TULSIRAMJI GAIKWAD-PATIL College of Engineering & Technology

Mohgaon, Wardha Road, Nagpur - 441 108

An Autonomous Institute

DEPARTMENT OF ELECTRICAL ENGINEERING

M.Tech. Integrated Power System

Teaching Scheme

Considering

National Education Policy 2020

From

Academic Year 2024-25

Vision of Institute

To emerge as a learning Center of Excellence in the National Ethos in domains of Science, Technology and Management.

Mission of Institute

1. To strive for rearing standard and stature of the students by practicing high standards of professional ethics, transparency and accountability.
2. To provide facilities and services to meet the challenges of Industryand Society.
3. To facilitate socially responsive research, innovation and entrepreneurship.
4. To ascertain holistic development of the students and staff members by inculcating knowledge and profession as work practices.

Vision of the Department

To emerge as a learning hub and center of excellence in the domain of Electrical Engineering.

Mission of the Department

1. To disseminate knowledge replete with quality education in the field of Electrical Engineering in meticulous and methodical manner.
2. To provide platform to address societal issues as well as challenges faced by industries.
3. To develop research culture and inculcate innovative and entrepreneurial skills.
4. To ensure overall development of students and staff by instilling knowledge and professional ethics as a part of lifelong learning.

Program Education Objectives (PEO)

1. Demonstrate and analyze the fundamental knowledge with respect to the various domains of Electrical Engineering.
2. Investigate and apply modern tools to develop innovativeness in different applications of Electrical Engineering domain.
3. Integrate new emerging trends and concepts in Electrical Engineering profession for sustainable development.
4. Develop professionals having managerial and administrative Qualities for Electrical Engineering related industries.
5. Promote lifelong learning, to prepare for the next challenges in the field of Electrical Engineering.

Program Outcomes (PO)

PO1: An ability to independently carry out research /investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report/document.

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. He should be able to inculcate research quality among himself.

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SCHEME OF INSTRUCTION & SYLLABI

Department of Electrical Engineering

Scheme of Instructions: First Year M. Tech. in Integrated Power System (As Per NEP 2020)

Semester – I

Sr. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs/Wk	Credits	Exam Scheme				
									CT-1	CT-2	TA/CA	ESE	TOTAL
1.	**PCC**	MIP21101	Advanced Power System Analysis	4	-	-	4	**4**	20	20	-	60	100
2.	**PCC**	MIP21102	High Power Converters	4	-	-	4	**4**	20	20	-	60	100
3.	**PCC**	MIP21103	Power System Modeling	4	-	-	4	**4**	20	20	-	60	100
4.	**PCC**	MIP21104	Electrical Power System Lab- I	-	-	4	4	**2**	-	-	25	25	50
5.	**PEC**	MIP21105-07	Programme Elective – I	4	-	-	4	**4**	20	20	-	60	100
6.	**PEC**	MIP21108-10	Programme Elective – II	4	-	-	4	**4**	20	20	-	60	100
			Total	**22**	**-**	**4**	**24**	**22**	**100**	**100**	**25**	**325**	**550**

L- Lecture P-Practical
CT1- Class Test 1 TA/CA- Teacher Assessment/Continuous Assessment
CT2- Class Test 2 ESE- End Semester Examination (For Laboratory End Semester performance)
TA/CA- Teacher Assessment/Class Assessment RM- Research Methodology

Course Category	PCC (Programme Core Courses)	PEC (Programme Elective courses)	OEC (Open Elective Course)	Research Methodology	Research Project/Dissertation	Semester Wise Credits
Credits	**14**	**08**	**-**	**-**	**-**	**22**
Cumulative Sum	**14**	**08**	**-**	**-**	**-**	**22**

PROGRESSIVE TOTAL CREDITS: 22

BoS Chairperson	Dean Academics PG	Vice Principal	Principal	Jul, 2024	1.00	Applicable for AY 2024-25 Onwards
				Date of Release	Version	

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SCHEME OF INSTRUCTION & SYLLABI

Department of Electrical Engineering

Scheme of Instructions: First Year M. Tech. in Integrated Power System (As Per NEP 2020)

Semester – II

Sr. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs/Wk	Credits	Exam Scheme				
									CT-1	CT-2	TA/CA	ESE	TOTAL
1.	**PCC**	MIP21201	Advanced Power System Protection	4	-	-	4	**4**	20	20	-	60	100
2.	**PCC**	MIP21202	HVDC and FACTS	4	-	-	4	**4**	20	20	-	60	100
3.	**PCC**	MIP21203	Electrical Power System Lab- II	-	-	4	4	**2**	-	-	25	25	50
4.	**PEC**	MIP21204-06	Programme Elective – III	4	-	-	4	**4**	20	20	-	60	100
5.	**PEC**	MIP21207-09	Programme Elective – IV	4	-	-	4	**4**	20	20	-	60	100
6.	**RM**	MME21204	Literature Review & Research Methodology	2	-	-	2	**2**	-	-	25	25	50
			Total	**20**	-	**06**	**22**	**20**	**80**	**80**	**50**	**290**	**500**

L- Lecture P-Practical
CT1- Class Test 1 TA/CA- Teacher Assessment/Continuous Assessment
CT2- Class Test 2 ESE- End Semester Examination (For Laboratory End Semester performance)
TA/CA- Teacher Assessment/Class Assessment RM- Research Methodology

Course Category	PCC (Programme Core Courses)	PEC (Programme Elective courses)	Research Methodology	Research Project/Dissertation	Semester Wise Credits
Semester -II	10	08	02	-	**20**
Cumulative Sum	**24**	**16**	**02**	**-**	**42**

PROGRESSIVE TOTAL CREDITS: 22+20=42

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Department of Electrical Engineering

Scheme of Instructions: Second Year M. Tech. in Integrated Power System (As Per NEP 2020)

Semester – III

Sr. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs/Wk	Credits	Exam Scheme				
									CT-1	CT-2	TA/CA	ESE	TOTAL
1.	**PEC**	MOOCs	MOOCs Course (12 weeks)	3	-	-	-	3	-	-	25	75	100
2.	**RP/DI**	MIP22302	Dissertation Phase-I	-	-	30	30	15	-	-	100	100	200
			Total	**3**	**0**	**30**	**30**	**18**	-	-	**125**	**175**	**300**

L- Lecture P-Practical
CT1- Class Test 1 TA/CA- Teacher Assessment/Continuous Assessment
CT2- Class Test 2 ESE- End Semester Examination (For Laboratory End Semester performance)
TA/CA- Teacher Assessment/Class Assessment RM- Research Methodology
RP/DI- Research Project/Dissertation

Course Category	PCC (Programme Core Courses)	PEC (Programme Elective courses)	Research Methodology	Research Project/Dissertation	Semester Wise Credits
Semester -III	-	3	-	15	**18**
Cumulative Sum	**24**	**19**	**02**	**15**	**60**

PROGRESSIVE TOTAL CREDITS: 42+18=60

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Department of Electrical Engineering

Scheme of Instructions: Second Year M. Tech. in Integrated Power System (As Per NEP 2020)

Semester – IV

Sr. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs/Wk	Credits	Exam Scheme				
									CT-1	CT-2	TA/CA	ESE	TOTAL
1	RP/DI	MIP22401	Dissertation Phase-II	-	-	40	40	20	-	-	100	200	300
			Total	**0**	**0**	**40**	**40**	**20**	-	-	**100**	**200**	**300**

L- Lecture SL-Self Learning P-Practical NHL- Notional Hrs/Wk (Total Notional Hrs)
CT1- Class Test 1 TA/CA- Teacher Assessment/Continuous Assessment
CT2- Class Test 2 ESE- End Semester Examination (For Laboratory End Semester performance)
ICA- Internal Class Assessment RP/DI- Research Project/Dissertation

Course Category	PCC (Programme Core Courses)	PEC (Programme Elective courses)	Research Methodology	Research Project/Dissertation	Semester Wise Credits
Semester-IV	-	-	-	20	**20**
Cumulative Sum	**24**	**19**	**02**	**35**	**80**

PROGRESSIVE TOTAL CREDITS: 60+20=80

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				Date of Release	Version	

Program: M. Tech. Integrated Power System
List of Program Electives offered
By
Electrical Engineering Department

Program Elective- I	Program Elective-II	Program Elective- III	Program Elective- IV
Semester -I		**Semester II**	
MIP21105 - Renewable Energy Technologies	**MIP21108 –** Restructured Power Systems	**MIP21204 -** Facts and Custom Power devices	**MIP21207 -** Power System Dynamics & Stability
MIP21106 - Micro and Smart Grid	**MIP21109 –** Electrical Power Distribution System	**MIP21205 -** Artificial Intelligence in Power System	**MIP21208 -** Utilization of Electric Energy
MIP21107 - EHV AC Transmission System	**MIP21110 –** Power Quality	**MIP21206 –** Power System Transients	**MIP21209 -** Neural Network & Fuzzy Applications to Power System

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Program: M.Tech. Integrated Power System (IPS)

Semester-II	MIP21201: Advanced Power System Protection

Teaching Scheme		**Examination Scheme**	
Theory	4 Hrs/week	**CT-I**	20 Marks
Tutorial	0 Hrs/week	**CT-II**	20 Marks
Total Credits	**04**	**ESE**	60 Marks
Duration of ESE: 3 Hrs		**Total Marks**	**100 Marks**

Pre-Requisites: Switchgear & Protection, Power System Modeling

Course Objectives:

1.	To aware students about protective relays, arc interruption theory and various faults in line.
2.	Familiarize students about protection of extra high voltage lines, electrical machines, bus bars, transformer etc.
3.	To aware students about construction, working of numerical relays and its applications.
4.	To study algorithms for numerical protection.

Course Contents

Unit I	**Review of power system Protection philosophy & Relays** Fundamental characteristics of protective relaying, types of abnormal conditions and faults, interruption of inductive and capacitive currents, pre striking voltage arc control.
Unit II	**EHV Line Protection** Protection of EHV lines against short circuit and overvoltage, Distance and carrier aided protection schemes for 3 phase lines, Stability of protection on Power Swing, Out-of-step blocking and tripping schemes, Implementation using Static relays.
Unit III	**Transformer, Machine and Bus bar Protection** Various faults occurring on transformers, alternators and large motors and complete protection against these faults, Schemes for complete protection of Bus bars
Unit IV	**Basic elements of digital protection:** Evolution of numerical relays from electromechanical relays, performance & operational characteristics of digital protection, Anti-aliasing filters, sampling, Digital filtering system- low pass, high pass, FIR and IIR Filters.
Unit V	**Algorithms** Algorithm I: Sinusoidal wave-based algorithm, first and second derivative method, two sample and three sample technique Algorithm II: Fourier analysis and Fourier transform based algorithm, Walsh function-based algorithm. Algorithm III: Incident & reflected wave, coefficient of reflection, superimposed quantities & their properties.

Text Books

T.1	Fundamentals of Power System Protection- Y. G Paithankar& S. R Bhide, 2003

T.2	Power System Protection & switchgear -Ram Badri; Vishwakarama D N , 1995

T.3	Power System Protection & switchgear -Ravindranath, B. Chander, M.; Jha, C. S.2005
T.4	Digital Protection for Power System-AT John & S.K. Salman,2004
Reference Books	
R.1	Power System Protection by Elmore (ABB)
R.2	Power System Protection by Ungradetal (Marcel Dekker Publication)
R.3	Power System Protection (Vol. I, II & III) by Warrington
Useful Links	
1	https://nptel.ac.in/courses/117/106/117106034/
2	https://nptel.ac.in/courses/108108076/
3	https://nptel.ac.in/courses/108105062/

Course Code	Course Outcomes	CL
MIP21201**.1**	**Predict** basic philosophy of power system protection.	3
MIP21201**.2**	**Evaluate** various parameters of short & long transmission line	3
MIP21201**.3**	**Apply** protective relayingfor transformers, machines, bus bars and transmission lines.	4
MIP21201**.4**	**Demonstrate** the principle, construction and application of numerical relays	4
MIP21201**.5**	**Articulate** the algorithms used for fault analysis.	3

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Program: M.Tech. Integrated Power System (IPS)

Semester-II | **MIP21202: HVDC and Facts**

Teaching Scheme		Examination Scheme	
Theory	4 Hrs/week	**CT-I**	20 Marks
Tutorial	0 Hrs/week	**CT-II**	20 Marks
Total Credits	**04**	**ESE**	60 Marks
Duration of ESE: 3 Hrs		**Total Marks**	**100 Marks**

Pre-Requisites: Power System, Switchgear and Protection, Control System

Course Objectives:

1.	To understand basics of HVDC Systems.
2.	To understand convert control modes. To understand filtering harmonics and ripple.
3.	To enable the students to acquire a comprehensive knowledge on various aspects of FACTS systems.
4.	To develop ability to implement FACTS controller.

Course Contents

Unit I	HVDC Technologies Developments in HVDC Technology, types of HVDC systems, equipments required for HVDC systems, comparison of HVDC system with AC systems in terms of technical performance, reliability of HVDC systems, comparison of HVDC link with EHVAC link, HVDC-VSC transmission systems.
Unit II	Rectifier and Inverter of HVDC systems Rectifier and inverter operation, two valve, two/three valve, three/four valve operation, voltage current equations, control chart. Control techniques of HVDC converter and systems.
Unit III	Multi terminal HVDC system and FACTS Multi terminal HVDC systems:Types, parallel operation, operation and control, control of power, faults and protection. Multi terminal networks for non conventional power sources. Flexible AC Transmission System (FACTS): Their role in power system, types of FACTS controller, principle of series and shunt controllers.
Unit IV	Shunt and series FACTS controllers Shunt controllers: Objectives, static switched capacitor, Thyristor controlled rectifier and STATCOM. Serious controllers: Objectives, GTO thyristor controlled series capacitor, thyristor controlled series capacitor, thyristor controlled series compensators (TCSC), static synchronous series compensator (SSSC)
Unit V	Other FACTS controller Working principle, control strategies and application of: Unified power flow controller (UPFC), interline power flow controller (IPFC)

Text Books

T.1	S. Kamakshaiah, V. Kamaraju, "HVDC TRANSMISSION,"McGraw Hill Education (India) Private Limited, New Delhi, 2011
T.2	K. R. Padiyar, "HVDC POWER TRANSMISSION SYSTEMS,"New Age International Publishers, 2012
T.3	Narain G. Hingorani, Laszlo Gyugyi,"Understanding FACTS concept and technology of Flexible AC Transmission Systems,"IEEE PRESS, WILEY INDIA EDITION, 2000

T.4	K. R. Padiyar, “FACTS CONTROLLERS IN POWER TRANSMISSION AND DISTRIBUTION,”NEW AGE INTERNATIONAL PUBLISHERS, 2007
Useful Links	
1	https://nptel.ac.in/courses/108104013
2	https://archive.nptel.ac.in/courses/108/106/108106160/
3	https://archive.nptel.ac.in/courses/108/107/108107114/

Course Code	Course Outcomes	CL
MIP21202.1	**Describe** types of topology and multi terminal HVDC System	3
MIP21202.2	**Describe** converter operation in various modes.	3
MIP21202.3	**Analyse** the fault in HVDC system and provide proper protection.	4
MIP21202.4	**Apply** shunt, series and their combination for compensation.	3
MIP21202.5	**Identify**, formulate and solve network problems with FACTS controller	3

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Program: M.Tech. Integrated Power System (IPS)

Semester-II MIP21204: FACTS & Custom Power Devices

Teaching Scheme		Examination Scheme	
Theory	4 Hrs/week	**CT-I**	20 Marks
Tutorial	0 Hrs/week	**CT-II**	20 Marks
Total Credits	**4**	**ESE**	60 Marks
Duration of ESE: 3 Hrs			
Pre-Requisites FACTS, Power System		**Total Marks**	**100 Marks**

Course Objectives:

1.	To understand the performance of uncompensated and compensated transmission line
2.	To understand the operation of Static VAR Compensator (SVC) and Static Synchronous Compensator (STATCOM)
3.	To understand the operation of Static Voltage and Phase angle Regulators and operation of various Series compensators
4.	To understand Sub Synchronous Resonance and how it is mitigated and the operation and control of UPFC
5.	To understand the operation of Interline power flow controller and Analyze facts controllers using simulation

Course Contents

Unit I	**Basics of Transmission System and FACTS Controllers-** Reactive power flow control in Power Systems, Control of dynamic power un-balances in Power System. Power flow control, Constraints of maximum transmission line loading, Benefits of FACTS Transmission line compensation, Reactive power compensation. - Shunt and Series compensation.
Unit II	**SVC and STATCOM -** Static versus passive VAR compensator, Static shunt compensators: SVC and STATCOM. Operation and control of TSC, TCR and STATCOM. Comparison between SVC and STATCOM.
Unit III	**Static Series Compensation-** TSSC, SSSC, static Voltage and phase angle regulators, TCVR and TCPAR Operation, Control and Applications, Static series compensation- GCSC, TSSC, TCSC and their Control.
Unit IV	**Unified Power Flow Controller-** 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 V	**Interline Power Flow Controller-** Introduction to interline power flow controller. Modelling and analysis of FACTS Controllers, Simulation of FACTS controllers, Power quality problems in distribution systems, Loads that create harmonics, series and parallel resonances, mitigation of harmonics.

Text Books	
T.1	K R Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age International Publishers, 2007.
T.2	N.G. Hingorani, L. Gyugyi, “Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems”, IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.
Reference Books	
R.1	X P Zhang, C Rehtanz, B Pal, “Flexible AC Transmission Systems-Modelling and Control”, Springer Verlag, Berlin, 2006
R.2	K.S.Suresh Kumar, S. Ashok, “FACTS Controllers & Applications”, E-book edition, Nalanda Digital Library, NIT Calicut, 2003.
Useful Links	
1	https://nptel.ac.in/courses/108107114/
2	https://new.siemens.com/global/en/products/energy/high-voltage/facts.html
3	https://new.abb.com/facts

Course Code	Course Outcomes	CL
MIP21204.1	**Analyze** the performance of Transmission line with and withoutFACTS Devices	4
MIP21204.2	**Relate** Static VAR Compensator (SVC) and Static Synchronous Compensator (STATCOM)	3
MIP21204.3	**Correlate** the operation and control ofvarious Static Series Compensators	4
MIP21204.4	**Articulate** Sub SynchronousResonance and how it is mitigated and the operation and control of UPFC	3
MIP21204.5	**Illustrate** various power quality issuesand how are they mitigated by various FACTS Devices	4

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Program: M. Tech. Integrated Power System (IPS)

Semester-II | MIP21205: Artificial Intelligence in Power System

Teaching Scheme		Examination Scheme	
Theory	4 Hrs/week	**CT-I**	20 Marks
Tutorial	0 Hrs/week	**CT-II**	20 Marks
Total Credits	**04**	**ESE**	60 Marks
Duration of ESE: 3Hrs		**Total Marks**	**100 Marks**

Pre-Requisites: Basics of Artificial Intelligence

Course Objectives:

1.	Gain a historical perspective of AI and its foundations.
2.	Become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.
3.	Investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
4.	Experience AI development tools such as an 'AI language', expert system shell, and/or data mining tool
5.	Experiment with a machine learning model for simulation and analysis
6.	Explore the current scope, potential, limitations, and implications of intelligent systems

Course Contents

Unit I	**Introduction of AI:** Introduction: AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.
Unit II	**Ontology:** Introduction to ontology, Semantic network, Frame, Structural knowledge, Declarative knowledge, Procedural knowledge. **First Order Predicate Logic:** Predicate logic, Term and logic formula, Clausal form/Conjunctive, canonical form, Standardization of logic formula, Unification and resolution, Horn clause and Prolog.
Unit III	**Fuzzy Logic: Human-like decision making:** Definition of fuzzy set, Membership function, Notation of fuzzy set, Operations of fuzzy set, Fuzzy number and operations, Extensionprinciple, Fuzzy rules, De-fuzzification, Fuzzy control Future Scope of AI.
Unit IV	**Expert Systems:** Building an expert system, application areas of expert system Knowledge Engineering, Knowledge Acquisition, Knowledge Based Systems, Automated Reasoning, Rule-Based Expert Systems Case studies: MYCIN, R1.
Unit V	**Application of AI in Power Systems:** Application of Neural Network and Expert Systems in Voltage Control, Application of ANN for security assessment, Schedule Maintenance of Electrical Power Transmission Networks using Genetic Algorithm, Intelligent Systems for Demand Forecasting.

Text Books

T.1	E. Rich and K. Knight, "Artificial intelligence", TMH, 2nd ed., 1992.
T.2	N.J. Nilsson, "Principles of AI", Narosa Publ. House, 1990.
T.3	D.W. Patterson, "Introduction to AI and Expert Systems", PHI, 1992.

Reference Books	
R.1	R.J. Schalk off, “Artificial Intelligence -an Engineering Approach”, McGraw Hill Int. Ed., Singapore, 1992.
R.2	Peter Jackson, “Introduction to Expert Systems”, AWP, M.A., 1992.
R.3	Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, Prentice Hall, 3rd, 2009
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc21_cs42/preview
2	https://nptel.ac.in/courses/106/105/106105077/
3	https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs42/

Course Code	Course Outcomes	CL
MIP21205.1	**Illustrate** the fundamentals of Artificial Intelligence and its characteristics	3
MIP21205.2	**Classification** of different aspect ofOntology and Predicate Logic	4
MIP21205.3	**Determine** the parameters ofFuzzy logic and its control.	5
MIP21205.4	**Analyze** the types of expertsystems	4
MIP21205.5	**Design** and develop application of AI inPower Systems	6

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First Year (Semester-II) M. Tech. Integrated Power System

MIP21206: Power System Transients

Teaching Scheme		Examination Scheme	
Lectures	4 Hrs./week	**CIE**	40 Marks
Tutorial	-	**ESE**	60 Marks
Total Credit	4	**Total**	100 Marks
		Duration of ESE: 03 Hrs. 00 Min.	

Course Objective:

1	Generation of switching transients and their control using circuit – theoretical concept.
2	Mechanism of lighting strokes and the production of lighting surges.
3	Propagation, reflection and refraction of travelling waves.
4	Voltage transients caused by faults, circuit breaker action, load rejection on integrated power system.

Course Contents		Hours
Unit I	**INTRODUCTION AND SURVEY:** Review and importance of the study of transients - causes for transients. RL circuit transient with sine wave excitation - double frequency transients - basic transforms of the RLC circuit transients. Different types of power system transients - effect of transients on power systems – role of the study of transients in system planning.	**(9)**
Unit II	**SWITCHING TRANSIENTS:** Over voltages due to switching transients - resistance switching and the equivalent circuit for interrupting the resistor current - load switching and equivalent circuit - waveforms for transient voltage across the load and the switch - normal and abnormal switching transients.	**(9)**
Unit III	**LIGHTNING TRANSIENTS:** Review of the theories in the formation of clouds and charge formation - rate of charging of thunder clouds – mechanism of lightning discharges and characteristics of lightning strokes – model for lightning stroke - factors contributing to good line design - protection using ground wires - tower footing resistance - Interaction between lightning and power system.	**(9)**
Unit IV	**TRAVELING WAVES ON TRANSMISSION LINE COMPUTATION OF TRANSIENTS:** Computation of transients - transient response of systems with series and shunt lumped parameters and distributed lines. Traveling wave concept - step response - Bewely's lattice diagram - standing waves and natural frequencies - reflection and refraction of travelling waves.	**9)**
Unit V	**TRANSIENTS IN INTEGRATED POWER SYSTEM:** The short line and kilometric fault - distribution of voltages in a power system – Line dropping and load rejection - voltage transients on closing and reclosing lines – over voltage induced by faults - switching surges on integrated system Qualitative application of EMTP for transient computation.	**(9)**

Text Books

1	Allan Greenwood, 'Electrical Transients in Power Systems', Wiley Inter Science, New York, 2nd Edition, 1991.
2	Pritindra Chowdhari, "Electromagnetic transients in Power System", John Wiley and Sons Inc., Second Edition, 2009.
3	C.S. Indulkar, D.P. Kothari, K. Ramalingam, 'Power System Transients – A statistical approach', PHI Learning Private Limited, Second Edition, 2010.

Reference Books	
1	M.S.Naidu and V.Kamaraju, 'High Voltage Engineering', McGraw Hill, Fifth Edition, 2013.
2	Y.Hase, Handbook of Power System Engineering," Wiley India, 2012.
3	J.L.Kirtley, "Electric Power Principles, Sources, Conversion, Distribution and use," Wiley, 2012.

Useful Links		
	Course Outcomes	**CL**
MIP21206.1	**Explain** the causes and effects of transients on power systems and electrical circuits.	**4**
MIP21206.2	**Analyze** the causes, effects, and waveforms of switching transients in electrical circuits, and evaluate the impact of resistance and load switching on system stability and protection.	**4**
MIP21206.3	**Explain** the formation and discharge mechanisms of lightning, and evaluate effective protection strategies to mitigate lightning transients in power systems.	**4**
MIP21206.4	**Analyze** the transient response on transmission lines, applying traveling wave theory, reflection, refraction, and standing wave concepts to evaluate system behavior	**4**
MIP21206.5	**Analyze** the transient behavior in integrated power systems due to faults, switching operations, and load changes, and apply EMTP for effective transient management and system design.	**4**

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First Year (Semester-II) M. Tech. Integrated Power System

MIP21207: Power System Dynamics & Stability (PE-IV)

Teaching Scheme		Examination Scheme	
Lectures	4 Hrs./week	**CIE**	40 Marks
Tutorial	-	**ESE**	60 Marks
Total Credit	4	**Total**	100 Marks
		Duration of ESE: 03 Hrs. 00 Min.	

Course Objective:

1	To introduce power stability problem and the basic concepts of modeling and analysis of dynamical systems
2	To analyze the Modeling of power system components – generator, transmission lines excitation and prime movers controllers
3	To compare Stability of single machine and multi machine system is analyzed using digital simulation and small signal analysis techniques
4	To understand and model reactive power voltage interaction and different methods of control for maintaining voltage profile against varying system load.

Course Contents		Hours
Unit I	**Representation of Power System:** Elements like Synchronous machines, transformers, transmission lines, power semiconductor devices, loads, power system load flow, short circuit studies and power system stability studies using MATLAB-SIMULINK PSCAD, CAPS softwares.	**(9)**
Unit II	Transient Stability Problem, Augmentation of Transient Stability by Discrete Supplementary Controls, Concept of resynchronization with discrete phase rotation for improvement in transient stability	**(9)**
Unit III	Fault analysis of large power systems, Transient stability – Review of classical methods, Dynamic and transient stability investigations and simulation of single machine infinite bus and multi-machine systems.	**(9)**
Unit IV	**Transient stability** by step-by-step solution of swing equation, Euler's & modified Euler's method, Runga-kutta method, and Transient state phasor diagram of synchronous machine. **Effects of various types of disturbances**, parameters and controls on stability, Effect of excitation control. Excitation system modeling, standard block diagram of excitation system.	**9)**
Unit V	**Control of Power Systems** : Review of AGC and reactive power control -System operating states by security control functions – Monitoring, evaluation of system state by contingency analysis – Corrective controls (Preventive, emergency and restorative) - Energy control center – SCADA system – Functions – monitoring , Data acquisition and controls – EMS system.	**(9)**

Text Books

1	Padiyar K.R.; Power System Dynamics, Stability and Control; B.S. Publications, Hyderabad 2002
2	Power System Dynamics Stability and Control by K R Padiyar, B S Publications.
3	Power System Stability & Control, By- P. Kundur, Tata McGraw hill

Reference Books	
1	Sauer, P. W., and Pai, M. A. *Power System Dynamics and Stability*. Prentice Hall.
2	IEEE Standards for Excitation and Governor System Models.

Useful Links	
1	https://nptel.ac.in/courses/117/106/117106034/
2	https://nptel.ac.in/courses/108108076/
3	https://nptel.ac.in/courses/108105062/

	Course Outcomes	CL
MIP21207.1	**Describe** the operation of power flow studies in power system.	**4**
MIP21207.2	**Examine** topical issues of stability study due to various faulty conditions	**4**
MIP21207.3	**Analyze** types of methods to improve stability in integrated power Systems.	**4**
MIP21207.4	**Examine** topical issues of transient stability	**4**
MIP21207.5	**Enable** Augmentation of stability of turbine governor control.	**4**

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First Year (Semester-II) M. Tech. Integrated Power System

MIP21208: Program Elective -IV: Utilization of Electrical Energy

Teaching Scheme		Examination Scheme	
Lectures	4Hrs./week	**CIE**	40Marks
Tutorial	-	**ESE**	60Marks
Total Credit	4	**Total**	100Marks
		Duration of ESE:03Hrs. 00Min.	

Course Objective:

1	To introduce various electric drives and their applications.
2	To discuss different methods of electrical heating and electric welding.
3	To explain various techniques for designing indoor &outdoor lighting schemes.
4	To illustrate the fundamentals on electrolytic and electrometallurgical processes.

Course Contents		Hours
Unit I	**UNIT-I Electric Drives:** Advantages of electric drives, Characteristics of different mechanical loads, Parts of electric drives electric motors, close loop of electric drive system, Types of motors used in electric drive pulley drives etc., Examples of selection of motors for different types of domestic loads, Selection of drive for applications such as general workshop, textile mill, paper mill, steel mill, printing press, crane and lift etc.	**(9)**
Unit II	**UNIT-II Illumination:** Nature of light, visibility spectrum curve of relative sensitivity of human eye and wave length of light, Definition: Luminous flux, solid angle, luminous intensity, illumination, luminous efficiency, depreciation factor, coefficient of utilization, space to height ratio, reflection factor, glare, shadow, lux, Laws of illumination, Different type of lamps, construction and working of incandescent and discharge lamps – their characteristics, fittings required for filament lamp, mercury vapour lamp, fluorescent lamp, metal halide lamp, neon lamp, Main requirements of proper lighting; absence of glare, contrast and shadow, General ideas bout street lighting, flood lighting, monument lighting and decorative lighting, light characteristics etc.	**(9)**
Unit III	**UNIT- III Electric Heating:** Advantages of electrical heating, Heating methods: Resistance heating – direct and indirect resistance heating, electric ovens, their temperature range, properties of resistance heating elements, domestic water heaters and other heating appliances and thermostat control circuit, Induction heating; principle of core type and coreless induction furnace, Electric arc heating; direct and indirect arc heating, construction, working and applications of arc furnace.	**(9)**
Unit IV	**UNIT -IV Electric Welding:** Advantages of electric welding, Welding method, Principles of resistance welding, types, Principle of arc production, electric arc welding, characteristics of arc; carbon arc, metal arc, hydrogen arc welding method of and their applications	**9)**
Unit V	**UNIT- V:** Electrical Circuits used in Refrigeration and Air Conditioning and Water Coolers: Principle of air conditioning, vapour pressure, refrigeration cycle, eco-friendly Refrigerants, Electrolytic Processes, Laws of electrolysis, process of electro-deposition clearing, operation, deposition of metals, polishing, buffing.	**(9)**

Text Books

1	"Utilization of electrical energy" by E.O.Taylor.

2	“Electrical Drives: Concept and applications” by Vedam Subrahmanyam” THM.

Reference Books	
1	“Art and Science of Utilisation of Electrical Energy” by H.Pratab, Dhanpat Rai& Co.

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MIP21208	**Course Outcomes**	**CL**
MIP21208.1	**Judge** the suitability of different motor drives to be used for a specific purpose.	4
MIP21208.2	**Develop**, select, and apply appropriate techniques for designing indoor & outdoor lighting schemes.	5
MIP21208.3	**Design** and develop smart electrical heating systems through the use of modern Electrical Engineering and IT tools.	6
MIP21208.4	**Design** and develop smart electrical welding systems through the use of modern Electrical Engineering and IT tools.	6
MIP21208.5	**Create**, select, and apply appropriate techniques, tools and resources in designing/developing electrolytic and electrometallurgical processes	5

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Program:	**M.Tech. Integrated Power System (IPS)**
Semester II:	**MIP21209: Neural Network and Fuzzy Application in Power System (Program Elective-IV)**

Teaching Scheme		**Examination Scheme**	
Lectures	4Hrs/week	**CT-1**	20 Marks
Tutorial		**CT-2**	20 Marks
Total Credit-04		**ESE**	60 Marks
		Total	100 Marks
		Duration of ESE:03Hrs 00Min.	

Course Objective:

1.	Understand the fundamentals and applications of Artificial Neural Networks (ANNs) and Fuzzy Logic Systems (FLS) in power systems.
2.	Explore ANN for load forecasting, fault detection, and stability enhancement..
3.	Examine fuzzy logic in power system decision-making, control, and energy management.
4.	Analyze hybrid AI systems like Neuro-Fuzzy models for smart grid integration and optimization

Course Contents

Unit I	**Introduction to Artificial Intelligence (8 Hours)** Overview of Artificial Neural Networks (ANNs) and Fuzzy Logic Systems (FLS). Role of AI in modern power systems: advantages and applications. ANN architecture: neurons, layers, activation functions, and learning algorithms. Introduction to fuzzy sets: membership functions, linguistic variables, and fuzzy operators. Comparison of conventional and AI-based approaches in power system analysis
Unit II	**Neural Network Applications in Power Systems (10 Hours)** Load forecasting using neural networks. Power system stability enhancement with ANN-based controllers. ANN applications in fault detection and diagnosis. Optimal power flow and state estimation using neural networks. Training and optimization techniques for neural networks in power systems.
Unit III	**Fuzzy Logic Applications in Power Systems (9 Hours)** Fuzzy rule-based systems for decision-making in power systems. Voltage stability and reactive power control using fuzzy logic.Fuzzy controllers for load frequency control and power system damping. Applications of fuzzy logic in energy management systems (EMS). Case studies on fuzzy logic in power quality improvement.
Unit IV	**Hybrid Systems: Integration of ANN and Fuzzy Logic (9 Hours)** Introduction to Neuro-Fuzzy systems: architecture and design. Adaptive Neuro-Fuzzy Inference Systems (ANFIS): working and applications. Hybrid control strategies for power system stability and protection. Smart grid applications using hybrid AI techniques. Implementation challenges and computational considerations in hybrid systems.
Unit V	**Advanced Topics and Case Studies (9 Hours)** AI for renewable energy integration in power systems. Real-time applications of AI in grid monitoring and management. Introduction to deep learning techniques for power system analysis. Case studies: AI-driven solutions for blackout prevention and restoration. Future trends in AI applications for power systems.

Text Books

1	Artificial Intelligence and Machine Learning for Power Systems: Alok Kumar Mohanty and Vikrant Bhateja, CRC Press (2020).
2	Neural Networks and Learning Machines: Simon Haykin, 3rd Edition, Pearson Education (2009).
3	Fuzzy Logic with Engineering Applications: Timothy J. Ross, 4th Edition, Wiley (2016)

Reference Books	
1.	Artificial Neural Networks for Engineering and Applied Sciences": S. Rajasekaran and G. A. Vijayalakshmi Pai, CRC Press (2003).
2.	Power System Stability and Control Using AI Techniques": K. R. Padiyar, 2nd Edition, BS Publications (2018).
Useful Links	
1.	https://www.tutorialspoint.com/artificial_neural_network/index.htm
2.	https://www.geeksforgeeks.org/fuzzy-logic-introduction/

Course Outcomes	Course Outcomes	CL
MIP21209.1	Explain the role and components of AI, ANNs, and FLS in modern power systems.	2
MIP21209.2	Implement ANN-based models for load forecasting, fault detection, and system optimization.	3
MIP21209.3	Analyze the effectiveness of fuzzy logic controllers in voltage stability and energy management	4
MIP21209.4	Design hybrid Neuro-Fuzzy solutions for smart grid stability and protection challenges.	6
MIP21209.5	Evaluate AI-driven innovations for renewable integration and blackout prevention in power systems	5

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First Year (Semester-II) M. Tech. Integrated Power System

MIP21203: Electrical Power System Lab - II

Teaching Scheme	
Lectures	- Hrs/week
Practical	4 Hrs/week
Total Credit	2

Examination Scheme	
CT-1	-
CT-2	-
ICA	25
ESE	25
Total	50

	Course Outcomes	CL
MIP21203.1	Evaluate the Parameters of Transmission Lines and Bus Admittance and Impedance Matrices using ETAP	**3**
MIP21203.2	Solve power flow using Newton-Raphson & Gauss-Seidal Iterative Method	**3**
MIP21203.3	Evaluate Single Machine & Multi Machine Infinite Bus System using MATLAB	**5**
MIP21203.4	Design Load – Frequency Dynamics of Single Area Power Systems	**3**
MIP21203.5	Implement Two Port Network using various parameters	**5**

	Course Contents
1.	Computation of Parameters and Modelling of Transmission Lines using ETAP
2.	Study and implementation of active low pass filter using MATLAB programming
3.	Solution of Power Flow Using Gauss-Seidel Method using ETAP
4.	Solution of Power Flow Using Newton-Raphson Method using ETAP
5.	Formation of Bus Admittance and Impedance Matrices using ETAP
6.	Transient and Small Signal Stability Analysis – Single Machine Infinite Bus System using MATLAB
7.	Transient Stability Analysis – Multi Machine Infinite Bus System using ETAP
8.	Load – Frequency Dynamics of Single Area Power Systems using MATLAB
9.	Representation of Two Port Network In Z,Y,H Type using PSIM
10.	Study of Effect of Faults (LG, LL, LLG,3 Phase) on A Single Machine Connected To Infinite Bus using PSIM

Text Books

1	Introduction to Matlab 7 for Engineers - William Palm Iii McGraw-Hill Education 2003
2	A Guide to MATLAB: For Beginners and Experienced Users - Brian R Hunt,Ronald L. Lipsman Et al 2006

Text Books

1	Modeling and Simulation using MATLAB - Simulink, Shailendra Jain, Second Edition, 2015
2	MATLAB and SIMULINK for Engineers - Agam Kumar Tyagi Oxford 2011

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