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	ICA	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	MIP21105-06	Programme Elective – I	4	-	-	4	4	20	20	-	60	100
6.	PEC	MIP21108-09	Programme Elective – II	4	-	-	4	4	20	20	-	60	100
			Total	**20**	**-**	**4**	**24**	**22**	**100**	**100**	**25**	**325**	**550**

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 ISS- Independent Study & Seminar

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

PROGRESSIVE TOTAL CREDITS: 22

				Jul, 2024	1.00	Applicable for AY 2024-25 Onwards
BoS Chairperson	Dean Academics PG	Vice Principal	Principal	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	ICA	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	**18**	**-**	**04**	**22**	**20**	**80**	**80**	**50**	**290**	**500**

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 ISS- Independent Study & Seminar OJT/FP – On Job Training/Internships/Field Projects

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

PROGRESSIVE TOTAL CREDITS: 22+20=42

BoS Chairperson	Dean Academics PG	Vice Principal	Principal	Jul, 2024	1.00	Applicable for AY 2024-25 Onwards
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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	ICA	ESE	TOTAL
1.	PEC	MOOCs	MOOCs Course (12 weeks)	3	-	-	-	4	-	-	25	75	100
2.	RP/DI	MIP22302	Dissertation Phase-I	-	-	32	32	16	-	-	100	100	200
			Total	**3**	**0**	**32**	**32**	**20**	-	-	**125**	**175**	**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	ISS (Independent Study & Seminar)	Research Project/Dissertation	Semester Wise Credits
Semester-III	-	04	-	-	16	**20**
Cumulative Sum	**24**	**20**	**02**	**Audit**	**16**	**62**

PROGRESSIVE TOTAL CREDITS: 42+20=62

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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	CA	ICA	ESE	TOTAL
1	RP/DI	MIP22401	Dissertation Phase-II	-	-	40	20	20	-	-	-	100	200	300
			Total	**0**	**0**	**40**	**20**	**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	ISS (Independent Study & Seminar)	Research Project/Dissertation	Semester Wise Credits
Semester-IV	-	-	-	-	20	**20**
Cumulative Sum	**24**	**20**	**02**	**-**	**36**	**82**

PROGRESSIVE TOTAL CREDITS: 62+20=82

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

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

MIP21101: Advanced Power System Analysis

Teaching Scheme	
Lectures	4 Hrs./week
Tutorial	-
Total Credit	4

Examination Scheme	
CIE	40 Marks
ESE	60 Marks
Total	100 Marks

Duration of ESE: 03 Hrs. 00 Min.

Course Objective:

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

Course Contents		Hours
Unit I	**Load flow:** Overview of Newton-Raphson, Gauss-Siedel fast decoupled methods, convergence properties, sparsity techniques, handling Q- max violations in constant matrix, inclusion in frequency effects, AVR in load flow, handling of discrete variable in load flow.	**(9)**
Unit II	**Fault Analysis:** Simultaneous faults, open conductor faults, generalized method of fault analysis.	**(9)**
Unit III	**Security Analysis:** Security state diagram, contingency analysis, generator shift distribution factors, line outage distribution factor, multiple line outages, overload index ranking	**(9)**
Unit IV	**Power System Equivalents:** WARD REI. Equivalents **State Estimation:** Sources of errors in measurement, Virtual and Pseudo, Measurement, Observability, Tracking state estimation, WSL method, bad data correction.	**(9)**
Unit V	**Voltage Stability:** Voltage collapse, P-V curve, multiple power flow solution, continuation power flow, optimal multiplies load flow, voltage collapse proximity indices	**(9)**

Text Books

1	J. J. Grainger & W.D.Stevenson, "Power system analysis," McGraw Hill, 2003
2	A. R. Bergen & Vijay Vittal, "Power System Analysis," Pearson, 2000
3	L. P. Singh, "Advanced Power System Analysis and Dynamics," New Age International, 2006

Reference Books	
1	G. L. Kusic, "Computer aided power system analysis," Prentice Hall India, 1986
2	A. J. Wood, "Power generation, operation and control," John Wiley, 1994
3	P. M. Anderson, "Faulted power system analysis," IEEE Press, 1995

Useful Links
https://onlinecourses.nptel.ac.in/noc21_ee77/preview
https://archive.nptel.ac.in/courses/108/104/108104051/

	Course Outcomes	CL
MIP21101.1	**Calculate** voltage phasors at all buses, given the data using various methods of load flow.	**3**
MIP21101.2	**Calculate** fault currents in each phase.	**3**
MIP21101.3	**Rank** various contingencies according to their severity.	**3**
MIP21101.4	**Estimate** the bus voltage phasors given various quantities viz. power flow, voltages, taps, CB status etc.	**5**
MIP21101.5	**Estimate** closeness to voltage collapse and calculate PV curves using continuation power flow.	**5**

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

MIP21102: High Power Converters

Teaching Scheme	
Lectures	4 Hrs/week
Tutorials	-
Practical	-
Total Credit: 4	

Examination Scheme	
ESE	60 Marks
CIE	40 Marks
Total	100 Marks
Duration of Exam: 3 Hours	

Course Objective:

The Objectives of this course is:

1	To introduce students the basic theory of power semiconductor devices and their practical application in power electronics.
2	To familiarize the operation principle of AC-DC, DC-DC, DC-AC conversion circuits and their applications.
3	To provide the basis for further study of power electronics circuits and systems.

Course Outcomes

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

MIP21102.1	**Study** the characteristics of power semiconductor devices such as SCRs, GTOs, IGBTs.
MIP21102.2	**Analyze** the operation of isolated and non-isolated converters.
MIP21102.3	**Examine** the resonant switch converter operation.
MIP21102.4	**Apply** the modulation techniques to pulse width modulated inverters for reducing the harmonic.
MIP21102.5	**Distinguish** the operation of AC-to-AC single phase and three phase Cycloconverters.

Course Contents

Unit I	**Power Semiconductor Devices:** Ideal and Typical Power Switching Waveforms, Ideal and Typical Power Device Characteristics. Study of switching devices, SCR, TRIAC, GTO, BJT, MOSFET, IGBT and IGCT- Static characteristics: SCR, MOSFET and IGBT Triggering and commutation circuit for SCR. Introduction to Driver and snubber circuits.
Unit II	**Isolated and Non-isolated Converters:** Buck converter, Boost converter, Buck–Boost converters, CUK converter, Fly-back converter, Forward converter, Push–pull converter, Full bridge and Half bridge converters, Design considerations and comparison.
Unit III	**Resonant Converters:** Introduction, Classification, Basic Resonant Circuit Concepts, Load Resonant Converter, Resonant Switch Converter, Zero Voltage and Zero Current Switching, Clamped Voltage Topologies, Resonant DC link Inverter, High Frequency Link Integral Half Cycle Converters.
Unit IV	**Inverters:** Review of single-phase bridge inverters, 3-phase bridge inverters, Pulse width modulated inverters, 1-pulse and multi pulse modulation, Sinusoidal PWM, Space Vector PWM, Reduction of harmonics – Selective Harmonic Elimination Technique.
Unit V	**AC to AC Converters:** Single phase and Three phase AC voltage controllers-Control strategy Power Factor control Multistage sequence control -single phase and three phase cyclo converters, Introduction to Matrix converters, Aplications -welding.

Text Books

T.1	Rashid, M. H., "Power Electronics Handbook", Elsevier Academic Press, 2001.
T.2	Ned Mohan, Tore M. Undeland and William P. Robbins, "Power Electronics Converters, Applications, and Design", John Willey & Sons, Inc., 2nd Edition, 1995.
T.3	Erickson Robert W., Maksimovic Dragan, "Fundamentals of Power Electronics", Kluwer Academic Publishers Group (Netherlands), 2001.
T.4	V. Ramanarayanan, "Course Material on Switched Mode Power Conversion", Department of Electrical Engineering, Indian Institute of Science, Bangalore.http://minchu.ee.iisc.ernet.in/new/people/faculty/vr/book.pdf
Reference Books	
R.1	A. Pressman, "Switching Power Supply Design", McGraw-Hill, 1998.
R.2	Agrawal, J. P., "Power electronic systems: Theory and design" Addison Wesley Longman (Singapore) Pte. Ltd. New Delhi, 2001.
R.3	Daniel W Hart, "Power Electronics", Tata McGraw Hill, 2011
R.4	John G. Kassakian, Martin F. Schlecht and George C.Verghese, "Principles of Power Electronics", Pearson, 2010.

	Useful Links
1	https://developer.mbed.org/handbook/AnalogIn
2	http://www.libelium.com/50_sensor_applications/
3	http://www.m2mlabs.com/framework

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

MIP21103: Power System Modelling

Teaching Scheme	
Lectures	4Hrs/week
Tutorial	-
Total Credit	4

Examination Scheme	
CIE	40 Marks
ESE	60 Marks
Total	100 Marks
Duration of ESE: 03Hrs 00Min.	

Course Objective:

1.	To analyze the mathematical modeling of long transmission line and compare the same with medium and short transmission line
2.	To analyze the mathematical modeling of single phase transformer and three phase transformer per phase per unit basis.
3.	To develop a simple but physically meaningful model of the synchronous machine.
4.	To study load modeling w.r.t voltage & frequency point of view and acquire the knowledge of AC & DC excitation system

Course Contents

UnitI	Synchronous Machine Modeling: Description and mathematical modeling of a Synchronous Machine, Synchronous Machine parameters, Voltage generation, Open-circuit voltage, Armature reaction, Terminal Voltage, Power delivered by generator.
UnitII	Synchronous Machine Modeling Per unit system and normalization: Equations of a synchronous machine: Stator circuit equations, Stator self, Stator mutual and stator to rotor mutual inductances, The Park's transformation, Flux linkage equations, Voltage and current equations for stator and rotor in dq0 coordinates, Phasor representation, Steady state analysis, Transient & sub-transient analysis, Equivalent Circuits for direct and quadrature axes, Transient & sub-transient inductances and Time constants.
Unit III	Standard block diagram of Excitation system, prime mover control system, Excitation and prime-mover controllers, excitation system modeling, examples.
UnitIV	Introduction to Transmission line Modeling & Load Modeling, derivation of terminal V, I relations, waves on transmission lines, transmission matrix, lumped circuit equivalent, simplified models, complex power transmission(short line, radial line, long or medium lines).Basic load- modeling concept, static load models, dynamic load model, acquisition of load model parameters.
UnitV	Introduction to Transformer modeling & the per unit system , single phase transformer model, three phase transformer connection, per phase analysis, p.u. normalization, p.u. three phase quantities, p.u. analysis of normal system , regulating transformer for voltage & phase angle control.

Text Books

1	Power System Analysis: Arthur R. Bergen, Vijay Vithal, Pearson Education Asia
2	Generalized Theory of Machine: P. S. Bimbra, Vol. 2, Khanna Publishers (1987)
3	Power System Stability and Control: Kundur P, McGraw Hill

ReferenceBooks

1.	Power System Dynamics, Stability and Control: Padiyar K. R., Interline Publishing Private Ltd., Banglore (1998)

2.	Power System Analysis Operation and Control: 3rd ed., A. Chakrabarti, S. Halder, PHI, Eastern Economy Edition.
UsefulLinks	
1.	NPTEL :: Electrical Engineering - Power System Analysis
2.	NPTEL :: Electrical Engineering - NOC:Advance power electronics and Control

Course Outcomes	Course Outcomes	PO/PSO	CL	Class Session
MIP21106.1	Apply the Park's transformation and per unit system for simulation and stability analysis of power system.	PO1& PO3	3	9
MIP21106.2	Analyze the operational behavior and problems of two machine and multi-machine power system for stability study	PO1& PO3	4	9
MIP21106.3	Design the equivalent circuit, its parameters and simulation model for various components including loads in power system for static and dynamic stability studies.	PO1& PO3	4	9
MIP21106.4	Develop analytical approach and program tools for testing transition processes in power system	PO1& PO3	3	9
MIP21106.5	Evaluate the effective inductance under open and short circuit condition, for three-phase transformers.	PO1& PO3	3	9

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

Semester	Course Code	Name of Course	L	T	P	Credit
I	MIP21109	**Electrical Power Distribution System**	4	-	-	4

Pre-Requisites: Electrical Power System-I, Power station Practice, Power Plant Engineering.

Course Objectives:

1. To aware students about Distribution Management System.
2. Understand the planning, design, analysis and operational concepts of the distribution system,
3. Understand the concept of Automated Distribution Systems in Actual Practice.

Course Contents

Unit I	Distribution of Power, Management, Power Loads, Load Forecasting Short-term & Long-term, Power System Loading, Technological Forecasting. Advantages of (D.M.S.)
Unit II	Distribution Automation: Definition, Restoration / Reconfiguration of Distribution Network, Different Methods and Constraints Power Factor Correction, Interconnection of Distribution, Control & Communication Systems, Remote Metering, Automatic Meter Reading and its implementation
Unit III	SCADA: Introduction, Block Diagram, SCADA Applied To Distribution Automation. Common Functions of SCADA, Advantages of Distribution Automation through SCADA
Unit IV	Calculation of Optimum Number of Switches, Capacitors, Optimum, Switching Device Placement in Radial, Distribution Systems, Sectionalizing Switches – Types, Benefits, Bellman's Optimality Principle, Remote Terminal Units, Energy efficiency in electrical distribution & Monitoring
Unit V	Maintenance of Automated Distribution Systems, Difficulties in Implementing Distribution. Automation in Actual Practice, Urban/Rural Distribution, Energy, Management, AI techniques applied to Distribution Automation

Text Books

1	A.S. Pabla, "Electric Power Distribution", Tata McGraw Hill Publishing Co. Ltd., Fourth Edition.(1997)
2	M.K. Khedkar, G.M. Dhole, "A Text Book of Electrical power Distribution Automation", University Science Press, New Delhi (2010)
3	Anthony J Panseni, "Electrical Distribution Engineering", CRC Press (2006)

Reference Books

1	James Momoh, "Electric Power Distribution, automation, protection & control", CRC Press (2012)

Useful Links

1	NPTEL :: Electrical Engineering - NOC:Electrical Distribution System Analysis
2	NOC | Electrical Distribution System Analysis (nptel.ac.in)

Course Outcomes	Course Outcomes	PO/PSO	CL	Class Sessio
MIP21109.1	**Analyze** different distribution network topologies and their advantages.	PO1& PO3	3	9
MIP21109.2	**Analyze** the benefits of DA in terms of reliability, efficiency, and operational flexibility.	PO1& PO3	3	9
MIP21109.3	**Illustrate** the block diagram of a SCADA system, including RTUs (Remote Terminal Units), PLCs (Programmable Logic Controllers), HMIs (Human Machine Interfaces), and communication networks.	PO1& PO3	3	9
MIP21109.4	**Discuss** strategies for improving energy efficiency and reducing losses in electrical distribution systems.	PO1& PO3	3	9
MIP21109.5	**Apply** energy management techniques to optimize distribution system performance and efficiency.	PO1& PO3	3	9

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

MIP21106: Micro and Smart Grid

Teaching Scheme	
Lectures	4 Hrs/week
Tutorial	
Total Credit	4

Examination Scheme	
CIE	40 Marks
ESE	60 Marks
TOTAL	100 Marks
Duration of ESE :03 Hrs 00Min.	

Course Objective:

1.	To acquire knowledge about fundamental concepts of Microgrid, its Power Electronics Interface, protection and islanding issues
2.	To investigate various Power quality issues in Microgrid and introduction to smart grid technologies
3.	To understand Renewable Energy and its storage options for smart grid technologies
4.	To analyze smart grid & it's communication Technologies

Course Contents

Unit I	**Micro grid Concept:** Micro grid drivers and benefits, review of sources of micro grids, typical structure and configuration of a micro grid, AC and DC micro grids, modes of operation and control of micro grid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques
Unit II	**Power Quality Issues In Micro Grid:** Modeling and Stability analysis of Micro grid, regulatory standards and Micro grid economics. Single phase / Three phase static converters, Battery chargers, Arc furnaces.
Unit III	**Smart Grid Protection:** Smart Grid Protection Basics & Smart Grid Protection Advance technologies, Modelling of storage devices, Modelling of DC smart grid components, Operation and control of AC and DC Microgrids.
Unit IV	**Smart Grid Communications and Measurement Technology:** Communication and Measurement - Monitoring, Phasor Measurement Unit (PMU), Smart Meters, Wide area monitoring systems (WAMS)- Advanced metering infrastructure- GIS and Google Mapping Tools, IP-based Systems , Network Architectures
Unit V	**Renewable Energy And Storage Renewable Energy Resources:** -Sustainable Energy Options for the Smart Grid-Penetration and Variability Issues Associated with Sustainable Energy Technology-Demand Response Issues, Electric Vehicles and Plug-in Hybrids-PHEV Technology-Environmental Implications-Storage Technologies-Grid integration issues of renewable energy sources. Status of application of custom power devices with control strategies

Text Books

1	Nikos Hatziargyriou, "Micro grid Architectures And Control", John Wiley & sons Ltd, IEEE press 2014.
2	James Momoh, "Smart Grid: Fundamentals of design and analysis", John Wiley & sons Inc, IEEE press 2012.
3	Fereidoon P. Sioshansi, "Smart Grid: Integrating Renewable, Distributed & Efficient Energy", Academic Press, 2012.

Reference Books

1.	Clark W.Gellings, "The smart grid: Enabling energy efficiency and demand response", Fairmont Press Inc, 2009
2.	Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", John Wiley & sons inc, 2012
Useful Links	
1.	NPTEL :: Mechanical Engineering - Micro and Smart Systems
2.	NPTEL :: Electrical Engineering - NOC: Introduction to Smart Grid

Course Outcomes	Course Outcomes	PO/PSO	CL	Class Session
MIP21106.1	**Interpret** Micro grid concepts, modes of operation and control, Protection and islanding issues, etc	PO1& PO3	3	9
MIP21106.2	**Analyze** and design Power quality issues in micro grids like modeling and stability analysis, regulatory standards and economics and basic smart grid concepts Load and generation	PO1& PO3	4	9
MIP21106.3	**Design** Power flow analysis, economic dispatch and unit commitment problems and various verticals of smart grid	PO1& PO3	4	9
MIP21106.4	**Implement** Smart grid communication and measurement technologies like Phasor Measurement Unit (PMU), Smart meters, Wide Area Monitoring system (WAMS) etc	PO1& PO3	3	9
MIP21106.5	**Explain** the role of custom power devices in enhancing grid stability and reliability.	PO1& PO3	4	9

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

MIP21105: Renewable Energy Technologies

Teaching Scheme	
Lectures	4 Hrs/week
Tutorial	
Total Credit	4

Examination Scheme	
CIE	40 Marks
ESE	60 Marks
TOTAL	100 Marks
Duration of ESE :03 Hrs 00Min.	

Course Objective:

1. To learn various renewable energy sources
2. To gain understanding of integrated operation of renewable energy sources
3. To understand Power Electronics Interface with the Grid

Course Contents

Unit I	Introduction, Distributed vs Central Station Generation, Sources of Energy such as Micro-turbines, Internal Combustion Engines.
Unit II	Introduction to Solar Energy, Wind Energy, Combined Heat and Power, Hydro Energy, Tidal Energy, Wave Energy, Geothermal Energy, Biomass and Fuel Cells.
Unit III	Power Electronic Interface with the Grid Impact of Distributed Generation on the Power System, Power Quality Disturbances
Unit IV	Transmission System Operation, Protection of Distributed Generators
Unit V	Economics of Distributed Generation, Case Studies

Text Books

1	Ranjan Rakesh, Kothari D.P, Singal K.C, "Renewable Energy Sources and Emerging Technologies," 2nd Ed. Prentice Hall of India ,2011
2	Math H.Bollen, Fainan Hassan, "Integration of Distributed Generation in the Power System," July 2011, Wiley –IEEE Press
3	Loi Lei Lai, Tze Fun Chan, "Distributed Generation: Induction and Permanent Magnet Generators," October 2007, Wiley-IEEE Press.

Reference Books

1.	Roger A.Messenger, Jerry Ventre, "Photovoltaic System Engineering," 3rd Ed, 2010
2.	James F.Manwell, Jon G.McGowan, Anthony L Rogers, "Wind energy explained: Theory Design and Application," John Wiley and Sons 2nd Ed, 2010

Useful Links

1.	https://onlinecourses.nptel.ac.in/noc19_ch26/preview
2.	https://onlinecourses.nptel.ac.in/noc22_ch27/preview

Course Outcomes	Course Outcomes	PO/PSO	CL	Class Session

MIP21105.01	Knowledge about renewable energy	PO1& PO3	3	9
MIP21105.02	Understand the working of distributed generation system in autonomous/grid connected modes	PO1& PO3	4	9
MIP21105.03	Know the Impact of Distributed Generation on Power System	PO1& PO3	4	9
MIP21105.04	Analyze the role of Power Electronics devices in RES	PO1& PO3	3	9
MIP21105.05	Discuss power quality disturbances	PO1& PO3	3	9

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

MIP21108: Restructured Power Systems

Teaching Scheme	
Lectures	4 Hrs/week
Tutorial	
Total Credit	4

Examination Scheme	
CIE	40 Marks
ESE	60 Marks
TOTAL	100 Marks
Duration of ESE :03 Hrs 00Min.	

Course Objective:

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

Course Contents

Unit I	Fundamentals of restructured system, Market architecture, Load elasticity, Social welfare maximization
Unit II	OPF: Role in vertically integrated systems and in restructured markets, congestion management
Unit III	Optimal bidding, Risk assessment, Hedging, Transmission pricing, Tracing of power
Unit IV	Ancillary services, Standard market design, Distributed generation in restructured markets Developments in India, IT applications in restructured markets
Unit V	Working of restructured power systems, PJM, Recent trends in Restructuring

Text Books

1. Lorrin Philipson, H. Lee Willis, "Understanding electric utilities and deregulation", Marcel Dekker Pub.,1998.
2. Steven Stoft, "Power system economics: designing markets for electricity", John Wiley and Sons, 2002.
3. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, "Operation of restructured power systems", Kluwer Academic Pub., 2001.

Reference Books

1. Mohammad Shahidehpour, Muwaffaq Alomoush, "Restructured electrical power systems: operation, trading and volatility", Marcel Dekker.

Useful Links

1. https://archive.nptel.ac.in/courses/108/101/108101005/
2. https://archive.nptel.ac.in/courses/108/104/108104052/

Course Outcomes	Course Outcomes	PO/PSO	CL	Class Sessions
MIP21108.01	Describe various types of regulations in power systems.	PO1& PO3	4	9
MIP21108.02	Identify the need of regulation and deregulation.	PO1& PO3	3	9
MIP21108.03	Define and describe the Technical and Non-technical issues in Deregulated Power Industry.	PO1& PO3	3	9
MIP21108.04	Identify and give examples of existing electricity markets.	PO1& PO3	3	9
MIP21108.05	Classify different market mechanisms and summarize the role of various entities in the market.	PO1& PO3	3	9

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

MIP21104: Electrical Power System Lab-I

Teaching Scheme	
Practical	4 Hrs/week
Total Credit	2

Examination Scheme	
CA	25 Marks
ESE	25 Marks
Total	50 Marks
Duration of ESE: 02 Hrs	

Course Outcomes (CO)

Students will be able to

1	**Analyze** the various power quality events like short and long duration variations, Waveform distortion , Unbalance, Transients, Power factor etc.
2	**Apply** the knowledge about the harmonics, harmonic introducing devices and effect of harmonics on system equipment and Non Linear loads.
3	**Apply** suitable mitigation strategies for some of the power quality issues.
4	**Judge** the mitigation of power quality issues like waveform distortion, unbalance, and poor power factor.
5	**Select** appropriate of Power Quality Improvement Methods

Sr. No.	List of Experiment	COS
1	To Study the effect of voltage sag on electrical equipments using MATLAB.	CO1
2	To study the effect of voltage flicker on Electric Arc furnace using MATLAB.	CO1
3	To Study the effect of non-linear loads on power quality using MATLAB.	CO2
4	Study the effect of balanced non linear load on neutral current in a three phase circuit using MATLAB.	CO2
5	To Study the effect the capacitor switching transients using MATLAB	CO3
6	Simulation of harmonic producing load and mitigating Current harmonics using shunt active Power filter.	CO3
7	To study the voltage sag due to starting of large induction motor using MATLAB.	CO4
8	To reduce the voltage sag and swell problem in distribution system using DVR with PI controller.	CO4
9	Analysis and Simulation of harmonics for various residential loads using MATLAB simulink.	CO5
10	To determine output voltage and current harmonics of a single phase Inverter and mitigate lower order harmonics using PWM technique by using PSCAD.	CO5

Text Books

1	G.T. Heydt, "Electric power quality", Mc Graw-Hill Professional, (1996)
2	Math H. Bollen, "Understanding Power Quality Problems", IEEE Press, 2000
3	R. C. Dugan, "Electrical Power Systems Quality", McGraw Hill Education, 2012.
4	Narain. G. Hingorani "Understanding of FACTS controllers" John Wiley (1999)

Reference Books

1	J. Arrillaga, "Power System Quality Assessment", John wiley, 2000

2	J. Arrillaga, B.C. Smith, N.R. Watson & A. R.Wood ,"Power system Harmonic Analysis", Wiley, 1997
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/

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