

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

CO1: Understand the role of business analytics within an organization.

CO2: Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.

CO3: To become familiar with processes needed to develop, report, and analyze business data.

CO4: Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

CO5: Use decision-making tools/Operations research techniques.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L2**	**M**	**-**	**M**	**L**	**M**	**-**	**M**	**L**	**-**	**-**	**L**	**-**
CO2	**L3**	**M**	**L**	**-**	**L**	**-**	**L**	**M**	**-**	**H**	**M**	**L**	**L**
CO3	**L6**	**M**	**-**	**L**	**-**	**L**	**M**	**-**	**H**	**-**	**M**	**M**	**L**
CO4	**L3**	**-**	**M**	**-**	**M**	**-**	**L**	**H**	**L**	**H**	**L**	**L**	**-**
CO5	**L3**	**M**	**L**	**H**	**M**	**L**	**-**	**H**	**L**	**L**	**-**	**L**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

Industrial Safety (MTEEPS302B)

COURSE OBJECTIVE

1. To know about Industrial safety
2. To know about fundamental concepts of maintenance engineering.
3. To know about preventive measures to be taken.

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

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

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

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

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

References:

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

COURSE OUTCOMES

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

CO1: Understand the role industrial safety.

CO2: Understand fundamentals of maintenance engineering.

CO3: Learn different methods of Wearing and Corrosion and their prevention.

CO4: Trace out the faults occurring in various electrical systems.

CO5: Know about Periodic and preventive maintenance of various systems.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L2**	**H**	**M**	**M**	**H**	**-**	**L**	**M**	**L**	**H**	**M**	**L**	**-**
CO2	**L2**	**-**	**L**	**M**	**-**	**M**	**L**	**M**	**-**	**H**	**M**	**L**	**L**
CO3	**L2**	**H**	**H**	**L**	**H**	**M**	**H**	**M**	**M**	**L**	**M**	**L**	**L**
CO4	**L5**	**H**	**-**	**-**	**M**	**-**	**H**	**H**	**H**	**M**	**L**	**M**	**-**
CO5	**L6**	**H**	**L**	**L**	**-**	**L**	**-**	**-**	**M**	**-**	**-**	**M**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

Operations Research (MTEEPS302C)

COURSE OBJECTIVE

1. To know about the optimization Techniques.
2. To know about Competitive Models.
3. To learn about Formulation of a LPP.

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

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

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

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

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

References:

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

COURSE OUTCOMES

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

CO1: Should able to carry out sensitivity analysis.
CO2: Should able to model the real world problem and simulate it.
CO3: Should able to apply the dynamic programming to solve problems of discreet and continuous variables.
CO4: Should able to apply the concept of non-linear programming
CO5: Should be able to formulate optimization techniques.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L3**	**M**	**-**	**L**	**M**	**-**	**M**	**M**	**M**	**-**	**M**	**L**	**-**
CO2	**L6**	**H**	**L**	**M**	**H**	**L**	**H**	**H**	**H**	**-**	**H**	**M**	**L**
CO3	**L3**	**M**	**M**	**L**	**M**	**L**	**M**	**M**	**-**	**M**	**M**	**L**	**L**
CO4	**L3**	**-**	**M**	**L**	**-**	**M**	**H**	**-**	**H**	**H**	**L**	**M**	**-**
CO5	**L6**	**L**	**-**	**L**	**M**	**L**	**-**	**-**	**L**	**L**	**-**	**M**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

Cost Management of Engineering Projects (MTEEPS302D)

COURSE OBJECTIVE

1. To know about Cost concepts in decision-making
2. To know about Project making.
3. To know about Cost Behavior and Profit Planning Marginal Costing

Unit 1: Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit 2: Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution : conception to commissioning. Project execution as conglomeration of technical and non technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team : Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

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

Unit 4: Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

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

References:

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

COURSE OUTCOMES

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

CO1: Should able to do cost management for various projects.

CO2: Should able to understand the meaning of cost management.

CO3: Should able to analyze Cost Behavior and Profit Planning.

CO4: Understand Quantitative techniques for cost management

CO5: Analyze the pricing and apply for various projects.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L3**	**L**	**L**	**-**	**L**	**M**	**L**	**-**	**M**	**M**	**-**	**L**	**M**
CO2	**L2**	**L**	**-**	**M**	**-**	**H**	**L**	**H**	**-**	**L**	**L**	**L**	**L**
CO3	**L5**	**-**	**M**	**L**	**L**	**M**	**-**	**M**	**M**	**-**	**M**	**L**	**L**
CO4	**L3**	**L**	**M**	**L**	**M**	**-**	**H**	**-**	**L**	**M**	**L**	**M**	**L**
CO5	**L2**	**L**	**-**	**L**	**-**	**L**	**M**	**M**	**L**	**L**	**-**	**L**	**L**

H- High, M- Moderate, L- Low, '-' for No correlation

Composite Materials (MTEEPS302E)

COURSE OBJECTIVE

1. To know about introduction to composite materials.
2. To know about reinforcements.
3. To know about manufacturing process of composite materials.

UNIT–I: INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II: REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

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

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

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

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES

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

CO1: Understand Definition – Classification and characteristics of Composite materials.

CO2: Know about Reinforcements.

CO3: Know about manufacturing of Metal Matrix Composites.

CO4: Know about manufacturing of Polymer Matrix Composites:

CO5: Know about strength and laminates.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L4**	**L**	**L**	**-**	**H**	**H**	**-**	**H**	**L**	**-**	**L**	**M**	**-**
CO2	**L2**	**L**	**-**	**M**	**H**	**-**	**L**	**H**	**-**	**M**	**M**	**L**	**L**
CO3	**L2**	**M**	**L**	**L**	**-**	**L**	**H**	**-**	**L**	**L**	**-**	**L**	**L**
CO4	**L2**	**-**	**M**	**-**	**M**	**M**	**-**	**H**	**M**	**-**	**M**	**L**	**-**
CO5	**L2**	**L**	**L**	**L**	**-**	**L**	**H**	**-**	**L**	**L**	**-**	**L**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

Waste to Energy (MTEEPS302F)

COURSE OBJECTIVE

1. To know about Energy waste introduction.
2. To know about Biomass process.
3. To know about various types of biomass plants and gasifiers.

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

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

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

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

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

References:

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

COURSE OUTCOMES

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

CO1: Know about various forms of Energy wastage.

CO2: Know about Biomass introduction.

CO3: Know about Biomass gasifiers.

CO4: Know about Biogas properties.

CO5: Know about Biomass combustion.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Bloom Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	**L4**	**H**	**-**	**H**	**L**	**-**	**L**	**H**	**H**	**H**	**-**	**M**	**L**
CO2	**L2**	**L**	**L**	**L**	**M**	**L**	**L**	**L**	**L**	**L**	**-**	**L**	**L**
CO3	**L2**	**H**	**L**	**-**	**L**	**-**	**-**	**H**	**H**	**H**	**-**	**L**	**L**
CO4	**L2**	**L**	**M**	**L**	**-**	**L**	**L**	**-**	**L**	**L**	**L**	**M**	**-**
CO5	**L2**	**H**	**-**	**H**	**M**	**L**	**-**	**H**	**-**	**H**	**-**	**M**	**-**

H- High, M- Moderate, L- Low, '-' for No correlation

Dissertation-I / Industrial Project (MTEEPS303)

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

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

COURSE OUTCOMES

By the end of this course every student is expected to be able to

CO1: handle research problems and use modern research tools/methods.
CO2: analyze and review the existing literature on a research problem.
CO3: design and conduct experiments.
CO4: write dissertation and technical reports.
CO5: publish research papers.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L3	M	H	H	L	M	-	-	-	-	-	**M**	**M**
CO2	L4	M	M	H	L	M	M	-	-	-	L	**M**	**L**
CO3	L6	H	L	M	M	H	L	-	-	-	M	**H**	**L**
CO4	L3	H	-	M	H	H	H	-	-	-	L	**M**	**M**
CO5	L3	H	-	M	H	M	H	-	-	-	L	**M**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

Semester IV

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

Dissertation II (MTEEPS401)

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

COURSE OUTCOMES

By the end of this course every student is expected to be able to

CO1: handle research problems and use modern research tools/methods.
CO2: analyze and review the existing literature on a research problem.
CO3: design and conduct experiments.
CO4: write dissertation and technical reports.
CO5: publish research papers.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L3	M	H	H	L	M	-	-	-	-	-	**M**	**M**
CO2	L4	M	M	H	L	M	M	-	-	-	L	**M**	**L**
CO3	L6	H	L	M	M	H	L	-	-	-	M	**H**	**L**
CO4	L3	H	-	M	H	H	H	-	-	-	L	**M**	**M**
CO5	L3	H	-	M	H	M	H	-	-	-	L	**M**	**M**

H- High, M- Moderate, L- Low, '-' for No correlation

Audit Courses (Common for all)

AUDIT 1 and 2 : English for Research Paper Writing

COURSE OBJECTIVE

- To understand that how to improve your writing skills and level of readability
- To learn about what to write in each section
- To understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

Syllabus

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

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

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

UNIT-3: key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when Writing a Review of the Literature.

UNIT-4: skills are needed when writing the Methods, skills needed when writing the Results, Skills are needed when writing the Discussion; skills are needed when writing the Conclusions.

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

Suggested Studies:

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

COURSE OUTCOMES

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

CO1: Students should know how to Plan and Prepare research paper.

CO2: Knowledge of Paraphrasing, Plagiarism and Literature review.

CO3: Knowledge and understanding of write every aspect and part of thesis like Abstract, Literature review, Title, etc,.

CO4: Discussion and skills developed in students when writing the Conclusions.

CO5: Ensuring students to write the paper first- time and also giving them knowledge about the quality of paper and procedure of Submission.

AUDIT 1 and 2: Disaster Management

COURSE OBJECTIVE

- To demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- To critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- To develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- To critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

Syllabus

UNIT-1: Introduction

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

UNIT-2: Repercussions Of Disasters And Hazards: Economic Damage, Loss Of Human And Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks Of Disease And Epidemics, War and Conflicts.

UNIT-3: Disaster Prone Areas In India Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics.

UNIT-4: Disaster Preparedness and Management

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT-5: Risk Assessment

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation In Risk Assessment and Warning, People's Participation In Risk Assessment. Strategies For Survival.

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

Suggested Studies:

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

COURSE OUTCOMES

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

CO1: Knowledge of disaster and its types.

CO2: Knowledge of Repercussions of Disasters And Hazards.

CO3: Study of Seismic Zones and Disaster Prone Areas In India.
CO4: Study of Disaster Preparedness and Management.
CO5: Understanding Disaster Risk Situation, Risk Assessment and Disaster Mitigation in India.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	L1	H	M	H	L	-	L	M	L	L	M	L	L
CO2	L1	M	H	L	L	M	M	-	-	M	L	L	L
CO3	L2	-	M	L	M	L	M	-	M	H	M	L	L
CO4	L2	M	H	-	L	M	L	-	M	M	M	L	L
CO5	L2	M	M	L	H	M	L	L	H	L	-	L	L

H- High, M- Moderate, L- Low, '-' for No correlation

AUDIT 1 and 2 : Sanskrit for Technical Knowledge

COURSE OBJECTIVE

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- To do Learning of Sanskrit to improve brain functioning
- To have thorough Learning of Sanskrit to develop the logic in mathematics, science & other subjects
- To enhance the memory power
- To explore the huge knowledge from ancient literature

Syllabus

UNIT-1: Alphabets in Sanskrit.

UNIT-2: Past/Present/Future Tense.

UNIT-3: Simple Sentences Order.

UNIT-4: Introduction of roots.

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

Suggested Studies:

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

COURSE OUTCOMES OF SANSKRIT FOR TECHNICAL KNOWLEDGE

At the end of the course, the student will be able to:

CO1: Knowledge of Alphabets in Sanskrit.

CO2: Knowledge of Past/Present/Future Tense.

CO3: Study of Simple Sentences Order.

CO4: Introduction of roots and its knowledge.

CO5: Understanding Technical information and concepts about Sanskrit Literature and related Engineering concepts.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L1	M	M	H	L	-	L	M	L	L	L	L	L
CO2	L1	M	-	L	L	M	-	H	M	M	L	L	L
CO3	L2	L	H	L	M	H	M	L	M	H	M	L	L
CO4	L1	M	H	-	L	M	L	-	-	M	L	L	L
CO5	L2	-	M	L	L	M	M	L	H	L	-	L	L

H- High, M- Moderate, L- Low, '-' for No correlation

AUDIT 1 and 2 : Value Education

COURSE OBJECTIVE

- To understand value of education and self-development
- To imbibe good values in students
- To let the should know about the importance of character

Syllabus

UNIT-1: Values and self-development –Social values and individual attitudes.

Work ethics, Indian vision of humanism.

 Moral and non- moral valuation. Standards and principles.

 Value judgments

UNIT-2: Importance of cultivation of values.

 Sense of duty. Devotion, Self-reliance. Confidence, Concentration.

Truthfulness, Cleanliness.

 Honesty, Humanity. Power of faith, National Unity.

 Patriotism. Love for nature ,Discipline

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

 Punctuality, Love and Kindness.

 Avoid fault Thinking.

 Free from anger, Dignity of labor.

 Universal brotherhood and religious tolerance.

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

 True friendship.

 Happiness Vs suffering, love for truth.

 Aware of self-destructive habits.

 Association and Cooperation.

 Doing best for saving nature

UNIT-5: Character and Competence –Holy books vs. Blind faith.

 Self-management and Good health.

 Science of reincarnation.

 Equality, Nonviolence ,Humility, Role of Women.

 All religions and same message.

 Mind your Mind, Self-control.

 Honesty, Studying effectively.

Suggested Studies:

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

COURSE OUTCOMES

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

CO1: Knowledge of Values and self-development.

CO2: Understanding the Importance of cultivation of values.

CO3: Study of Personality and Behavior Development.

CO4: Understanding and inculcating Positive Thinking.

CO5: Study of Character and Competence.

Mapping of Course Outcomes with Program Outcomes

Course Outcome S	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L2	M	H	H	L	-	L	M	L	L	L	L	L
CO2	L1	M	M	L	L	M	L	M	-	M	L	L	L
CO3	L2	L	H	L	M	M	M	M	L	H	-	L	L
CO4	L2	M	H	-	L	M	-	-	L	M	L	L	L
CO5	L2	-	M	L	L	M	L	L	L	L	L	L	L

H- High, M- Moderate, L- Low, '-' for No correlation

AUDIT 1 and 2 : Constitution of India

COURSE OBJECTIVE

- To understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- 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.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the IndianConstitution.

Syllabus

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

History Drafting Committee, (Composition & Working).

Philosophy of the Indian Constitution: Preamble Salient Features.

UNIT-2: Contours of Constitutional Rights & Duties:

 Fundamental Rights

 Right to Equality

 Right to Freedom

 Right against Exploitation

 Right to Freedom of Religion

 Cultural and Educational Rights

 Right to Constitutional Remedies

 Directive Principles of State Policy

 Fundamental Duties.

UNIT-3: Organs of Governance:

 Parliament

 Composition

 Qualifications and Disqualifications

 Powers and Functions

 Executive

 President

 Governor

 Council of Ministers

 Judiciary, Appointment and Transfer of Judges, Qualifications

 Powers and Functions

UNIT-3: Local Administration:

 District's Administration head: Role and Importance,

 Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.

 Pachayati raj: Introduction, PRI: Zila Pachayat.

 Elected officials and their roles, CEO Zila Pachayat: Position and role.

 Block level: Organizational Hierarchy (Different departments),

 Village level: Role of Elected and Appointed officials,

 Importance of grass root democracy

UNIT-5: Election Commission:

 Election Commission: Role and Functioning.

 Chief Election Commissioner and Election Commissioners.

 State Election Commission: Role and Functioning.

 Institute and Bodies for the welfare of SC/ST/OBC and women.

Suggested Studies:

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

COURSE OUTCOMES

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

CO1: Knowledge of History and Philosophy of the Indian Constitution.

CO2: Understanding the Contours of Constitutional Rights & Duties.

CO3: Study of Organs of Governance.

CO4: Understanding the Local Administration.

CO5: Study of Election Commission.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L1	M	H	H	L	-	L	M	L	L	M	L	L
CO2	L2	M	M	L	M	M	-	M	M	M	H	-	-
CO3	L2	L	M	L	M	L	M	H	M	H	M	-	-
CO4	L2	-	H	-	L	M	H	-	M	M	-	L	-
CO5	L2	L	M	L	L	M	L	L	-	L	L	L	L

H- High, M- Moderate, L- Low, '-' for No correlation

AUDIT 1 and 2 : Pedagogy Studies

COURSE OBJECTIVE

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

Syllabus

UNIT-1: Introduction and Methodology:

 Aims and rationale, Policy background, Conceptual framework and terminology

 Theories of learning, Curriculum, Teacher education.

 Conceptual framework, Research questions**.**

 Overview of methodology and Searching.

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

 Curriculum, Teacher education

UNIT-3: Evidence on the effectiveness of pedagogical practices

 Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

 Theory of change.

 Strength and nature of the body of evidence for effective pedagogical practices.

 Pedagogic theory and pedagogical approaches.

 Teachers' attitudes and beliefs and Pedagogic strategies

UNIT-4: Professional development: alignment with classroom practices and follow up support

 Peer support

 Support from the head teacher and the community.

 Curriculum and assessment

 Barriers to learning: limited resources and large class sizes

UNIT-5: Research gaps and future directions

 Research design

 Contexts

 Pedagogy

 Teacher education

 Curriculum and assessment

 Dissemination and research impact

Suggested Studies:

- Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
- Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
- Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
- Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
- Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
- Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
- www.pratham.org/images/resource%20working%20paper%202.pdf.

COURSE OUTCOMES

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

CO1: Knowledge of Theories of learning and Conceptual framework.

CO2: Understanding the Pedagogical practices.

CO3: Interpretating the Theory of change when pedagogical practices are done.

CO4: Understanding the Professional development and Barriers to learning.

CO5: Study of Research gaps and future directions.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L1	H	M	H	L	-	L	M	L	L	L	L	L
CO2	L2	M	M	L	L	M	M	-	M	M	L	L	L
CO3	L2	H	H	L	M	M	M	M	M	H	M	L	L
CO4	L2	L	H	-	L	M	-	M	-	M	M	L	L
CO5	L2	L	M	L	L	M	L	L	L	L	-	L	L

H- High, M- Moderate, L- Low, '-' for No correlation

AUDIT 1 and 2: Stress Management by Yoga

COURSE OBJECTIVE

- To achieve overall health of body and mind
- To overcome stress

Syllabus

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

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

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

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

UNIT-4: Asan and Pranayam

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

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

Suggested Studies:

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

COURSE OUTCOMES

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

CO1: Knowledge of Eight parts of yog (Ashtanga).

CO2: Understanding the Do`s and Don't's in life.

CO3: Knowledge and application of Ahinsa, satya, astheya, bramhacharya, aparigraha, Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

CO4: Pracicing Asan and Pranayam..

CO5: Regularization of breathing techniques and its effects.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L1	M	M	H	L	-	L	M	L	L	L	L	L
CO2	L2	M	M	L	L	M	M	H	-	M	-	L	L
CO3	L1,L3	L	H	L	M	L	M	M	M	H	M	L	L
CO4	L3	M	H	-	L	M	M	-	M	M	M	-	-
CO5	L1,L2	L	M	L	L	M	L	H	L	L	L	-	-

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AUDIT 1 and 2: Personality Development through Life Enlightenment Skills

COURSE OBJECTIVE

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

Syllabus

UNIT-1: Neetisatakam - Holistic development of personality

 Verses- 19,20,21,22 (wisdom)

 Verses- 29, 31, 32 (pride & heroism)

 Verses- 26,28,63,65 (virtue)

 Verses- 52, 53, 59 (dont's)

 Verses- 71,73,75,78 (do's)

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

 Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47, 48,

 Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5, 13, 17,

23, 35,

 Chapter 18-Verses 45, 46, 48.

UNIT-3: Statements of basic knowledge.

 Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68

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

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

 Chapter2-Verses 17,

 Chapter 3-Verses 36, 37, 42,

 Chapter 4-Verses 18, 38, 39

 Chapter18 – Verses 37, 38, 63

Suggested Studies:

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata.

2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

COURSE OUTCOMES

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

CO1: Knowledge of Neetisatakam - Holistic development of personality.

CO2: Approach to day to day work and duties.

CO3: Understanding the Theory of Statements of basic knowledge.

CO4: Understanding the Personality of Role model. Shrimad Bhagwad Geeta.

CO5: Study of Personality Development through Life Enlightenment Skills.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2
CO1	L1	M	M	M	L	-	L	M	L	L	M	-	-
CO2	L1,L2	M	H	L	L	M	M	-	H	M	L	-	-
CO3	L2	L	H	L	M	M	L	M	L	H	L	-	-
CO4	L2	M	L	-	L	L	M	M	M	M	-	-	-
CO5	L2	M	M	L	L	M	L	L	L	L	M	-	-

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6. TEACHING-LEARNING PROCESS/ METHODOLOGY (TLM):

The teaching-learning process should be aimed at systematic exposition of basic concepts so as to acquire knowledge of technical program in a canonical manner. In this context, applications of technical program and linkage with the theory constitute a vital aspect of the teaching-learning process. The course offers many modes of learning and assessment methods. Students have great freedom of choice of course which they can study. The various components of teaching learning process are summarized in the following heads.

1. **Class room Lectures:** The most common method of imparting knowledge is through lectures.There are diverse modes of delivering lectures such as through blackboard, power point presentation and other technology aided means. A judicious mix of these means is a key aspect of teaching-learning process.

2. **Tutorials:** To reinforce learning, to monitor progress, and to provide a regular pattern ofstudy, tutorials are essential requirements. During these tutorials, difficulties faced by the students in understanding the lectures, are dealt with. Tutorials are also aimed at solving problems associated with the concepts discussed during the lectures.

3. **Practical:** To provide scientific visualization and obtaining results of Technical program inpractical sessions. These sessions provide vital insights into scientific concepts and drawlearner's attention towards limitations of scientific computations. During practical, scientific models arising in real life problems can also be simulated.

4. **Choice based learning/Open elective:** LOCF in this undergraduate program providesgreat flexibility both in terms of variety of courses and range of references in each course.

5. **Field based learning:** Students may enhance their knowledge through field based learningwhile understanding the practical importance.

6. **Textbooks learning:** A large number of books are included in the list of references of eachcourse for enrichment and enhancement of knowledge.

7. **E-learning:** Learner may also access electronic resources and educational websites for betterunderstanding and updating the concepts.

8. **Self-study materials:** Self-study material provided by the teachers is an integral part oflearning. It helps in bridging the gaps in the classroom teaching. It also provides scope for teachers to give additional information beyond classroom learning.

9. **Assignment/Problem solving:** Assignments at regular intervals involving applications oftheory are necessary to assimilate basic concepts of courses. Hence, it is incumbent on the part of a learner to complete open-ended projects assigned by the teacher.

10. **Internships:** The teaching-learning process needs to be further supported by other activitiesdevoted to subject-specific and interdisciplinary skills, summer and winter internships. During these internships it is expected that a learner will interact with experts and write a report on a topic provided to the learner.

11. **Institute visits:** Institute visit by a learner is also a part of learning process. During suchvisits a learner has access to knowledge by attending academic activities such as seminars, colloquia, library consultation and discussion with faculty members. These activities provide guidance and direction for further study.

12. **Industrial visits:** Industrial visits offer an opportunity to observe applications of scientific concepts. These visits also give an opportunity to realize the power of mathematical ideas and their translation in problem solving.

13. **Training programs:** Training programs organized by various agencies/institutes provide an opportunity to learn various dimensions of courses.