GANGA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, KABLANA (JHAJJAR)

An Autonomous Institute

'A' GRADE ACCREDITED BY NAAC

Evaluation Scheme & Syllabus For

Master of Technology

(Electrical Power System)

(Effective from the Session: 2024-25)

APPROVED BY AICTE, NEW DELHI AND AFFILIATED TO MDU, ROHTAK

1. DEFINITION OF CREDIT

1	1 Lecture (L) per week	1 Credit
2	4 Project per week	2 Credit
3	2 Practical (Lab) per week	1 Credit
4	2 Seminar per week	2 Credit

2. RANGE OF CREDIT

A credits of 81 for a student to be eligible to get Post Graduate degree in Engineering.

3. STRUCTURE OF POSTGRADUATE ENGINEERING PROGRAM (M.TECH)

Sr. No.	Category	Breakup of Credits
1	Professional Core Courses	28
2	Professional Elective Courses (Relevant to chosen specialization/branch)	8
3	Multidisciplinary Open Elective Courses	6
4	Foundation Elective Courses	3
5	Mandatory Learning Courses	3
6	Seminar	6
7	Lab Courses	3
8	Project	2
9	Dissertation	22
	Total Credits	**81**

**Minor variation is allowed as per need of the respective disciplines.*

4. COURSE CODE AND DEFINITIONS

Sr. No.	Category	Course Code
1	Professional Core Courses	PCC
2	Professional Elective Courses (Relevant to chosen specialization/branch)	PEC
3	Mandatory Learning Courses	MLC
4	Multidisciplinary Open Elective Courses	OEC
5	Foundation Elective Courses	FEC
6	Seminar	SM
7	Lab Courses	LC
8	Project	PROJ
9	Dissertation	DISS

GANGA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, KABLANA, JHAJJAR (HR.)

Scheme of Studies and Examination

M.Tech (Electrical Power Systems) – 1st Semester

w.e.f. 2024-25

Sr. No.	Category	Course Code	Course Title	Hours per week			Total Load Per Week	Credits	Examination Scheme (Marks)				Exam Duration in H
				Lecture (L)	Tutorial (T)	Practical (P)			Assessment	End Semester Examination		Total	
										Theory	Practical		
1	Professional Core Courses	PCC-MTEPS-101A	Microprocessor & Microcontroller	4	0	0	4	4	40	60		100	3
2	Professional Core Courses	PCC-MTEPS-103A	HVDC Transmission	4	0	0	4	4	40	60		100	3
3	Professional Core Courses	PCC-MTEPS-105A	Power System Operation and Control	4	0	0	4	4	40	60		100	3
4	Professional Core Courses	PCC-MTEPS-107A	Reactive Power Compensation & Management	4	0	0	4	4	40	60		100	3
5	Professional Core Courses	PCC-MTEPS-109A	Electrical Distribution System	4	0	0	4	4	40	60		100	3
6	Lab Course	LC-MTEPS-111A	Power System Lab	0	0	2	2	1	25		25	50	3
7	Lab Course	LCMTEPS-113A	Simulation Lab	0	0	2	2	1	25		25	50	3
8	Seminar	SM-MTEPS-115A	Seminar-I	0	0	2	2	2	50			50	
Total Credits								**24**				**650**	

GANGA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, KABLANA, JHAJJAR (HR.)

Scheme of Studies and Examination

M.Tech (Electrical Power Systems) – 2nd Semester

w.e.f. 2024-25

Sr. No.	Category	Course Code	Course Title	Hours per week			Total Load Per Week	Credits	Examination Scheme (Marks)				Exam Duration in H
				Lecture (L)	Tutorial (T)	Practical (P)			Assessment	End Semester Examination		Total	
										Theory	Practical		
1	Professional Core Courses	PCC-MTEPS-102A	Power System Dynamics and Stability	4	0	0	4	4	40	60		100	3
2	Professional Core Courses	PCC-MTEPS-104A	FACTS Controller	4	0	0	4	4	40	60		100	3
3	Professional Elective Courses	Refer Table -I	……	4	0	0	4	4	40	60		100	3
4	Multidisciplinary Open Elective Courses	Refer Table -II	……	3	0	0	3	3	40	60		100	3
5	Foundation Elective Courses	Refer Table -III	……	3	0	0	3	3	40	60		100	3
6	Lab Course	LC-MTEPS-116A	Soft Computing Lab	0	0	2	2	1	25		25	50	3
7	Seminar	SM-MTEPS-118A	Seminar-II	0	0	2	2	2	50			50	
Total Credits								**21**				**600**	

GANGA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, KABLANA, JHAJJAR (HR.)

Scheme of Studies and Examination

M.Tech (Electrical Power Systems) – 3rd Semester

w.e.f. 2024-25

Sr. No.	Category	Course Code	Course Title	Hours per week			Total Load Per Week	Credits	Examination Scheme (Marks)				Exam Duration in H
				Lecture (L)	Tutorial (T)	Practical (P)			Assessment	End Semester Examination		Total	
										Theory	Practical		
1	Mandatory learning courses	MLC-01A	Research Methodology & IPR	3	0	0	3	3	40	60		100	3
2	Professional Elective Courses	Refer Table -IV	……	4	0	0	4	4	40	60		100	3
3	Multidisciplinary Open Elective Courses	Refer Table -V	……	3	0	0	3	3	40	60		100	3
4	Project Courses	PROJ-MTEPS-211A	Project	0	0	4	4	2	50		50	100	3
5	Seminar	SM-MTEPS-213A	Seminar-III	0	0	2	2	2	50			50	
6	Dissertation	DISS-MT-EPS-215A	Literature Survey (Dissertation stage 1)	0	0	4	4	2	100			100	
Total Credits								**16**				**550**	

GANGA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, KABLANA, JHAJJAR (HR.)

Scheme of Studies and Examination

M.Tech (Electrical Power Systems) – 4th Semester

w.e.f. 2024-25

Sr. No.	Category	Course Code	Course Title	Hours per week			Total Load Per Week	Credits	Examination Scheme (Marks)				Exam Duration in H
				Lecture (L)	Tutorial (T)	Practical (P)			Assessment	End Semester Examination		Total	
										Theory	Practical		
1	Dissertation	DISS-MTEPS-202A	Dissertation and viva (Dissertation Stage 2)	-	-	-	-	20	250		500	750	
Total Credits								**20**				**750**	

Notes:

- The student has to publish at least one research paper related to his/her research work in peer-reviewed/Refereed/UGC/ SCOPUS/SCI Journal/Proceeding of National/ International conference before the final viva of Dissertation Stage-2.

Table I (Professional Elective Courses)

Sr. No.	Course Code	Course
1	PEC-MTEPS-106A	Real-time control of Power System
2	PEC-MTEPS-108A	EHVAC Transmission
3	PEC-MTEPS-110A	AI Techniques
4	PEC-MTEPS-112A	Insulation technology
5	PEC-MTEPS-114A	Smart Grid Technology

Table II (Multidisciplinary Open Elective-I Courses)

Students of all M.Tech programmes are required to study one Multidisciplinary open elective course in each of the 2nd and 3rd semesters and one foundation elective course in 2nd semester for 2-year programmes. They may choose any one of the following courses (excluding the course offered by the department of their own subjects, if not stated otherwise).

Sr. No.	Course Code	Course Name	Offered by Department
1	OEC-130A	Basics of Economics	Management Department
2	OEC-132A	Fundamental of Management	Management Department
3	OEC-134A	Disaster Management	Civil department
4	OEC-136A	Industrial Safety	Fire Technology and Safety
5	OEC-138A	Indian Literature in Translation-I	Applied Sc. & Humanities (English)
6	OEC-140A	Environmental Issues	Applied Sc. & Humanities (Chemistry)
7	OEC-142A	Quantitative Research	Applied Sc. & Humanities (Mathematics)
8	OEC-144A	Sources of Energy-I	Electrical Engineering
9	OEC-146A	Operation Research	Mechanical Engineering
10	OEC-148A	Multimedia Communication	Electronics and Communication Engineering
11	OEC-150A	Introduction to Information technology	Computer science & Applications
12	OEC-152A	Cyber forensics and Security	Computer Sc. & Engineering
13	OEC-154A	Computer science and Principles	Computer Sc. & Engineering
14	OEC-156A	Software Engineering Practice	Computer Sc. & Engineering

Table III (Foundation Elective Courses)

Sr. No.	Course Code	Course Name	Offered by Department
1	FEC-158A	Basics of Accounting	Management Department
2	FEC-160A	Basics of E-Commerce	Management Department
3	FEC-162A	Elements of Banking	Management Department
4	FEC-164A	Computer Fundamentals	Computer Sc. & Engineering
5	FEC-166A	Communication and Soft Skills	Applied Sc. & Humanities (English)
6	FEC-168A	Entrepreneurship Development	Management Department
7	FEC-170A	Electronics Engineering	Electronics and Communication Engineering

Table IV (Professional Elective Courses)

Sr. No.	Course Code	Course
1	PEC-MTEPS-203A	Advanced Power System Protection
2	PEC-MTEPS-205A	Power Quality
3	PEC-MTEPS-207A	Digital Control System
4	PEC-MTEPS-209A	Demand side Energy Management

Table V (Multidisciplinary Open Elective-II Courses)

Sr. No.	Course Code	Course Name	Offered by the Department
1	OEC-131A	Fundamental of Income Tax	Management Department
2	OEC-133A	Stress Management	Management Department
3	OEC-135A	Fundamental of Marketing	Management Department
4	OEC-137A	Business Analytics	Management Department
5	OEC-139A	Statistical Tools using SPSS	Applied Sc. & Humanities (Mathematics)
6	OEC-141A	Mathematical Techniques and Applications	Applied Sc. & Humanities (Mathematics)
7	OEC-143A	MATLAB	Electrical Engineering
8	OEC-145A	Sources of Energy - II	Electrical Engineering
9	OEC-147A	Natural and Manmade Disaster	Civil Engineering
10	OEC-149A	Optimization Techniques	Computer Sc. & Engineering
11	OEC-151A	Composite Materials	Mechanical Engineering
12	OEC-153A	Cost Management of Engineering Projects	Mechanical Engineering
13	OEC-155A	Voice and Data Network	Electronics and Communication Engineering
14	OEC-157A	IT for Professionals	Computer Sc. & Applications

Course code	**PCC-MTEPS-101A**				
Category	Professional Core Courses				
Course title	**Microprocessors & Micro Controllers**				
Scheme and Credits	L	T	P	Credits	Semester-I
	4	0	0	4	
Course Objectives:	The objectives of this course are to • Gain a foundational understanding of the architecture and organization of the 8086 and 8051 microcontrollers. • Develop proficiency in using the instruction sets of the 8086 and 8051, focusing on writing and debugging assembly language programs. • Learn fundamental I/O concepts and interfacing methods for connecting peripherals to microcontroller systems. • Analyze simple embedded systems using the 8086 and 8051 microcontrollers through hands-on projects.				
Class work	40 Marks				
Exam	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	**Skills Demonstrated**	**RBT Level**
CO1	Describe the basic concept of microprocessor, microcontroller and peripheral chips.	Level 1: Remember
CO2	Compare the design and working of microprocessor and microcontroller.	Level 2: Understand
CO3	Applying interfacing between microprocessor or microcontroller and peripheral chips.	Level 3: Apply
CO4	Differentiate architecture, pin diagram and working of microprocessor and microcontroller.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2 marks each from all units and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	**Contents**
Unit-I	Introduction to 8086 Microprocessor: Register Organization of 8086, Architecture, Signal description of 8086, Physical memory Organization, and addressing modes of 8086, 8086/8088 Instruction set and assembler directives, machine language instruction formats. Introduction to advanced microprocessor: 80386 & 80486

Unit-II	Bus Operation and I/O Operations: General Bus Operation, Minimum and Maximum Mode of 8086 system, Fundamental I/O consideration, Programmed I/O, Interrupt I/O, Block transfers and DMA.
Unit-III	Introduction to Stack, Interrupts and Interfacing: Introduction to stack, stack structure of 8086/8088, interrupts and Interrupts service routine, interrupt cycle of 8086/8088, Interfacing ROM, RAM and I/O ports to Micro computer system, PPI (Programmable Peripheral Interface), 8255 modes of Operation, Interfacing A/D and D/A converters, Interfacing principles and stepper motor interfacing.
Unit-IV	Microcontroller: Introduction to 8051/31 Micro-Controller, PIN Diagram, architecture, Different modes of operation of timer/counter, addressing modes of 8051 and instruction set, Programmable interval timer 8254, Programmable Interrupt Controller 8259A, key board or display controller 8279, Programmable Communication Interface 8251 USART.

Suggested Readings:

- Microprocessors and Interfacing: Programming and Hardware by Douglas V. Hall, 2nd edition, TMH, New Delhi, 1999.
- Micro Computer Systems : The 8086/8088 family by YU-CHENG LIU, GLENN A. GIBSON, 2nd edition, PHI India, 2000.
- The 8051Microcontrollers: Architecture, Programming & Applications by Kenneth J Ayala, Second Edition, Penram International Publishing (India).
- Advanced Microprocessors and Peripherals, Architecture Programming and Interfacing by A.K. Ray & K.M. Bhurchandi, Forth reprint 2004, TMH.
- The 8051 Microcontroller and Embedded Systems – Mohammad Ali Mazdi, Janice GillispieMazidi, Pearson Education (Singapore) Pvt. Ltd., 2003.

Useful Video links:

Unit No.	Topics	Links
Unit-I	Introduction to 8086 Microprocessor	https://archive.nptel.ac.in/courses/108/103/108103157/
Unit-II	8086 Microprocessor	https://youtu.be/LnDMIaTJF6s
	I/O Operations	https://archive.nptel.ac.in/courses/108/103/108103157/
Unit-III	Stack, Interrupts and Interfacing	https://archive.nptel.ac.in/courses/108/103/108103157/
	Microprocessors and Interfacing	https://youtu.be/0t4LROuEVnw?list=PLwdnzlV3ogoXgNjr_oe5cWQIbf72ZY4Zf
	stack structure of 8086	https://archive.nptel.ac.in/courses/108/105/108105102/
Unit-IV	8051 Microcontroller	https://archive.nptel.ac.in/courses/108/105/108105102/
	Programmable Interrupt Controller 8259A	https://archive.nptel.ac.in/courses/108/107/108107029/

Course code	**PCC-MTEPS-103A**				
Category	Professional Core Courses				
Course title	**H.V.D.C. Transmission**				
Scheme and Credits	L	T	P	**Credits**	Semester-I
	4	0	0	4	
Course Objectives:	The objectives of this course are to • Understand the principles and configurations of HVDC systems and static converters. • Analyze harmonics in HVDC systems and explore control strategies for optimal performance. • Evaluate the interactions between HV AC and DC systems, focusing on stability and modulation techniques. • Implement protection methods for HVDC systems against overvoltage's and faults to ensure reliability.				
Class work	40 Marks				
Exam	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	**Skills Demonstrated**	**RBT Level**
CO1	Recall substation, general power electronics components, harmonics, transients, components of substation and transmission line components in HVDC and HVAC system.	Level 1: Remember
CO2	Understand working principle, converters, rectifier, filters, firing angle, DC links, voltage disturbances, protection system in HVDC System.	Level 2: Understand
CO3	Apply converters, rectifier, harmonics and transients filters, firing angle, DC links, voltage disturbances, protection system in HVDC System.	Level 3: Apply
CO4	Compare HVDC and HVAC system with its components, Converters. Control Schemes, power handling capabilities and other factors	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2 marks each from all units and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	**Introduction to HVDC System and Converters:** General considerations, Power Handling Capabilities of HVDC Lines, Basic Conversion principles, static converter configuration. Static Power Converters: 3-pulse, 6-pulse and 12-pulse converters, converter station and Terminal equipment, commutation process, Rectifier and inverter operation, equivalent circuit for converter – special features of converter transformers.
Unit-II	**Harmonics and Control of HVDC System:** Harmonics in HVDC Systems, Harmonic elimination, AC and DC filters, Control of HVDC Converters and systems: constant current, constant extinction angle and constant Ignition angle control. Individual phase control and equidistant firing angle control, DC power flow control.
Unit-III	**MTDC System:** Interaction between HV AC and DC systems – Voltage interaction, Harmonic instability problems and DC power modulation, Multi-terminal DC links and systems: series, parallel and series parallel systems, their operation and control.
Unit-IV	**Faults and Protection in HVDC system:** Transient over voltages in HV DC systems: Over voltages due to disturbances on DC side, over voltages due to DC and AC side line faults, Converter faults and protection in HVDC Systems: Converter faults, over current protection - valve group, and DC line protection, circuit breakers. Over voltage protection of converters, surge arresters.

Suggested Readings

1. K.R.Padiyar : High Voltage Direct current Transmission, Wiley Eastern Ltd., New Delhi – 1992.
2. E.W. Kimbark : Direct current Transmission, Wiley Inter Science – New York.
3. J.Arillaga : H.V.D.C.Transmission Peter Peregrinus ltd., London UK 1983
4. E.Uhlman : Power Transmission by Direct Current, Springer Verlag, Berlin Helberg –1985.

Useful Video links:

Unit No.	Topics	Links
Unit-I	HVDC System	https://nptel.ac.in/courses/108104013
	Converters	https://archive.nptel.ac.in/courses/108/102/108102157/
Unit-II	Harmonics and Control of HVDC System	https://archive.nptel.ac.in/courses/108/104/108104013/
	Harmonics in HVDC Systems	https://archive.nptel.ac.in/courses/108/106/108106160/
Unit-III	HVAC AND HVDC system	https://archive.nptel.ac.in/courses/108/108/108108099/
	DC power modulation	https://archive.nptel.ac.in/courses/108/108/108108035/
Unit-IV	Faults and Protection in HVDC system	https://youtu.be/6WmOuK7oVHI

Course code	**PCC-MTEPS-105A**				
Category	Professional Core Courses				
Course title	**Power System Operation and Control**				
Scheme and Credits	L	T	P	**Credits**	Semester-I
	4	0	0	4	
Course Objectives:	The objectives of this course are to • Enable students to solve Unit Commitment Problems using various methods while considering thermal and hydro constraints. • Equip students to apply Load Frequency Control techniques, including Proportional-Integral control. • Train students to analyze and optimize load frequency control in two-area systems. • Develop skills to assess economic interchange impacts, including unit commitment and transmission losses in power systems.				
Class work	40 Marks				
Exam	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	**Skills Demonstrated**	**RBT Level**
CO1	Define Unit commitment, load frequency control and generation with limited Energy supply.	Level 1: Remember
CO2	Explain unit commitment problem by different method and fuel scheduling by linear programming.	Level 2: Understand
CO3	Examine single-area and two-area load frequency control systems, focusing on steady-state and dynamic responses.	Level 3: Apply
CO4	Analyze power interchange strategies, focusing on economy interchange and transmission loss evaluation.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2 marks each from all units and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	**Unit Commitment:** Unit commitment problem: Introductions to UCP, thermal & Hydro constraints in Unit commitment: Priority list scheme method, unit commitment problem solution by priority list scheme method, Unit commitment problem solutions by Dynamic Programming Approach. Introduction, advantages of DP method over priority list scheme, Backward & forward DP approach algorithm and their flow charts.
Unit-II	**Load Frequency control-I**: Necessity of keeping frequency constant. Definition of control area, single area control, Block diagram representation of an isolated Power System, Steady State analysis, Dynamic response-uncontrolled case, Proportional plus Integral control of single area and its block diagram representation, steady state response, load frequency control and Economic dispatch control.
Unit-III	**Load Frequency control-II**: Load frequency control of 2-area system: uncontrolled case and controlled case, tie-time bias control, Optimal LF control-steady state representation, performance Index and optimal parameter adjustment.
Unit-IV	**Interchange of Power and Energy:** Interchange Evaluation and Power Pools Economy Interchange, Economy interchange Evaluation, Interchange Evaluation with unit commitment, Multiple Interchange contracts. After-the-fact production costing, Transmission Losses in transaction Evaluation, other types of Interchange, power pools, Take-or-pay fuel supply contract, composite generation production cost function.

Suggested Readings

1. Electrical Energy Systems Theory - by O.I.Elgerd, Tata McGraw-Hill Publishing Company Ltd, 2nd edition.
2. Power System Analysis by HadiSaadat – Tata McGraw Hill Publications
3. Power Generation, Operation and Control - by A.J.Wood and B.F.Wollenberg, Johnwiley & sons Inc. 1984.
4. Modern Power System Analysis - by I.J.Nagrath & D.P.Kothari, Tata McGraw-Hill Publishing Company ltd, 2nd edition.

Useful Video links:

Unit No.	Topics	Links
Unit-I	Unit Commitment	https://archive.nptel.ac.in/courses/108/102/108102047/
	Dynamic programming	https://archive.nptel.ac.in/courses/108/105/108105104/
Unit-II	Load Frequency control-I	https://archive.nptel.ac.in/courses/108/105/108105104/
	LFC single area case	https://archive.nptel.ac.in/courses/108/102/108102047/
Unit-III	LFC for two area case	https://archive.nptel.ac.in/courses/108/105/108105104/
Unit-IV	Interchange of Power and Energy	https://archive.nptel.ac.in/courses/108/101/108101005/

Course code	**PCC-MTEPS-107A**				
Category	Professional Core Courses				
Course title	**Reactive Power Compensation and Management**				
Scheme and Credits	L	T	P	**Credits**	Semester-I
	4	0	0	4	
Course Objectives:	The objectives of this course are to • Grasp the key principles of reactive power and its impact on voltage regulation and load compensation. • Explore and evaluate various methods of compensation to enhance system performance in different operating conditions. • Assess power quality issues and develop effective strategies for reactive power planning and loss reduction. • Implement load-shaping techniques and analyze power tariffs to improve efficiency in electrical systems, especially for industrial applications.				
Class work	40 Marks				
Exam	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	**Skills Demonstrated**	**RBT Level**
CO1	Recall Reactive Power Characteristics, Types of Compensation and Reactive Power Management	Level 1: Remember
CO2	Explain load compensation and its importance to society and industry	Level 2: Understand
CO3	Identify disturbances-steady –state variations – effects of under voltages – frequency Harmonics,	Level 3: Apply
CO4	Examine Load patterns – basic methods load shaping – power tariffs- KVAR based tariffs Penalties for voltage flickers and Harmonic voltage levels.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2 marks each from all units and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	**Load Compensation and Reactive Power Coordination:** Objectives and specifications – reactive power characteristics – inductive and capacitive approximate biasing – Load compensator as a voltage regulator – phase balancing and power factor correction of unsymmetrical loads- examples, Objective – Operation planning – transmission benefits – Basic concepts of quality of power supply – disturbances- steady –state variations – effects of under voltages – frequency – Harmonics, radio frequency and electromagnetic interferences**.**
Unit-II	**Reactive Power Compensation in Transmission System:** Transient state: Characteristic time periods – passive shunt compensation – static compensations- series capacitor compensation – compensation using synchronous condensers – examples, Steady-state: Uncompensated line – types of compensation – Passive shunt and series and dynamic shunt compensation – examples**.**
Unit-III	**Reactive Power Management:** Distribution side: System losses –loss reduction methods – examples – Reactive power planning – objectives – Economics Planning capacitor placement – retrofitting of capacitor, User Side: KVAR requirements for domestic appliances – Purpose of using capacitors – selection of capacitors – deciding factors – types of available capacitor, characteristics and Limitations**.**
Unit-IV	**Demand side Management:** Load patterns – basic methods load shaping – power tariffs- KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels, Typical layout of traction systems – reactive power control requirements – distribution transformers- Electric arc furnaces – basic operations- furnaces transformer –filter requirements – remedial measures –power factor of an arc furnace.

Suggested Readings

1. Reactive power control in Electric power systems by T.J.E. Miller, John Wiley and sons, 1982
2. Reactive power Management by D.M. Tagare, Tata McGraw Hill, 2004.
3. Power System Analysis by HadiSaadat – Tata McGraw Hill Publications
4. Power Generation, Operation and Control - by A.J.Wood and B.F.Wollenberg, Johnwiley & sons Inc. 1984.
5. Modern Power System Analysis - by I.J.Nagrath & D.P.Kothari, Tata McGraw-Hill Publishing Company ltd, 2nd edition.

Useful Video links:

Unit No.	Topics	Links
Unit-I	Reactive power and voltage control	http://kcl.digimat.in/nptel/courses/video/108105133/L50.html
Unit-II	Reactive Power Compensation in Transmission System	https://www.youtube.com/watch?app=desktop&v=OR5Fdfh9Hbw
Unit-III	Reactive Power Management	https://archive.nptel.ac.in/courses/108/105/108105133/
Unit-IV	Demand side management	https://youtu.be/ExIYoi8_WPM

Course code	**PCC-MTEPS-109A**				
Category	Professional Core Courses				
Course title	**Electrical Distribution System**				
Scheme and Credits	L	T	P	**Credits**	Semester-I
	4	0	0	4	
Course Objectives:	The objectives of this course are to • Develop a foundational knowledge of key concepts in distribution systems, including load modeling and load factor relationships. • Acquire skills to design and evaluate distribution feeders and substations for optimal performance and service delivery. • Learn to identify common faults and coordinate protective devices to enhance system reliability and safety. • Explore strategies for power factor correction and voltage control, focusing on the effective use of capacitors in distribution systems.				
Class work	40 Marks				
Exam	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	**Skills Demonstrated**	**RBT Level**
CO1	Recall economic factors, substation, feeders, basic components of substation and feeders etc.	Level 1: Remember
CO2	Understand the construction, design, modeling, protection systems of distribution system.	Level 2: Understand
CO3	Apply construction, design, modeling, protection systems, loss calculation techniques of distribution system..	Level 3: Apply
CO4	Analyze different factors, parameters, location, and coordination of different devices of the distribution system.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2 marks each from all units and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	**Introduction to Distribution System:** Introduction to Distribution systems, an overview of the role of computers in distribution system planning-Load modeling and characteristics: definition of basic terms like demand factor, utilization factor, load factor, plant factor, diversity factor, coincidence factor, contribution factor and loss factor-Relationship between the load factor and loss factor - Classification of loads (Residential, Commercial, Agricultural and Industrial) and their characteristics.
Unit-II	**Feeders and Substations:** Distribution Feeders and Substations: Design consideration of Distribution feeders: Radial and loop types of primary feeders, voltage levels, feeder-loading, Design practice of the secondary distribution system, Location of Substations: Rating of a Distribution Substation, service area with primary feeders. Benefits derived through optimal location of substations.
Unit-III	**Protective Devices and coordination**: Objectives of distribution system protection, types of common faults and procedure for fault calculation, Principle of operation of fuses, circuit reclosers, line sectionalizer and circuit breakers. Coordination of protective devices: General coordination procedure.
Unit-IV	**Capacitive compensation for power factor control:** Different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (Fixed and switched) power factor correction, capacitor location. Economic justification. Procedure to determine The best capacitor location, Voltage control: Equipment for voltage control, effect of series capacitors, effect of AVB/AVR, line drop compensation.

Suggested Readings

1. Electric Power Distribution System Engineering by Turan Gonen, Mc.Graw-Hill Book Company, 1986.
2. Electric Power Distribution-by A.S. Pabla, Tata McGraw-Hill Publishing Company, 4th edition, 1997.
3. M.K. Khedkar, G.M. Dhole, "A Text Book of Electrical power Distribution Automation", University Science Press, New Delhi.
4. Anthony J Panseni, "Electrical Distribution Engineering", CRC Press.
5. James Momoh, "Electric Power Distribution, automation, protection & control", CRC Press.

Useful Video links:

Unit No.	Topics	Links
Unit-I	Introduction to Distribution System	https://archive.nptel.ac.in/courses/108/107/108107112/
	Operation and planning of Distribution system	https://archive.nptel.ac.in/courses/117/103/117103149/
Unit-II	Substation	https://youtu.be/5Y_XAQMXsC8
	Distribution System Components, Systems and Operations	https://youtu.be/su2wlj877Kc
Unit-III	Protective Devices	https://archive.nptel.ac.in/courses/108/107/108107167/
Unit-IV	Capacitive compensation for power factor control	https://youtu.be/2td7tXl7Nhc

Course code	**LC-MTEPS-111A**				
Category	Laboratory Core Courses				
Course title	**Power System Laboratory**				
Scheme and Credits	L	T	P	**Credits**	Semester-I
	0	0	2	1	
Course Objectives:	The objectives of this course are to ● **Analyze the performance of synchronous machines** by determining sub-transient reactance and sequence impedances under various operating conditions. ● **Understand power system protection** through the study of IDMT overcurrent relays, static negative sequence relays, and differential relays, focusing on their characteristics and applications. ● **Analyze transmission lines**, examining the Ferranti effect, surge impedance loading, and voltage control techniques. ● **Perform transformer oil testing** to assess transformers' health, and evaluate dielectric strength, moisture content, and other key parameters.				
Assessment	25 Marks				
Practical Examination	25 Marks				
Total Marks	50				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the methods for determining sub-transient reactance and sequence impedances for synchronous machines.	Level 1: Remember
CO2	Explain the fault analysis techniques for different fault types in synchronous machines, including LG, LL, LLG, and LLLG faults.	Level 2: Understand
CO3	Apply fault analysis and relay characteristics for fault protection in power systems, including IDMT and Over Voltage Relays.	Level 3: Apply
CO4	Analyze the simulation of transmission lines and transformer testing techniques, including Ferranti effect and surge impedance.	Level 4: Analyze

LIST OF EXPERIMENTS:

S. No.	Contents
1	Determination of Sub-Transient Reactance of a Salient Pole Machine.
2	Determination of Sequence Impedances of a Cylindrical Rotor Synchronous Machine.
3	Fault Analysis of i) LG Fault ii) LL Fault iii) LLG Fault iv) LLLG Fault

4	Power Angle Characteristics of a Salient Pole Synchronous Machine.
5	Equivalent Circuit of a Three Winding Transformer.
6	Characteristics of IDMT Over Current Relay (Electro Magnetic Type).
7	Characteristics of Static Negative Sequence Relay.
8	Characteristics of Over Voltage Relay. i) Electromagnetic Type ii) Microprocessor Type
9	Characteristics of Percentage Biased Differential Relay. i) Electromagnetic Type ii) Static Type
10	Simulation of 220KV Transmission line model. i) Ferranti Effect ii) Transmission line parameter iii) Surge Impedance loadings iv) Voltage control methods
11	Transformer Oil Testing.

Virtual Lab Links:

Experiment Name	Virtual Lab Links
Determination of Sub-Transient Reactance of a Salient Pole Machine.	https://vp-dei.vlabs.ac.in/Dreamweaver/exp8.html
Determination of Sequence Impedances of a Cylindrical Rotor Synchronous Machine.	https://vp-dei.vlabs.ac.in/Dreamweaver/exp3.html
Characteristics of IDMT Over Current Relay (Electro Magnetic Type).	https://vp-dei.vlabs.ac.in/Dreamweaver/exp7.html
Characteristics of Percentage Biased Differential Relay. i) Electromagnetic Type ii) Static Type	https://vp-dei.vlabs.ac.in/Dreamweaver/exp10.html
Transformer Oil Testing.	https://vp-dei.vlabs.ac.in/Dreamweaver/exp4.html

Note: At least 10 experiments are to be performed by the students. Faculty members can add 2-3 extra experiment if they feel useful to add.

Course code	**LC-MTEPS-113A**				
Category	Laboratory Core Courses				
Course title	**Simulation Laboratory**				
Scheme and Credits	L	T	P	**Credits**	Semester-I
	0	0	2	1	
Course Objectives:	The objectives of this course are to ● Apply methods for load flow, fault analysis, and stability assessment in power systems. ● Solve economic load dispatch and unit commitment problems, with and without transmission losses. ● Perform transient stability analysis and evaluate system responses using simulation tools like SIMULINK. ● Implement control techniques, such as integral control, for multi-area power system stability and efficiency.				
Course Pre-requisite	B.Tech				
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Determine sub transient reactance of salient pole machine and Produce characteristics of different relays.	Level 1: Remember
CO2	Analyze Different types of fault and testing of transformer oil	Level 2: Understand
CO3	Analyze fault timing in different types of relays.	Level 3: Apply
CO4	Evaluate Ferranti effect and Transmission line parameters.	Level 4: Analyze

LIST OF EXPERIMENTS:

S. No.	Contents
1	Y - Bus Formation
2	Gauss-Seidel Load Flow Analysis.
3	Fast Decoupled Load Flow Analysis.
4	Decoupled Load Flow Analysis.
5	Load Flow Analysis for Distribution Systems.
6	Formation of Z-Bus.
7	Symmetrical and Unsymmetrical fault analysis using Z-Bus.
8	Economic load dispatch without and with transmission loss.
9	Unit Commitment Problem.
10	Hydro-thermal scheduling problem.
11	Transient stability analysis using point-by-point method.

12	Step Response of Two Area System with Integral Control and Estimation of Tie Line Power Deviation using SIMULINK

Virtual Lab Links

Experiment Name	Virtual Lab Link
Y - Bus Formation	https://srmeeevlab.github.io/PSA/3_Formation_of_Bus_admittance_Matrix_(without_mutual_coupling)/index.html
Gauss-Seidel Load Flow Analysis.	https://srmeeevlab.github.io/PSA/4_Power_Flow_Analysis_by_Gauss_Seidel_method/index.html
Fast Decoupled Load Flow Analysis.	https://srmeeevlab.github.io/PSA/6_Power_Flow_Analysis_by_Fast_Decoupled_Power_Flow_method/index.html

Note: At least 10 experiments are to be performed by the students. Faculty members can add 2-3 extra experiment if they feel useful to add.

Course Code	**SM-MT-115A**				
Category	Seminar				
Course Title	**Seminar-I**				
Scheme and Credits	L	T	P	**Credits**	**Semester-I**
	0	0	2	**2**	
Course Objectives	The objectives of this course are • To develop students' ability to effectively present research topics and findings by effective communication. • To improve problem-solving and critical thinking skills of the students. • **To expose students to the latest trends and advancements** by reviewing and discussing contemporary research.				
Assessment	50 Marks				
End Semester Examination	-				
Total Marks	50				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	**Skills Demonstrated**
CO1	Identify the trends and advancements in the related field.
CO2	Analyze and synthesize research literature with in-depth reviews of key studies and methodologies.
CO3	Undertake problem identification, formulation, proposing solution and analyze the impact on society, economy and environment.
CO4	Prepare a well-organized report employing elements of effective communication and critical thinking.
CO5	Demonstrate a sound technical knowledge of their research field.

Overview:
This is a course designed to help M. Tech students develop research presentation skills. The focus is on selecting a topic or research paper relevant to their specialization, conducting an in-depth review, and effectively presenting the research findings.

General Guidelines:

Topic Selection	Each student is required to choose the research topic based on published review paper(s) or literature related to their relevant field. The same topic cannot be selected by multiple students.
Approval Process	The selected paper or topic must be approved by the faculty members/committee appointed by the Head of Department.
Presentation Guidelines	Each student will have 30-40 minutes for their presentation, followed by 5 minutes for Q&A.
Evaluation	The presentation will be evaluated by a committee constituted by the Head of Department. The evaluation will be based on:

Parameters for the Evaluation of Seminar

Sr. No.	Parameters	Marks Allotted	Relevant COs
1	Clarity of the topic	10	CO1
2	Literature Survey	10	CO2
3	Content Relevancy	10	CO3
4	Presentation Skills	10	CO4
5	Q&A Response	10	CO5

Course code	**PCC-MTEPS-102A**				
Category	Professional Core Courses				
Course title	**Power System Dynamics and Stability**				
Scheme and Credits	L	T	P	**Credits**	Semester-II
	4	0	0	4	
Course Objectives:	The objectives of this course are to • Understand and apply synchronous machine models in state-space form. • Analyze steady-state and dynamic stability limits of power systems. • Gain practical experience in digital simulation for transient stability assessment. • Explore the impact of excitation systems and governors on power system stability.				
Class work	40 Marks				
Exam	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the fundamental concepts, modeling techniques, and stability analysis of synchronous machines and power systems.	Level 1: Remember
CO2	Explain the state-space representation, machine equations, and dynamic stability analysis of power systems.	Level 2: Understand
CO3	Apply eigenvalue methods and digital simulation techniques for analyzing transient stability in multi-machine systems.	Level 3: Apply
CO4	Analyze the effects of excitation systems, governors, and voltage regulators on power system stability.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2 marks each from all units and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	System Dynamics: Synchronous machine model in state space form, computer representation for excitation and governor systems –modelling of loads and induction machines, Stability – steady state stability limit – Dynamic Stability limit – Dynamic stability analysis.
Unit-II	State space representation of synchronous machine connected to infinite bus, Time response – Stability by Eigen value approach, Digital Simulation of Transient Stability: Swing equation, Machine equations.
Unit-III	Concept of Multi-machine Stability, Multi-machine Transient Stability Under Different Faulted Conditions, Effect of governor action and exciter on power system stability. Effect of saturation, saliency & automatic voltage regulators on stability.

Unit-IV	Excitation Systems : Rotating Self-excited Exciter with direct acting Rheostatic type, voltage regulator – Rotating main and Pilot Exciters with Indirect Acting Rheostatic Type Voltage Regulator, Rotating Main Exciter, Rotating Amplifier and Static Voltage Regulator – Static excitation scheme – Brushless excitation system.

Suggested Readings

1. Power System Stability by Kimbark Vol. I&II, III – 1968, Dover Publication Inc, New York 1968.
2. Power System control and stability by Anderson and Fund, Vol – I,
3. P.M. Arolerson & A.A. fouad, Galgotia Publications, New Delhi, 1981, 1 st edition.
4. Power System Dynamics Stability and Control by K.R. Padiyar, Second edition B.S. Publications 2002.
5. Computer Applications to Power Systems–Glenn.W. Stagg &Ahmed. H.El. Abiad
6. Power Systems Analysis & Stability – S.S. VadheraKhanna Publishers.
7. Power System Analysis by "HadiSaadat" – Tata McGraw Hill Publication.
8. Power System Analysis by John J.Graniger William D.Stevenson. JR. – Tata McGraw Hill Publications.

Useful Video links:

Unit No.	Topics	Links
Unit-I	Power system stability	https://archive.nptel.ac.in/courses/108/105/108105067/
	Load modelling and stability	https://archive.nptel.ac.in/courses/108/101/108101004/
Unit-II	Swing equation	https://archive.nptel.ac.in/content/storage2/courses/108104051/chapter_9/9_3.html
	Transient stability analysis	https://archive.nptel.ac.in/courses/108/105/108105133/
Unit-III	Automatic voltage regulators	https://archive.nptel.ac.in/courses/108/101/108101004/
	Effect of governor action and exciter on power system stability	https://archive.nptel.ac.in/courses/108/102/108102080/
Unit-IV	Excitation Systems	https://archive.nptel.ac.in/courses/108/101/108101004/

Course code	**PCC-MTEPS-104A**				
Category	Professional Core Courses				
Course title	**FACTS Controller**				
Scheme and Credits	L	T	P	**Credits**	Semester-II
	4	0	0	4	
Course Objectives:	The objectives of this course are to • Understand AC transmission interconnections, power flow, and dynamic stability in power systems. • Explore the types, principles, and benefits of Flexible AC Transmission Systems (FACTS) controllers. • Analyze voltage and current source converters, focusing on their configurations and harmonic characteristics. • Implement shunt and series compensation methods to improve voltage regulation and transient stability in power systems.				
Class work	40 Marks				
Exam	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the concepts, components, and operation of power systems and FACTS controllers.	Level 1: Remember
CO2	Explain the principles, characteristics, and advantages of various FACTS controllers and high-power devices.	Level 2: Understand
CO3	Apply voltage source and current source converter principles for the design and operation of FACTS controllers.	Level 3: Apply
CO4	Analyze the performance, stability enhancement, and power oscillation damping in power systems using FACTS controllers.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2 marks each from all units and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	Transmission interconnections, power flow in an AC System, loading capability limits, Power flow and Dynamic stability considerations, importance of controllable parameter, Opportunities for FACTS, basic types of FACTS controllers, benefits from FACTS controllers, Requirements and Characteristics of High-Power devices – Voltage and Current rating, losses and speed of switching, parameter trade-off of devices.
Unit-II	Basic concept of Voltage source converter, Single phase full wave bridge converter, Single phase-leg (pole) operation, Square-wave voltage harmonics for a single-phase Bridge, 3 Phase full wave bridge converter, Transformer connections for 12 pulse, 24 and 48 pulse operation. Three level voltage source converter, pulse width modulation converter, basic concept of current source converters, and comparison of current source converters with voltage source converters.
Unit-III	Objectives of shunt compensation, mid-point voltage regulation for line Segmentation, End of line voltage support to prevent voltage instability, improvement of transient stability, Power oscillation damping. Methods of controllable var generation: variable impedance type static var generators – TCR and TSR, TSC, FC-TCR, TSC-TCR, switching converter type var generators, hybrid var generators.
Unit-IV	SVC and STATCOM : The regulation and slope transfer function and dynamic Performance, transient stability enhancement and power oscillation damping, operating point control and summary of compensation control, Static series compensators: Concept of series capacitive compensation, improvement of transient stability, power oscillation damping, functional requirements. GTO thyristor controlled series capacitor (GSC), thyristor switched series capacitor (TSSC), and thyristor controlled series capacitor (TCSC), control schemes for GSC, TSSC and TCSC.

Suggested Readings

1. Understanding FACTS, N.G.Hingorani and L.Guygi, IEEE Press, Standard Publications, 2001.
2. Flexible ac transmission system (FACTS), Edited by YONG HUE SONG and ALLAN T JOHNS, Institution of Electrical Engineers, London.
3. FACTS Controllers in Power Transmission and Distribution by K.R. Padiyar, 2016, New age International Publishers.
4. Introduction to FACTS Controllers by Kalyan K Sen, Mey Ling Sen, Wiley 2009

Useful Video links:

Unit No.	Topics	Links
Unit-I	Introduction to FACTS	https://archive.nptel.ac.in/courses/108/107/108107114/
	PWM	https://youtu.be/IKrr6olW4pY
Unit-II	Multi-Level Inverter	https://youtu.be/X-_dUk-VEIY
Unit-III	Shunt compensator TCR and TSC	https://youtu.be/eGRtNTt61TI
Unit-IV	STATCOM	https://archive.nptel.ac.in/courses/108/107/108107114/
	Series compensator	https://archive.nptel.ac.in/courses/108/107/108107114/

Course code	**PEC-MTEPS-106A**				
Category	Professional Elective Courses				
Course title	**Real Time Control of Power System**				
Scheme and Credits	L	T	P	**Credits**	Semester-II
	4	0	0	4	
Course Objectives:	The objectives of this course are to • Apply various state estimation techniques, including Weighted Least Squares, to improve system accuracy. • Identify and eliminate bad data in power system measurements for enhanced reliability. • Perform security analysis and contingency evaluations to assess the impact of outages on power systems. • Implement SCADA systems for real-time control and monitoring of power systems.				
Class work	40 Marks				
Exam	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the concepts, techniques, and methods for state estimation and bad data detection in power systems.	Level 1: Remember
CO2	Explain security analysis, contingency evaluation, and the role of SCADA in power system monitoring and control.	Level 2: Understand
CO3	Apply voltage stability analysis, including P-V and Q-V curves, to assess and improve power system stability.	Level 3: Apply
CO4	Analyze the role of AI and ANN techniques for power system applications like load forecasting and fault diagnosis.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2 marks each from all units and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	**State Estimation:** Different types of State Estimations, Theory of WLS state estimation, sequential and non-sequential methods to process measurements, Bad data Observability, Bad data detection, identification and elimination.
Unit-II	**Security and Contingency Evaluation:** Security concept, Security Analysis and monitoring, Contingency Analysis for Generator and line outages by iterative linear power flow method, Fast Decoupled model, and network sensitivity methods, Computer Control of Power Systems: Need for real time and computer control of power systems, operating states of a power system.
Unit-III	**SCADA** - Supervisory control and Data Acquisition systems implementation considerations, energy control centres, software requirements for implementing the above functions, Voltage Stability: What is voltage stability, voltage collapse, and voltage security, relation of voltage stability to rotor angle stability
Unit-IV	**Voltage stability analysis**: Introduction to voltage stability analysis `P-V' curves and 'Q-V' curves, voltage stability in mature power systems, long-term voltage stability, power flow analysis for voltage stability, voltage stability static indices and Research Areas Application of AI and ANN in Power System : Basic concepts and definitions, algorithms for load flow, short term load forecasting, fault diagnosis and state estimation.

Suggested Readings

1. John J.Grainger and William D.Stevenson, Jr.: Power System Analysis, McGraw-Hill, 1994, International Edition.
2. Allen J.Wood and Bruce F.Wollenberg : Power Generation operation and control, John Wiley & Sons, 1984.
3. R.N.Dhar : Computer Aided Power Systems Operation and Analysis, Tata McGraw Hill, 1982
4. L.P.Singh : Advanced Power System Analysis and Dynamics, Wiley Eastern Ltd. 1986.
5. PrabhaKundur : Power System Stability and Control -, McGraw Hill, 1994.
6. P.D.Wasserman : `Neural Computing : Theory and Practice' Van Nostrand-Feinhold, New York.

Useful Video links:

Unit No.	Topics	Links
Unit-I	State Estimation	https://youtu.be/x0g_Oua0SkA
Unit-II	Newton-Raphson Technique	https://archive.nptel.ac.in/courses/108/107/108107028/
Unit-III	SCADA	https://archive.nptel.ac.in/courses/108/106/108106022/
Unit-IV	Criterion for assessing voltage stability	https://archive.nptel.ac.in/courses/108/107/108107028/

Course code	**PEC-MTEPS-108A**				
Category	Professional Elective Courses				
Course title	**EHVAC Transmission**				
Scheme and Credits	L	T	P	**Credits**	Semester-II
	4	0	0	4	
Course Objectives:	The objectives of this course are • Understand the principles and standards of EHV A.C. transmission, including voltage levels, power handling, and line losses. • Analyze the electrical parameters of transmission lines, including the effects of bundled conductors. • Study the electrostatic effects on system performance and biological organisms. • Explore methods for voltage control, compensation, and harmonic mitigation in power systems, focusing on SVC schemes and filter design.				
Class work	40 Marks				
Exam	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the principles, properties, and calculations for transmission lines and associated electrical parameters.	Level 1: Remember
CO2	Explain the effects of electrostatic fields, corona, and surface voltage gradients on EHV transmission systems.	Level 2: Understand
CO3	Apply power frequency voltage control techniques and compensation methods for improving EHV transmission line stability.	Level 3: Apply
CO4	Analyze static reactive compensating systems and the effects of harmonics in EHV transmission networks.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2 marks each from all units and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	E.H.V. A.C. Transmission, line trends and preliminary aspects, standard transmission voltages – power handling capacities and line losses – mechanical aspects, Calculation of line resistance and inductance: resistance of conductors, temperature rise of conductor and current carrying capacity. Properties of bundled conductors and geometric mean radius of bundle, inductance of two conductor lines and multi conductor lines, Maxwell's coefficient matrix.
Unit-II	Line capacitance calculation: capacitance of two conductor line, and capacitance of multi conductor lines, potential coefficients for bundled conductor lines, sequence inductances and capacitances and diagonalization, Calculation of electro static field of AC lines - Effect of high electrostatic field on biological organisms and human beings.
Unit-III	Surface voltage Gradient on conductors, surface gradient on two conductor bundle and cosine law, maximum surface voltage gradient of bundle with more than 3 sub-conductors, Mangolt formula, Corona : Corona in EHV lines – corona loss formulae – attenuation of traveling waves due to corona – Audio noise due to corona, its generation, characteristics and limits, measurement of audio noise.
Unit-IV	Power Frequency voltage control : Problems at power frequency, generalized constants, No load voltage conditions and charging currents, voltage control using synchronous condenser, cascade connection of components : Shunt and series compensation, sub synchronous resonance in series – capacitor compensated lines Static reactive compensating systems : Introduction, SVC schemes, Harmonics injected into network by TCR, design of filters for suppressing harmonics injected into the system.

Suggested Readings

1. Extra High Voltage AC Transmission Engineering – Rakosh Das Begamudre, Wiley Eastem ltd., New Delhi – 1987.
2. EHV Transmission line reference book – Edision Electric Institute (GEC) 1986.
3. EHV AC, HVDC Transmission and Distribution Engineering by Sunil S. Rao, 2023 Khanna Publications.
4. EHV AC, HVDC Transmission and Distribution Engineering by Sanjay Kumar Sharma, 2013 KATSON books.

Useful Video links:

Unit No.	Topics	Links
Unit-I	Introduction	https://youtu.be/1AeJ0zC90e0
Unit-II	Effect of high electrostatic field	https://archive.nptel.ac.in/courses/108/108/108108099/
Unit-III	Corona interference on transmission lines	https://youtu.be/gPxNeOYozvk
Unit-IV	Voltage control	https://www.youtube.com/watch?v=opocYkK_oSA

Course code	**PEC-MTEPS-110A**				
Category	Professional Elective Courses				
Course title	**AI Techniques**				
Scheme and Credits	L	T	P	**Credits**	Semester-II
	4	0	0	4	
Course Objectives:	The objectives of this course are • Understand neural network fundamentals and their biological inspiration, learning processes, and applications. • Master Perceptron models and training algorithms, including their limitations and real-world uses. • Explore advanced AI techniques like backpropagation, RBF networks, and genetic algorithms for optimization and classification tasks. • Apply AI methods to solve real-world problems in power systems, including load forecasting, economic dispatch, and motor control.				
Class work	40 Marks				
Exam	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define fundamental concepts and models of neural networks and fuzzy sets in AI.	Level 1: Remember
CO2	Explain the structure, training algorithms, and limitations of neural network models and their applications in AI systems.	Level 2: Understand
CO3	Apply genetic algorithms, fuzzy logic systems, and backpropagation methods to AI-based solutions.	Level 3: Apply
CO4	Analyze the use of AI techniques in load forecasting, economic dispatch, and motor control applications.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2 marks each from all units and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	**Neural Networks:** Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, introduction-neural network models-architectures knowledge representation-learning process-learning tasks, Feed Forward Neural Networks: Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem, Limitations of the Perceptron Model, Applications, ANN paradigm-back propagation-RBF algorithms-Hope field network.
Unit-II	**Genetic algorithms** - introduction- encoding - fitness function- reproduction operators, Genetic modelling- genetic operators- cross over and mutation -generational cycle-convergence of genetic algorithm.
Unit-III	**Classical AND Fuzzy Sets:** Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions, Fuzzy Logic System Components: Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.
Unit-IV	**Applications of Ai Techniques**-load forecasting-load flow studies-economic load dispatch-load frequency control-reactive power control-speed control of dc and ac motors

Suggested Readings

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajase kharan and Rai – PHI Publication.
2. Introduction to Artificial Neural Systems - Jacek M. Zuarda, Jaico Publishing House, 1997.
3. Working with AI by Steven M. Miller, Thomas H. Davenport, 2022
4. Generative Ai: Techniques, Models & Applications,18 March 2025 by Rajan Gupta, Sanju Tiwari , Poonam Chaudhary, Springer

Useful Video links:

Unit No.	Topics	Links
Unit-I	Optimal design of Neural Networks	https://youtu.be/p-77tEMG_Vg
Unit-II	Introduction to Genetic Algorithm	https://youtu.be/UzfSy2WHORM
Unit-III	Fuzzy sets	https://archive.nptel.ac.in/courses/127/105/127105006/
Unit-IV	Application of ANN	https://youtu.be/Faqe8ioMIyk

Course code	**PEC-MTEPS-112A**				
Category	Professional Elective Courses				
Course title	**Insulation Technology**				
Scheme and Credits	L	T	P	**Credits**	Semester-II
	4	0	0	4	
Course Objectives:	The objectives of this course are to • To understand the properties of dielectric materials and how external factors) affect their performance. • To analyze dielectric breakdown to predict and mitigate failure in electrical systems. • To examine the behavior of gaseous and liquid dielectrics under electric fields, including ionization and discharge phenomena. • To evaluate various insulating materials for their suitability in electrical applications, focusing on both natural and synthetic options.				
Class work	40 Marks				
Exam	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the basic properties and behavior of insulating materials under different conditions.	Level 1: Remember
CO2	Explain the breakdown mechanisms in gaseous, solid, and liquid dielectrics, and their impact on insulation systems.	Level 2: Understand
CO3	Apply theories of breakdown mechanisms and the electrical properties of dielectrics to insulation system design.	Level 3: Apply
CO4	Analyze the factors affecting dielectric strength, breakdown mechanisms, and material behavior in various environments.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2 marks each from all units and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	**General Properties of Insulating Materials:** Requirements for insulating materials - electrical properties - molecular properties of dielectrics - dependence of permittivity on temperature, pressure, humidity and voltage - permittivity of mixtures - practical importance of permittivity-behavior of dielectrics under alternating fields - complex dielectric constants-bipolar relaxation and dielectric loss - dielectric strength
Unit-II	**Breakdown Mechanisms in Gaseous Dielectrics:** Behavior of gaseous dielectrics in electric fields-gaseous discharges-different ionization processes-effect of electrodes on gaseous discharge - Townsend's theory - streamer theory - electronegative gases and their influence on gaseous discharge - Townsend's criterion for spark break down-gaseous discharges in non-uniform fields - breakdown in vacuum insulation.
Unit-III	**Breakdown Mechanisms in Solid Dielectrics:** Intrinsic breakdown of solid dielectrics - electromechanical breakdown – streamer breakdown and thermal breakdown of solid dielectrics - erosion-electrochemical breakdown - tracking in dielectrics and treeing.
Unit-IV	**Breakdown Mechanisms in Liquid Dielectrics:** Electronic breakdown of - cavitation breakdown of liquid dielectrics - suspended particle theory of breakdown of liquid dielectrics, Insulation Materials: Natural inorganic insulating materials - synthetic inorganic insulating materials – natural organic insulating materials - synthetic organic insulating materials.

Suggested Readings

1. Adrianus, J.Dekker, "Electrical Engineering materials", Prentice Hall of India Pvt. Ltd., New Delhi, 1979
2. Van Vlack, "Elements of materials science", Addison Wesley, 1964
3. Kuffel, E., Zaengl, W.S. and Kuffel J., "High Voltage Engineering Fundamentals", Newness, Second Edition, Butterworth-Heinemann Publishers, New Delhi, 2000
4. Dissado. L.A., Fothergill. J.C, "Electrical Degradation and Breakdown in Polymers", Peter Peregrinus, 1992

Useful Video links:

Unit No.	Topics	Links
Unit-I	Cables	https://youtu.be/wh6egdeiFdk
	Insulation cordination	https://youtu.be/l4yQkZd6H2U
Unit-II	Breakdown in gaseous dielectrics	https://digimat.in/nptel/courses/video/113104090/L26.html
Unit-III	Breakdown in solid dielectrics	https://digimat.in/nptel/courses/video/113104090/L26.html
Unit-IV	Breakdown in liquid dielectrics	https://digimat.in/nptel/courses/video/113104090/L26.html

Course code	**PEC-MTEPS-114A**				
Category	Professional Elective Courses				
Course title	**S**mart Grid Technology				
Scheme and Credits	L	T	P	**Credits**	Semester-I
	4	0	0	4	
Course Objectives:	The objectives of this course are to • Develop a foundational knowledge of key concepts in distribution systems, including load modeling and load factor relationships. • Acquire skills to design and evaluate distribution feeders and substations for optimal performance and service delivery. • Learn to identify common faults and coordinate protective devices to enhance system reliability and safety. • Explore strategies for power factor correction and voltage control, focusing on the effective use of capacitors in distribution systems.				
Class work	40 Marks				
Exam	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the basic concepts, components, and principles of smart grid systems and their planning.	Level 1: Remember
CO2	Explain the operation, control, and regulatory aspects of smart grids, including voltage and frequency control.	Level 2: Understand
CO3	Apply smart grid planning techniques, including demand-side management and optimal power flow analysis.	Level 3: Apply
CO4	Analyze the economic dispatch, contingency, and voltage stability in smart grid operations and control.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2 marks each from all units and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	Analysis of Smart Grid System: Smart grid concepts, smart grid components and control elements, Distributed generation resources and Energy Storage, Plug-in-Hybrid Electric Vehicles (PHEV), Microgrids, Load Flow study for AC/DC power system, smart grid Monitoring, smart grid standards and policies.
Unit-II	Smart Grid Planning: Planning Aspects of smart grid, Optimal power flow, Demand side management of smart grid, Demand response analysis of smart grid, Planning and Design of smart grid systems.
Unit-III	Voltage and frequency control of Smart Grid: (Angle/Voltage instability Phenomena, stability constraints), frequency & voltage regulations, Automatic generation Control, Tie-line power sharing, Voltage Stability assessment, Voltage and reactive power control, Shunt compensation, SVC, Voltage stability Indexing, and Volt-VAR support.
Unit-IV	Operation and Control of Smart Grids: Operational aspects of smart grid system, Economic Dispatch, Load Dispatch Centre Functions: Contingency Analysis, preventive, Emergency and Restorative, control objectives of smart distribution system, architecture and different schemes of smart grid control, bottleneck in smart grid control, Ancillary Services.

Suggested Readings

6. Electric Power Distribution System Engineering by Turan Gonen, Mc.Graw-Hill Book Company, 1986.
7. Electric Power Distribution-by A.S. Pabla, Tata McGraw-Hill Publishing Company, 4th edition, 1997.
8. M.K. Khedkar, G.M. Dhole, "A Text Book of Electrical power Distribution Automation", University Science Press, New Delhi.
9. Anthony J Panseni, "Electrical Distribution Engineering", CRC Press.
10. James Momoh, "Electric Power Distribution, automation, protection & control", CRC Press.

Useful Video links:

Unit No.	Topics	Links
Unit-I	Introduction to Distribution System	https://archive.nptel.ac.in/courses/108/107/108107112/
	Operation and planning of Distribution system	https://archive.nptel.ac.in/courses/117/103/117103149/
Unit-II	Substation	https://youtu.be/5Y_XAQMXsC8
	Distribution System Components, Systems and Operations	https://youtu.be/su2wlj877Kc
Unit-III	Protective Devices	https://archive.nptel.ac.in/courses/108/107/108107167/
Unit-IV	Capacitive compensation for power factor control	https://youtu.be/2td7tXl7Nhc

Course code	**LC-MTEPS-116A**				
Category	Lab Course				
Course title	**Soft Computing Lab**				
Scheme and Credits	L	T	P	**Credits**	**Semester-II**
	0	0	2	1	
Course Objectives	The objectives of this course are to • Master fuzzy set operations (union, intersection, complement) and apply De Morgan's laws to solve real-world problems. • Design and implement FIS using MATLAB's FIS Editor for applications like predicting tip values based on quality and service. • Use McCulloch-Pitts neurons to solve logical functions (AND, ANDNOT, XOR) and explore multi-layer networks for non-linear problems. • Implement and test Hopfield networks for storing and retrieving patterns, handling noisy or incomplete input data.				
Assessment	25 Marks				
Practical Examination	25 Marks				
Total Marks	50				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define and perform fundamental set operations such as Union, Intersection, and Complement with fuzzy sets.	Level 1: Remember
CO2	Explain De Morgan's Law and demonstrate its application with fuzzy set operations, including membership function plotting.	Level 2: Understand
CO3	Apply neural network models (McCulloch-Pitts, Hebb, and Perceptron) for logical functions, classification, and weight calculation.	Level 3: Apply
CO4	Analyze associative and Hopfield neural networks for storing and testing input patterns, weight matrices, and self-connections.	Level 4: Analyze

List of Experiments

Sr. No.	Contents
1	To perform Union, Intersection and Complement operations.
2	To implement De- Morgan's Law.
3	To plot various membership functions.
4	To implement FIS Editor. Use Fuzzy toolbox to model tip value that is given after a dinner based on quality and service.

5	To implement FIS Editor.
6	Generate AND, NOT function using McCulloch-Pitts neural net.
7	Generate XOR function using McCulloch-Pitts neural net.
8	Hebb Netto classify two dimensional input pattern sin ipolar with given targets.
9	Perceptron net for an AND function with bipolar inputs and targets.
10	To calculate the weights for given patterns using hetero-associative neural net.
11	To store vector in a nauto-associative net. Find weight matrix & amp;test the net with input.
12	To store the vector, find the weight matrix with no self-connection. Test this using a discrete Hopfield net.

Virtual Lab Links

Experiment Name	**Virtual Lab Link**
To implement FIS Editor. Use Fuzzy toolbox to model tip value that is given after a dinner based on quality and service	https://scte-iitkgp.vlabs.ac.in/exp/fuzzy-inference-system/procedure.html
Perceptron net for an AND function with bipolar inputs and targets.	https://cse22-iiith.vlabs.ac.in/exp/perceptron-learning/
To store the vector, find the weight matrix with no self-connection. Test this using a discrete Hopfield net	https://cse22-iiith.vlabs.ac.in/exp/mean-field-annealing/procedure.html
To perform Union, Intersection and Complement operations.	https://scte-iitkgp.vlabs.ac.in/exp/fundamental-fuzzy-logic/procedure.html

Course Code	**SM-MTEPS-118A**				
Category	Seminar				
Course Title	**Seminar-II**				
Scheme and Credits	L	T	P	**Credits**	**Semester-II**
	0	0	2	**2**	
Course Objectives	The objectives of this course are • To develop students' ability to effectively present research topics and findings by effective communication. • To improve problem-solving and critical thinking skills of the students. • **To expose students to the latest trends and advancements** by reviewing and discussing contemporary research.				
Assessment	50 Marks				
End Semester Examination	-				
Total Marks	50				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	**Skills Demonstrated**
CO1	Identify the trends and advancements in the related field.
CO2	Analyze and synthesize research literature with in-depth reviews of key studies and methodologies.
CO3	Undertake problem identification, formulation, proposing solution and analyze the impact on society, economy and environment.
CO4	Prepare a well-organized report employing elements of effective communication and critical thinking.
CO5	Demonstrate a sound technical knowledge of their research field.

Overview:
This is a course designed to help M. Tech students develop research presentation skills. The focus is on selecting a topic or research paper relevant to their specialization, conducting an in-depth review, and effectively presenting the research findings.

General Guidelines:

Topic Selection	Each student is required to choose the research topic based on published review paper(s) or literature related to their relevant field. The same topic cannot be selected by multiple students.
Approval Process	The selected paper or topic must be approved by the faculty members/committee appointed by the Head of Department.
Presentation Guidelines	Each student will have 30-40 minutes for their presentation, followed by 5 minutes for Q&A.
Evaluation	The presentation will be evaluated by a committee constituted by the Head of Department. The evaluation will be based on:

Parameters for the Evaluation of Seminar

Sr. No.	Parameters	Marks Allotted	Relevant COs
1	Clarity of the topic	10	CO1
2	Literature Survey	10	CO2
3	Content Relevancy	10	CO3
4	Presentation Skills	10	CO4
5	Q&A Response	10	CO5