ACADEMIC REGULATIONS, COURSE STRUCTURE AND DETAILED SYLLABUS

From the Academic Year 2022-23 onwards

M. Tech. Two Year Degree Course

(MR22 Regulation)

in

Electrical Power Systems (EPS)

Department of Electrical & Electronics Engineering

MALLA REDDY ENGINEERING COLLEGE (Autonomous)

(An UGC Autonomous Institution, Approved by AICTE and Affiliated to JNTUH Hyderabad,
Recognized under 2(f) &12 (B) of UGC Act 1956, Accredited by NBA & NAAC with 'A++' Grade (III Cycle)
Maisammaguda, Dhulapally (Post Via Kompally), Secunderabad-500 100
Website: www.mrec.ac.in E-mail: principal@mrec.ac.in

MALLA REDDY ENGINEERING COLLEGE (AUTONOMOUS)

MR20 ACADEMIC REGULATIONS (CBCS)

For M. Tech. (REGULAR) DEGREE PROGRAMME

Applicable for the students of M. Tech. (Regular) programme admitted from the Academic Year ***2022-23*** and onwards.

The M. Tech. Degree of Jawaharlal Nehru Technological University Hyderabad shall be conferred on candidates who are admitted to the programme and who fulfill all the requirements for the award of the Degree.

INSTITUTION VISION

To be a premier centre of professional education and research, offering quality programs in a socio-economic and ethical ambience.

INSTITUTION MISSION

- To impart knowledge of advanced technologies using state-of-the-art infrastructural facilities.
- To inculcate innovation and best practices in education, training and research.
- To meet changing socio-economic needs in an ethical ambience.

DEPARTMENT VISION

To become a reputed centre for imparting quality education and research in the field of Electrical and Electronics Engineering with human values, ethics and social responsibility.

DEPARTMENT MISSION

- To impart quality education and research to undergraduate and postgraduate students in Electrical and Electronics Engineering.
- To produce professionally competent and ethically committed engineers to meet changing socio-economic needs.
- To impart knowledge of advanced technologies for continual improvement in teaching, learning and research.

PROGRAMME OUTCOMES (POs)

Programme Outcomes are narrow statements that describe what the students are expected to know and would be able to do upon the graduation. These relate to the skills, knowledge, and behavior that students acquire through the programme. On completion of M.Tech (**Electrical Power System**) program, the student will be able to,

POs	STATEMENT
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. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
PO4	Pursue for the research and to design, develop and propose theoretical and practical methodologies in Power System domain.
PO5	Inculcate 'Design Thinking Process' among the students, and they are trained to apply Design methodologies for modeling, analyzing and solving various Engineering problems related to Power Systems
PO6	Exhibit broad program management capabilities in addition to their interdisciplinary technical subject expertise. The student is trained to carry out the same in an efficient and effective manner giving due reflections to societal, environmental, economical and financial factors.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Program educational objectives describe the career and professional accomplishments that **programs** are preparing graduates to attain within a few years of graduation.

PEOs	STATEMENT
PEO 1	To equip the engineering graduates with ample and appropriate knowledge which help them to hone their skills in the areas of Power Systems so as to excel in advanced level jobs in current corporate sector and/or teaching and learning domain/or higher education and/or research field
PEO 2	To transform engineering graduates to be future thought leaders in their respective domains. The course is geared to help students solve for complex inter-disciplinary problems by analyzing, designing and create world class solutions and services to issues in the areas of Power System that are technically sound, economically feasible and socially acceptable
PEO 3	To train engineering graduates to exhibit professionalism, keep up ethics in their profession and relate engineering issues to address technical and social challenges.

MALLA REDDY ENGINEERING COLLEGE

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
COURSE STRUCTURE FOR PG - M.Tech. ELECTRICAL POWER SYSTEMS
(MR22 Regulations - Effective from Academic Year 2022-23 onwards)
I Semester

S. No.	Category	Course Code	Name of the Course	Contact hours/week			Credits
				L	T	P	
1	PCC	C2101	Advanced Power System Analysis	3	1	-	4
2	PCC	C2102	Economic Operation of Power Systems	3	-	-	3
3	PEC - I	**Professional Elective–I**		3	-	-	3
		C2113	Smart Grid Technologies				
		C2114	Analysis of HVDC Systems				
		C2115	Renewable Energy Technologies				
		C2116	Advanced Power Electronic Converters				
4	PEC - II	**Professional Elective–II**		3	-	-	3
		C2117	Power Quality Improvement Techniques				
		C2118	Reactive Power Compensation and Management				
		C2119	Electrical Power Distribution System				
		C2120	Power System Modeling				
5	HSMC	C0H18	Research Methodology and IPR	2	-	-	2
6	PCC	C2103	Power Systems Computation Lab-I	-	-	3	1.5
7	PCC	C2104	Power Converters and Drives Lab	-	-	3	1.5
8	AC	C0A04	English for Research Paper Writing	2	-	-	-
Total				**16**	**1**	**6**	**18**
Contact Hours: 23							

MALLA REDDY ENGINEERING COLLEGE
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
COURSE STRUCTURE FOR PG - M.Tech. ELECTRICAL POWER SYSTEMS
(MR22 Regulations - Effective from Academic Year 2022-23 onwards)
II Semester

S. No.	Category	Course Code	Name of the Course	Contact hours/week			Credits
				L	T	P	
1	PCC	C2105	Digital Protection of Power System	3	-	-	3
2	PCC	C2106	EHVAC Transmission	3	-	-	3
3	PCC	C2107	Power System Operation and Deregulation	3	-	-	3
4	PEC – III	**Professional Elective–III**		3	-	-	3
		C2121	Restructured Power Systems				
		C2122	Industrial Load Modelling and Control				
		C2123	Power System Dynamics				
		C2124	Hybrid Electric Vehicles				
5	PEC – IV	**Professional Elective–IV**		3	-	-	3
		C2125	AI Techniques in Power Systems				
		C2126	Modern Control Theory				
		C2127	Power System Reliability and Planning				
		C2128	Distributed Generation and Microgrid				
6	PCC	C2108	Power Systems Computation Lab-II	-	-	3	1.5
7	PCC	C2109	Power System Protection Lab	-	-	3	1.5
8	AC	C0A05	Value Education	2	-	-	-
Total				**17**	**-**	**6**	**18**
Contact Hours: 23							

MALLA REDDY ENGINEERING COLLEGE

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE STRUCTURE FOR PG - M.Tech. ELECTRICAL POWER SYSTEMS

(MR22 Regulations - Effective from Academic Year 2022-23 onwards)

III Semester

S. No.	Category	Course Code	Name of the Course	Contact hours/week			Credits
				L	T	P	
1	PEC - V	**Professional Elective–V**		3	-	-	3
		C2129	Power System Transients				
		C2130	FACTS and Custom Power Devices				
		C2131	Gas Insulated Systems				
		C2132	Electric Vehicle Charging Techniques				
2	OEC	**Open Elective**		3	-	-	3
		C3228	Industrial Safety				
		C0B20	Optimization Techniques				
		C1128	Waste to Energy				
3	PROJ	C2110	Technical Seminar	-	-	4	2
4	PROJ	C2111	Project/ Dissertation Phase-I	-	-	16	8
Total				**6**	**-**	**20**	**16**
Contact Hours:26							

MALLA REDDY ENGINEERING COLLEGE

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE STRUCTURE FOR PG - M.Tech. ELECTRICAL POWER SYSTEMS

(MR22 Regulations - Effective from Academic Year 2022-23 onwards)

IV Semester

S. No.	Category	Course Code	Name of the Course	Contact hours/week			Credits
				L	T	P	
1	PROJ	C2112	Project/ Dissertation Phase-II	-	-	32	16
Total				**-**	**-**	**32**	**16**
Contact Hours: 32							

Category

- PCC - Professional Core Course
- PEC - Professional Elective Course
- OEC - Open Elective Course
- PROJ – Project

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. I Semester		
Code: C2101	**ADVANCED POWER SYSTEM ANALYSIS**	**L**	**T**	**P**
Credits: 4		**3**	**1**	**-**

Prerequisites: Power system Analysis

Course Objectives:

To analyze a Power System Network using graph theory, interpret the formation of Network matrices. To construct the necessity of load flow studies and various methods of Analysis, examine short circuit analysis using Z_{BUS}.

MODULE I: Admittance Model and Network Calculations 13 Periods

Admittance Model and Network Calculations, Branch and Node Admittances, Mutually Coupled Branches in Y_{BUS} , An Equivalent Admittance Network, Modification of Y_{BUS} , Network Incidence Matrix and Y_{BUS} , Method of Successive Elimination, Node Elimination, Triangular Factorization, Sparsity and Near Optimal Ordering.

MODULE II: Impedance Model and Network Calculations 13 Periods

Impedance Model and Network Calculations, the BUS Admittance and Impedance Matrices, Thevenin's Theorem and Z_{BUS}, Algorithms for building Z_{BUS}, Modification of existing Z_{BUS}, Calculation of Z_{BUS} elements from Y_{BUS}, Power Invariant Transformations, Mutually Coupled Branches in Z_{BUS}.

MODULE III: Power flow Analysis 13 Periods

A: Power flow analysis by Gauss Seidel method and N-R Method.

B: Power flow analysis by Decoupled method and fast decoupled method. Comparison between power flow solutions. DC load flow.

MODULE IV: Optimal Power Flow 13 Periods

Introduction- Solution to the optimal power flow-gradient method-Newton's method-Linear sensitivity analysis- Linear programming methods- Security constrained OPF - Interior point algorithm- Bus incremental costs

MODULE V: Fault Analysis 12 Periods

Symmetrical faults - Fault calculations using Z_{BUS} - Fault calculations using Z_{BUS} equivalent circuits – Selection of circuit breakers - Unsymmetrical faults - Problems on various types of faults.

TEXT BOOKS

1. John J.Grainger and W.D. Stevenson, "Power System Analysis", McGraw Hill Education, 1st Edition, 1994.

2. P. Kundur, **"Power System Stability and Control"**, McGraw Hill Education, 1st Edition, 2006.

REFERENCES

1. I.J.Nagrath and D.P.Kothari, **"Modern Power System Analysis"**, Tata McGraw Hill, New Delhi, 4th Edition, 2011.
2. Olle. L.Elgard, **"Electrical Energy Systems Theory"**, McGraw Hill Education, 2nd Edition, 2001.
3. M.A. Pai, **"Computer Techniques in Power System Analysis"**, McGraw Hill, New Delhi, 3rd Edition, 2014.
4. Dr. K. Uma Rao, **"Power System: Operation and Control"**, Wiley India Pvt. Ltd., 2012.
5. Robert Miller and James Malinowski, **"Power System Operation (Electronics)"**, McGraw Hill Education, 3rd Edition, 1994.

E-RESOURCES

1. **http://www.ieee-pes.org/ieee-transactions-on-power-systems**
2. **http://www.ieee-pes.org/**
3. **http://nptel.ac.in/courses/108105067/**

Course Outcomes

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

COs	CO Statement	Blooms Level	
CO1	Summarize the different matrices to analyze the power network.	Analyze	**L4**
CO2	Evaluate bus impedance matrix for the given network.	Evaluate	**L5**
CO3	Apply numerical methods for power flow analysis.	Apply	**L3**
CO4	Analyze the power system under single and multiple contingency.	Analyze	**L4**
CO5	Analyze the power system under fault condition.	Analyze	**L4**

CO-PO Mapping

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**-**	**3**	**2**	**2**	**1**
CO2	**2**	**-**	**2**	**2**	**2**	**2**
CO3	**3**	**-**	**3**	**2**	**2**	**3**
CO4	**2**	**-**	**3**	**2**	**2**	**2**
CO5	**3**	**-**	**2**	**2**	**2**	**3**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. I Semester		
Code:C2102	ECONOMIC OPERATION OF POWER SYSTEMS	L	T	P
Credits: 3		3	-	-

Prerequisites: Electrical Power Systems, Power System Analysis.

Course Objectives: This course deals with Economic operation of Power Systems, Hydrothermal scheduling and modelling of governors, turbines and generators. It emphasizes on single area and two area load frequency control, reactive power control and load compensation.

MODULE I Economic Operation of Power Systems 10 Periods

Optimal operation of Generators in Thermal Power Stations - Heat rate Curve – Cost Curve – Incremental fuel and Production costs - Input - Output characteristics - Optimum generation allocation with line losses neglected.

Optimum generation allocation including the effect of transmission line losses – Loss Coefficients - General transmission line loss formula.

MODULE II Hydrothermal Scheduling 10 Periods

Hydrothermal scheduling problem: short term and long term-mathematical model, algorithm. Dynamic programming solution methodology for Hydro-thermal scheduling with pumped hydro plant: Optimization with pumped hydro plant-Scheduling of systems with pumped hydro plant during off-peak seasons: algorithm.

MODULE III Load Frequency Control – I 10 Periods

A: Modeling of Governor, Turbine and Generators with corresponding block diagram representation and transfer function.

B: Single Area Load Frequency Control: Necessity of keeping frequency constant. Definitions of control area – Single area control – Block diagram representation of an isolated power system – Steady state analysis – Dynamic response – Uncontrolled case.

MODULE IV Load Frequency Control – II 9 Periods

Proportional plus Integral control of single area and its block diagram representation - Steady state response – Load Frequency Control and economic dispatch control.

Load frequency control of two area system – Uncontrolled case and controlled case – Tie - Line bias control.

MODULE V Reactive Power Control 9 Periods

Overview of Reactive Power control – Reactive Power compensation in transmission systems – Advantages and disadvantages of different types of compensating equipment for transmission systems. Load compensation – Specifications of load compensator. Uncompensated and compensated transmission lines: Shunt and Series Compensation (qualitative treatment).

TEXT BOOKS

1. Abhijit Chakrabarthi and Sunita Halder, **"Power System Analysis Operation and Control"**, PHI Learning Pvt. Ltd., 3rd Edition, 2010.
2. I.J.Nagrath and D.P.Kothari, **"Modern Power System Analysis"**, Tata McGraw Hill Publishing Company Ltd, 4th Edition, 2011.

REFERENCES

1. C.L.Wadhwa, **"Electrical Power Systems"**, New Age International (P) Limited, Publishers, 4th Edition, 2005.
2. T.J.E. Miller, "**Reactive Power Control in Electric Systems"**, John Wiley & Sons, New York, 1982.
3. J.Duncan Glover, M.S.Sarma and Thomas J.Overbye, "**Power System Analysis and Design",** Global Engineering Publisher, 5th Edition, 2012.
4. O.I.Elgerd, **"Electric Energy Systems Theory"**, Tata McGraw - Hill Education, 2nd Edition, 2003.
5. John J Grainger, William D Stevenson Jr, **"Power System Analysis"**, Tata McGraw – Hill Education, 2003.

E - RESOURCES

1. http://nptel.ac.in/courses/108101040/
2. https://www.eeweb.com/power-management
3. http://nptel.ac.in/courses/108104052

COURSE OUTCOMES

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

COs	CO Statement	Blooms Level	
CO1	Compute the optimal scheduling of thermal power plants and allocation of affect of transmission line loss.	Understand	**L2**
CO2	Analyse the optimal scheduling of Hydro-thermal system.	Analyse	**L4**
CO3	Evaluate the steady state behaviour of the power system for voltage and frequency fluctuations.	Evaluate	**L5**
CO4	Apply suitable controller for the frequency and voltage steady state oscillations.	Apply	**L3**
CO5	Analyse different shunt and series reactive power compensation schemes/equipments for compensated and uncompensated transmission systems, its advantages and disadvantages.	Analyse	**L4**

CO-PO Mapping

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**2**	**-**	**2**	**2**	**2**	**1**
CO2	**3**	**-**	**2**	**2**	**2**	**2**
CO3	**2**	**-**	**2**	**2**	**2**	**3**
CO4	**3**	**-**	**2**	**2**	**2**	**2**
CO5	**3**	**-**	**2**	**2**	**2**	**3**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. I Semester		
Code: C2113	SMART GRID TECHNOLOGIES	L	T	P
Credits: 3	(Professional Elective - I)	3	-	-

Prerequisites: Power Systems, Renewable Energy Resources, Electrical Power Quality

MODULE I: Introduction to Smart Grid **10 Periods**

Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient & Self-Healing Grid, Present development & International policies in Smart Grid.

MODULE II: Tools and Technologies of Smart Grid **10 Periods**

Introduction to Smart Meters, Real Time Pricing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers.

MODULE III: Smart Grid Distribution Technologies **10 Periods**

A: Smart Substations, Substation Automation, Feeder Automation. Geographic Information System(GIS)

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

MODULE IV: Micro grids and Distributed Energy Resources **9 Periods**

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

MODULE V: Power Quality Management in Smart Grid **9 Periods**

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Case study of Smart Grid . CDM opportunities in Smart Grid .

TEXT BOOKS

1. Ali Keyhani, Mohammad N. Marwali, Min Dai, **"Integration of Green and Renewable Energy in Electric Power Systems"**, Wiley.
2. Clark W. Gellings, **"The Smart Grid: Enabling Energy Efficiency and Demand Response"**,CRC Press.

3.Stuart Borlase,**Smart Grids,Infrastructure,Technology and Solutions**,CRC Press,2013

4.Gil Masters,**Renewable and Effecient Electric Power System**,Wiley-IEEE Press,2004.

REFERENCES

1. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama**," Smart Grid: Technology and Applications",** Wiley.
2. Jean Claude Sabonnadière, Nouredine Hadjsaïd, **"Smart Grids",** Wiley Blackwell.

3.A.G.Phadke and J.S.Thorp, "Synchronized Phasor Measurements and their Application" Springer,Edition,2010

4.T.Ackeman,Wind Power in Power Systems,Hoboken,NJ,USA,John Wiley,2005

E-RESOURCES

1. smartgrid.ieee.org/
2. ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=5165411
3. nptel.ac.in/courses/108105067/

Course Outcomes

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

COs	CO Statement	Blooms Level	
CO1	Group the various aspects of smart grid.	Understand	L2
CO2	Emphasize the use of smart meters and plug in hybrid electric vehicles.	Analyse	L4
CO3	Describe smart substations and it functions.	Evaluate	L5
CO4	Understand the concept of micro grid and distributed energy resources.	Understand	L2
CO5	Analyze the power quality management in smart grid.	Analyse	L4

CO-PO Mapping

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**1**	**2**	**2**	**3**	**3**
CO2	**1**	**1**	**2**	**2**	**3**	**2**
CO3	**3**	**2**	**2**	**2**	**3**	**2**
CO4	**1**	**1**	**2**	**2**	**3**	**2**
CO5	**3**	**1**	**2**	**2**	**3**	**3**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. I Semester		
Code: C2114	**ANALYSIS OF HVDC SYSTEMS**	**L**	**T**	**P**
Credits: 3	(Professional Elective - I)	**3**	**-**	**-**

Prerequisites: Power Electronics, Power Transmission Systems

Course Objectives: To comprehend the conversion principles of HVDC Transmission and analyze 3, 6, 12 pulse converters, rectifier and inverter operations of HVDC converters. Also to identify the different types of Harmonics and reduction by using Filters and comprehend interaction between HVAC and DC systems in various aspects.

MODULE I: INTRODUCTION 10 Periods

General consideration, Power Handling Capabilities of HVDC Lines, Basic Conversion principles, static converter configuration.

MODULE II: Static Power Converters 10 Periods

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. Harmonics in HVDC Systems, Harmonic elimination, AC and DC filters. VSC based HVDC and Hybrid HVDC systems. Back to back thyristor converter system.

MODULE III: Control of HVDC Converters and systems 10 Periods

A: Constant current, constant extinction angle and constant ignition angle control, Individual phase control, Equidistant firing angle control.

B: DC power flow control. Interaction between HV AC and DC systems – Voltage interaction Harmonic instability problems and DC power modulation.

MODULE IV: MTDC SYSTEMS & OVER VOLTAGES 9 Periods

Series, Parallel and Series-Parallel systems their operation and control. Over voltages due to disturbances on DC side, over voltages due to DC and AC side line faults.

MODULE V: Converter faults & protection 9 Periods

Converter faults, over current protection – valve group, and DC line protection over voltage protection of converters, surge arresters.

TEXT BOOKS

1. E.W. Kimbark: Direct current Transmission, Wiely Inter Science – New York.

2. J. Arillaga HVDC Transmission Peter Peregrinus ltd. London UK 1983

REFERENCES

1. K. R. Padiyar, "High Voltage Direct current Transmission", Wiely Esatern Ltd New Delhi – 1992
2. E. Uhlman, "Power Transmission by Direct Current", Springer Verlag, Berlin Helberg. 1985.

E-RESOURCES:

1. https://aits-tpt.edu.in/wp-content/uploads/2018/08/HVDC-2-Unit.pdf
2. https://www.youtube.com/watch?v=VpZ1qTWSbyY
3. https://www.ripublication.com/aeee/009_pp%20%20%20%20711-716.pdf

COURSE OUTCOMES

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

COs	CO Statement	Blooms Level	
CO1	Compute power handling capabilities of HVDC lines	Understand	L2
CO2	Analyse the performance of static power converters	Analyse	L4
CO3	Evaluate the control methods of HVDC converters	Evaluate	L5
CO4	Distinguish between HVDC and multi terminal DC systems	Analyse	L4
CO5	Design over voltage and over current protection circuits.	Create	L6

CO-PO Mapping

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**-**	**3**	**3**	**2**	**2**
CO2	**3**	**-**	**2**	**3**	**3**	**3**
CO3	**2**	**-**	**3**	**3**	**3**	**2**
CO4	**3**	**-**	**2**	**3**	**3**	**2**
CO5	**3**	**-**	**3**	**2**	**3**	**3**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. I Semester		
Code: C2115	RENEWABLE ENERGY TECHNOLOGIES	L	T	P
Credits: 3	(Professional Elective - I)	3	-	-

Prerequisites: Power Systems, Energy conversion systems.

Course Objectives: To create the awareness of energy conservation in students. To identify renewable energy sources for electrical power generation. To analyze different energy storage methods. To have knowledge on environmental effects of energy conversion.

MODULE I: Solar Energy **10 Periods**

Introduction to solar radiation, Solar thermal energy conversion, Flat plate collector, Concentric collectors, Solar Pond, Central receiver system, Solar pumping, Solar photovoltaic systems, Characteristics of PV cell, Photo voltaic modules, Types of Photo voltaic systems

MODULE II: Wind Energy and MHD Power Generation **10 Periods**

Wind Energy conversion: Basics of wind energy, Classification of turbines, Wind characteristics, Energy extraction, Betz limit, Modes of wind power generation.

MHD Generation: Principles of MHD power generation, ideal MHD generator performance, practical MHD generator, MHD technology.

MODULE III: Tidal and Wave Energy **10 Periods**

Tidal Energy: Tidal Energy generation, Characteristics of Tides, Power generation schemes, Components in Tidal power Plant.

Wave Energy: Principle of wave energy plant, Wave energy conversion machines. Ocean Thermal Energy conversion: Principle, Cycles of operation, Types of OTEC plants, Applications.

MODULE IV: Biomass and Geothermal Energy **9 Periods**

Biomass Energy: Bio Mass energy conversion, Anaerobic Digestion, Aerobic Digestion, Gasification, Bio Gas Plants.

Geothermal Energy: Structure of Earth's interior, geothermal fields, Gradient, Resources, Geothermal power generation.

MODULE V: Fuel Cells **9 Periods**

Introduction, Principle of operation, Types of Fuel cells, Energy output of a fuel cell, Operating characteristics of fuel cells, Application of fuel cells.

TEXT BOOKS

1. "Energy conversion systems" by Rakosh das Begamudre, New age International publishers, New Delhi - 2000.
2. Renewable Energy Resources" by John Twidell and Tony Weir, 2nd Edition, Fspon & Co.

3. D.P.Kothari, K.C.Singal, R.Ranjan, "Renewable Energy Resources and emerging technologies", PHI 2 nd Edition, 2011

REFERENCES

1. Understanding Renewable Energy Systems" , by Volker Quaschning, 2005, UK.
2. Renewable Energy Systems-Advanced Conversion, Technologies & Applications" by Faner Lin Luo Honer Ye, CRC press, Taylor & Francis group.
3 Rakosh Das Begamudre, "Energy conversion systems", New Age International Publishers, New Delhi, 2000.

E-RESOURCES:

1. https://www.nrel.gov/docs/legosti/old/1846.pdf
2. https://www.elprocus.com/mhd-generator/
3. https://www.pnnl.gov/explainer-articles/tidal-energy
4. https://americanhistory.si.edu/fuelcells/basics.htm

COURSE OUTCOMES

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

COs	CO Statement	Blooms Level	
CO1	Analyze the performance of PV system	Analyze	**L4**
CO2	Demonstrate the operation and characteristics of Wind and MHD Energy conversion systems.	Apply	**L3**
CO3	Discriminate between Tidal and Wave energy generation in respect of their operation and components.	Analyze	**L4**
CO4	Illustrate the process of biomass energy conversion through aerobic and anerobic digestion, operation of geothermal power plant.	Analyze	**L4**
CO5	Describe the operation, types, energy output and characteristics of a fuel cell.	Understand	**L2**

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CO-PO Mapping

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**2**	**-**	**2**	**3**	**2**	**-**
CO2	**3**	**-**	**2**	**3**	**2**	**-**
CO3	**1**	**-**	**2**	**3**	**2**	**-**
CO4	**3**	**-**	**2**	**3**	**2**	**-**
CO5	**3**	**-**	**2**	**3**	**2**	**-**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. I Semester		
Code: C2116	ADVANCED POWER ELECTRONIC CONVERTERS (Professional Elective - I)	L	T	P
Credits: 3		3	-	-

Prerequisites: Power Electronics, Power Electronic Converters

Course Objectives:

To understand various advanced power electronics devices.

To describe the operation of multi-level inverters with switching strategies for high power applications.

To comprehend the design of resonant converters and switched mode power supplies.

MODULE I: MODERN POWER SEMICONDUCTOR DEVICES 10 Periods

Modern power semiconductor devices – Insulated Gate Bipolar Transistor (IGBT) –MOSFET-MOS Turn off Thyristor (MTO) – Emitter Turn Off Thyristor (ETO) – Integrated Gate-Commutated Thyristor (IGCTs) – MOS controlled thyristors (MCTs)– Power integrated circuits (PICs) – symbol, structure and equivalent circuit – comparison of their features.

MODULE II: RESONANT PULSE INVERTERS 10 Periods

Resonant pulse inverters – series resonant inverters – series resonant inverters with unidirectional switches – series resonant inverters with bidirectional switches – analysis of half bridge resonant inverter – evaluation of currents and voltages of a simple resonant inverter – analysis of half bridge and full bridge resonant inverter with bidirectional switches – Frequency response of series resonant inverters – for series loaded inverter – for parallel loaded inverter – For series and parallel loaded inverters – parallel resonant inverters – Voltage control of resonant inverters – class E resonant rectifier – evaluation of values of C's and L's for class E inverter and Class E rectifier – numerical problems.

MODULE III: RESONANT CONVERTERS 10 Periods

Resonant converters – zero current switching resonant converters – L type ZCS resonant converter – M type ZCS resonant converter – zero voltage switching resonant converters – comparison between ZCS and ZVS resonant converters – Two quadrant ZVS resonant converters – resonant dc-link inverters – evaluation of L and C for a zero current switching inverter – Numerical problems.

MODULE IV: MULTILEVEL INVERTERS 9 Periods

Multilevel concept – Classification of multilevel inverters – Diode clamped Multilevel inverter – principle of operation – main features – improved diode Clamped inverter – principle of

operation – Flying capacitors multilevel inverter-principle of operation – main features – cascaded multilevel inverter – principle of operation – main features – Multilevel inverter applications – reactive power compensation – back to back intertie system – adjustable drives - Switching device currents – dc link capacitor voltage balancing – features of Multilevel inverters – comparisons of multilevel converters.

MODULE V: D.C & A.C POWER SUPPLIES 9 Periods

DC power supplies – classification - switched mode dc power supplies – fly back Converter – forward converter – push-pull converter – half bridge converter – Full bridge converter – Resonant d c power supplies – bidirectional power supplies – Applications. AC power supplies – classification – switched mode ac power supplies – Resonant AC power supplies – bidirectional ac power supplies – multistage conversions – control circuits – applications. Introduction – power line disturbances – power conditioners – Uninterruptible Power supplies – applications.

TEXT BOOKS

1. Mohammed H. Rashid – "Power Electronics"– Pearson Education-Third Edition – first Indian reprint -2004.
2. Ned Mohan,Tore M. Undeland and William P. Robbins, " Power Electronics: Converters, Applications and Design, John Wiley and Sons, 2nd Edition,2007

REFERENCES

1. Milliman Shepherd and Lizang – "Power converters circuits" – Chapter 14 (Matrix converter) PP- 415-444, M.H.Rashid - Power electronics hand book
2. Marian P. Kaźmierkowski, Ramu Krishnan, Frede Blabjerg Edition:" Control in power electronics" illustrated Published by Academic Press, 2002

E-RESOURCES:

1. NPTEL online course, "Pulse width Modulation for Power Electronic Converters" Dr., G. Narayanan,https://www.youtube.com/playlist?list=PLbMVogVj5nJQoZqyLxx-cg_dYE-Dt2UMH.
2. https://electronicscoach.com/resonant-converters.html
3. https://link.springer.com/chapter/10.1007/978-94-011-2350-1_3

COURSE OUTCOMES

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

COs	CO Statements	Blooms Level	
CO1	Understand the structure, operation and characteristics of power semiconductor devices.	Understand	L2
CO2	Evaluate and analyze various converter topologies.	Evaluate	L5
CO3	Analyze the different types of resonant converters.	Analyze	L4
CO4	Determine the multilevel inverter topologies for various applications of electrical engineering.	Apply	L3
CO5	Analyze the various power supplies and to determine	Analyze	L4

	components for switched mode power supplies.		

CO-PO Mapping

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**2**	**-**	**2**	**3**	**2**	**-**
CO2	**3**	**-**	**2**	**3**	**2**	**-**
CO3	**2**	**-**	**2**	**3**	**2**	**-**
CO4	**3**	**-**	**2**	**3**	**2**	**-**
CO5	**3**	**-**	**2**	**3**	**2**	**-**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. I Semester		
Code: C2117	POWER QUALITY IMPROVEMENT TECHNIQUES	L	T	P
Credits: 3	(Professional Elective - II)	3	-	-

Prerequisites: AC Circuits, Power System Components, High Voltage Engineering

Course Objectives:

The students will be able to familiarize different power quality issues with emphasis on their analysis and applications to practical engineering problems efficiently and effectively.

MODULE I: INTRODUCTION AND POWER QUALITY STANDARDS 10 Periods

Introduction, Classification of Power Quality Problems, Transients, Long Duration Voltage Variations, Short-Duration Voltage Variations, Voltage Imbalance, Waveform Distortion, Voltage Fluctuations, Power Frequency Variations, Causes and Effects of Power Quality Problems, Power Quality Standards and Indices.

MODULE II: VOLTAGE SAGS & INTERRUPTIONS 9 Periods

Sources of Sags and Interruptions, Estimating Voltage Sag Performance, Computer Business Equipment Manufacturers Associations (CBEMA) Curve, Equipment sensitivity to voltage sag, Fundamental Principles of Protection, Solutions at the End-User Level: Ferro resonant transformer, Magnetic synthesizers, Active series compensators, Uninterruptible Power Supply.

MODULE III: TRANSIENT OVER VOLTAGES 10 Periods

Sources of transient over voltages: Capacitor switching - magnification of capacitor switching transients – lightning - ferro resonance and other switching transients; Devices for over voltage protection: Surge arresters and transient voltage surge suppressors – isolation transformers - low pass filters - utility surge arresters, utility system lightning protection: shielding, line arresters - low side surges.

MODULE III: FUNDAMENTALS OF HARMONICS 8 Periods

Harmonic distortion: Voltage and current distortion - harmonic indices - harmonic sources from commercial and industrial loads. Locating harmonic sources - system response characteristics: resonance.

MODULE V: APPLIED HARMONICS 9 Periods

Effects of harmonic distortion - harmonic distortion evaluation, principles for controlling harmonics - devices for controlling harmonic distortion – inter harmonics caused by induction furnaces - IEEE standard 519-1992 – over view of IEC standards on harmonics – reasons for grounding – typical

wiring and grounding problems – isolated ground – summary of wiring and grounding solutions.

TEXT BOOKS

1. Roger.C.Dugan, Mark.F. Mc Granagham**, "Electrical Power Systems Quality"** 3rd Edition, McGraw Hill, 2012.
2. Ewald F. Fuchs, Mohammad A. S. Masoum**, "Power Quality in Power Systems and Electrical Machines"**, 2nd Edition, Academic Press, 2011.

REFERENCES

1. Francisco C. De La Rosa, **"Harmonics and Power Systems",** 1st Edition, CRC Press, 2006.
2. Angelo Baggiri, **"Handbook of Power Quality",** 1st Edition, John Wiley & Sons, 2008.
3. C. Sankaran, **"Power Quality",** 1st Edition, CRC Press, 2002.
4. P.S. Satnam P.S. Kang, **"Power Capacitor for Reactive Compensation",** 1st Edition, Dhanpat Rai & Sons Publications, 2008.

E-RESOURCES

1. Web material on "Electrical Power Systems Quality" https://www.globalspec.com/reference/59761/203279/chapter-1-introduction
2. Web course on "Power Quality" by Professor Bhim. Singh CEA Chair Professor Indian Institute of Technology Delhi, available on NPTEL at https://nptel.ac.in/courses/108102179
3. Web course on "Power Quality Improvement Technique" by Professor Prof. Avik Bhattacharya Indian Institute of Technology Roorkee, available on NPTEL at https://nptel.ac.in/courses/108107157
4. Web material on "Harmonic mitigation" https://www.fuseco.com.au/articles/what-is-harmonic-mitigation
5. Web material on **"**How to find harmonics in electrical systems" **"** https://www.fluke.com/en-in/learn/blog/power-quality/how-to-find-harmonics-in-electrical-systems-2#:~:text=What%20are%20harmonics%20in%20electricity,the%20third%20is%20180%20Hz.

COURSE OUTCOMES

COs	CO Statements	Blooms Level	
CO1	**Describe** and **Classify** power quality disturbances and typical problems associated with it.	Apply	L3
CO2	**Identify** the sources of voltage sag and to **provide** solutions at the end user levels; **Estimate** the performance of voltage sag	Evaluate	L5
CO3	**Describe** the causes of transient over voltages and **analyze** the devices for over voltage protections.	Analyze	L4
CO4	**Analyse** the sources of current and voltage harmonics and locate the harmonics producing source in power system.	Analyze	L4
CO5	**Analyze** the effect of harmonics on power system equipment and load, **Evaluate** the harmonic distortions and **select** suitable controlling techniques for the mitigation of harmonics.	Evaluate	L5

CO – PO MAPPING

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**-**	**2**	**2**	**1**	**3**
CO2	**2**	**-**	**3**	**3**	**2**	**3**
CO3	**2**	**-**	**3**	**3**	**2**	**3**
CO4	**2**	**-**	**3**	**3**	**2**	**3**
CO5	**2**	**-**	**3**	**3**	**2**	**3**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. I Semester		
Code: C2118	**REACTIVE POWER COMPENSATION AND MANAGEMENT**	**L**	**T**	**P**
Credits: 3	(Professional Elective - II)	**3**	**-**	**-**

Prerequisites: Power Systems, Electrical Power Quality, FACTS

Course Objectives:

To understand the necessity of reactive power compensation. To design load compensation. To analyze various types of reactive power compensation in transmission systems. To get exposed to distribution side and utility side reactive power management.

MODULE I: Load Compensation **10 Periods**

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.

MODULE II: Steady – State Reactive Power Compensation In Transmission System **10 Periods**

Uncompensated line – types of compensation – Passive shunt and series and dynamic shunt compensation –examples

Transient state reactive power compensation in transmission systems: Characteristic time periods – passive shunt compensation – static compensations- series capacitor compensation – compensation using synchronous condensers – examples.

MODULE III: Reactive Power Coordination **10 Periods**

A: Objective – Mathematical modeling – Operation planning – transmission benefits – Basic concepts of quality of power supply – disturbances- steady –state variations.

B: Effects of under voltages – frequency –Harmonics, radio frequency and electromagnetic interferences.

MODULE IV: Demand Side Management **9 Periods**

Load patterns – basic methods load shaping – power tariffs- KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels.

Distribution side Reactive power Management: System losses –loss reduction methods – examples – Reactive power planning – objectives – Economics Planning capacitor placement – retrofitting of capacitor banks.

MODULE V: User Side Reactive Power Management **9 Periods**

KVAR requirements for domestic appliances – Purpose of using capacitors – selection of capacitors – deciding factors – types of available capacitor, characteristics and Limitations.

Reactive power management in electric traction systems and are furnaces: 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.

TEXT BOOKS

1. T.J.E.Miller, **"Reactive Power Control in Electric Power Systems",** John Wiley and sons, 1982.
2. D.M.Tagare , **"Reactive Power Management",**Tata McGraw Hill,2004.

REFERENCES

1. "Understanding FACTS –Concepts and Technology of Flexible AC Transmission Systems" Narain G.Honorani, Laszlo Gyugyi.
2. "R. Sastry Vedam and Mulukutla S. Sarma", "Power Quality VAR Compensation in Power Systems", CRC Press, 2008.

E-RESOURCES

1. https://archive.nptel.ac.in/content/storage2/courses/108104051/chapter_10/10_1.html
2. https://nptel.ac.in/courses/108107114
3. http://www.nitttrc.edu.in/nptel/courses/video/108107114/lec10.pdf

Course Outcomes

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

CO's	CO Statement	Blooms Level	
CO1	Analyse the importance of load compensation in symmetrical as well as unsymmetrical loads.	Apply	L3
CO2	Analyze the various compensation methods in transmission lines.	Apply	L5
CO3	Design the mathematical model for reactive power coordination.	Create	L6
CO4	Recognize the different load patterns and distribution side reactive power management	Evaluate	L4
CO5	Comprehend user side reactive power management and reactive power management in electric traction systems and furnaces.	Understand	L2

CO-PO Mapping

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	Program Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	3	1	1
CO2	2	-	2	1	3	1
CO3	3	-	2	3	3	2
CO4	2	-	3	3	1	1
CO5	3	-	2	3	3	1

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. I Semester		
Code: C2119	ELECTRICAL POWER DISTRIBUTION SYSTEM	L	T	P
Credits: 3	(Professional Elective - II)	3	-	-

Prerequisite: Electrical Power Systems, Power System Analysis.

Course Objectives:

- To learn about Load Forecasting Short-term & Long-term and Power System Loading ,To learn about power Distribution Management System, To learn of SCADA system, Calculation of Optimum Number of Switches, Capacitors, Optimum Switching Device Placement in Radial Distribution Systems
- To understand distribution automation.

MODULE I Load Forecasting

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

MODULE II Distribution Management System

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

MODULE III SCADA

Interconnection of Distribution, Control & Communication Systems, Remote Metering, Automatic Meter Reading and its implementation. SCADA: Introduction, Block Diagram, SCADA Applied to Distribution Automation, Common Functions of SCADA, Advantages of Distribution Automation through SCADA.

MODULE 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.

MODULE V Automated Distribution Systems

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

TEXTBOOKS

1. A.S. Pabla, "Electric Power Distribution", Tata McGraw Hill Publishing Co. Ltd., 4 th Edition.
2. M.K. Khedkar, G.M. Dhole, "A Text Book of Electrical Power Distribution Automation", University Science Press, New Delhi

REFERENCES:

1. Anthony J Panseni, "Electrical Distribution Engineering", CRC Press.
2. James Momoh, "Electric Power Distribution automation protection & control", CRC Press.

E-RESOURCES

1. http://nptel.ac.in/courses/108101040/
2. https://www.eeweb.com/power-management
3. http://nptel.ac.in/courses/108104052

COURSE OUTCOMES

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

COs	CO Statement	Blooms Level	
CO1	Understand the Load Forecasting Short-term & Long-term and Power System Loading	Understand	**L2**
CO2	Analyse Restoration / Reconfiguration of Distribution Network, Different Methods and Constraints	Analyse	**L4**
CO3	Analyse Common Functions of SCADA and Distribution Automation.	Analyse	**L4**
CO4	Evaluate Calculation of Optimum Number of Switches, Capacitors, Optimum Switching Device Placement in Radial Distribution Systems.	Evaluate	**L5**
CO5	Apply AI techniques applied to Distribution Automation..	Apply	**L3**

CO-PO Mapping

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**2**	**3**	**3**	**1**	**1**
CO2	**2**	**2**	**2**	**1**	**3**	**1**
CO3	**3**	**2**	**2**	**3**	**3**	**2**
CO4	**2**	**2**	**3**	**3**	**1**	**1**
CO5	**3**	**2**	**2**	**3**	**3**	**1**

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2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. I Semester		
Code: C2120	**POWER SYSTEM MODELING**	**L**	**T**	**P**
Credits: 3	(Professional Elective - II)	**3**	**-**	**-**

Prerequisite: Power system analysis, Power electronics

Course Objectives:

To describe characteristics and appropriate mathematical models for representations of power system components such as synchronous machine, transmission line, transformer, induction motor, excitation systems and non-electrical components in power system dynamic studies. Review of steady state and transient performance characteristic of synchronous machine.

MODULE I Modeling of Power System Components 10 Periods

The need for modeling of power system, different areas of power system analysis. Models of non-electrical components like boiler, steam & hydro-turbine & governor system. Transformer modeling such as auto-transformer, tap-changing & phase shifting transformer.

MODULE II Synchronous Machine Modeling 10 Periods

Model required for steady-state analysis. The development of model required for dynamic studies. The current & flux linkage models using Park's transformation leading to simulation as linear model.

MODULE III Analysis of Synchronous Machine Modeling 9 Periods

Synchronous machine connected to an infinite bus, its simulation for steady-state condition.

MODULE IV Excitation Systems 9 Periods

Simplified view of excitation control. Excitation configuration, primitive systems, Definitions of voltage response ratio & exciter voltage ratings.

MODULE V Excitation System Modeling 10 Periods

Excitation control systems using dc generator exciter, alternator-rectifier, alternator SCR, and voltage regulators such as electro-mechanical and solid state. Modeling of excitation systems.

TEXTBOOKS

1. P. Kundur, “Power System Stability and Control”, McGraw-Hill, 1993.
2. R.Ramunujam,” Power System Dynamics Analysis and Simulation, PHI Learning Private Limited, New Delhi, 2009.
3. Electric Power Systems: B.M. Weddy and B.J. Cory, John Wiely and Sons, Fourth edition (2002).

4. Power System Analysis and Design :J. Duncan Glover, MulukutlaS. Sarma, Thomson Brooks/cole/ Third Edition (2003)

E-RESOURCES

1. Power System Modeling and Control (mdpi.com)
2. Power system modeling | IEEE Journals & Magazine | IEEE Xplore
3. https://books.google.co.in/books

Course Outcomes

COs	CO Statements	Blooms Level	
CO1	Develop power system components modeling and analyze their performance	Create	L6
CO2	Develop modeling of synchronous machine.	Create	L6
CO3	Analyze its performance of synchronous machines connected to infinite bus	Analyze	L4
CO4	Understand configuration and functioning of synchronous machine excitation system.	understand	L2
CO5	Develop excitation system components modeling and analyze their performance.	Create	L6

CO-PO Mapping

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	Program Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	3	2	-
CO2	3	1	3	2	3	-
CO3	3	-	2	3	2	-
CO4	2	-	3	2	2	-
CO5	3	-	2	3	3	-

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. I Semester		
Code: C0H18	**RESEARCH METHODOLOGY AND IPR**	**L**	**T**	**P**
Credits: 2		**2**	**-**	**-**

Prerequisites: NIL

Course Objectives: The objective of the course is to make students familiar with the basics of research methodology and various types of Intellectual Properties, IPR legislations and policies.

MODULE-I Research Problem **6 Periods**

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

MODULE – II Technical Writing and Research Proposal **7 Periods**

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

MODULE – III Intellectual Property Rights **6 Periods**

A: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.

B: International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

MODULE – IV Patent Rights **6 Periods**

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

MODULE – V Case Studies **7 Periods**

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

References:

1. Prabhuddha Ganguli: ‘ Intellectual Property Rights” Tata Mc-Graw –Hill, New Delhi
2. M.Ashok Kumar and Mohd.Iqbal Ali: “Intellectual Property Right” Serials Pub.
3. Carlos M.Correa- **‘‘Intellectual property rights , The WTO and Developing countries”**-Zed books
4. Law relating to patents, trademarks, copyright designs, Wadehra, B.L. & 2 ed. Universal Law Publishing 2000.
5. C.R.Kothari, **“Research Methodology”** New Age International Publishers, Fourth edition, 2018.

6. Donald Cooper & Pamela Schindler, **"Business Research Methods",** TMGH, 9th edition.
7. Alan Bryman & Emma Bell, **"Business Research Methods"**, Oxford University Press.

E Resources:

1. https://www.wto.org/english/tratop_e/trips_e/trips_e.htm
2. https://www.wto.org/english/thewto_e/whatis_e/tif_e/agrm7_e.htm
3. http://nptel.ac.in/courses/110999906/
4. http://nptel.ac.in/courses/109105112/

Course Outcomes:

COs	**CO Statements**	**Blooms Level**	
CO1	Comprehend the concepts of research methodology and its concepts.	Evaluate	L5
CO2	Realize the concepts of literature review and developing a research proposal.	Elaborate	L4
CO3	Understand the basic concepts of Intellectual property rights.	Understand	L2
CO4	Understand the types of patents and their procedures	Understand	L2
CO5	Recognize the recent developments in IPR administration.	Evaluate	L5

CO-PO Mapping

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**3**	-	-	**3**	**3**
CO2	**3**	**3**	-	-	**3**	**3**
CO3	**3**	**3**	-	-	**3**	**3**
CO4	**3**	**3**	-	-	**3**	**3**
CO5	**3**	**3**	-	-	**3**	**3**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. I Semester		
Code: C2103	**POWER SYSTEMS COMPUTATION LAB-I**	**L**	**T**	**P**
Credits: 1.5		**-**	**-**	**3**

Course Objectives:

To acquire knowledge about the computational methods in load flow analysis and short circuit analysis.

List of Experiments:

1. Line Parameters of Three Phase Transmission system
2. Modeling of Transmission Line
3. Ferranti Effect in a Power System
4. Formation of Bus Admittance Matrix
5. Formation of Z – bus by Bus Building Algorithm
6. Load Flow Solution using Gauss-Seidal Method
7. Load Flow Solution using Newton-Raphson Method
8. Line to Ground (L-G) Fault in a Power System
9. Line to Line (L-L) Fault in a Power System
10. Double Line to Ground (L-L-G) Fault in a Power System

Course Outcomes

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

CO's	CO Statement	Blooms Level	
CO1	Analyze the Performance of Transmission Line	Analyze	L4
CO2	Analyze the Ferranti Effect in a Power System	Analyze	L4
CO3	Estimate the Bus Impedance and Admittance Matrix	Evaluate	L5
CO4	Estimate the bus voltage magnitude and phase angle by G-S and N-R methods	Evaluate	L5
CO5	Estimate the fault current for L-G, L-L and L-L-G faults	Evaluate	L5

CO-PO Mapping

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**2**	**1**	**3**	**2**	**1**
CO2	**2**	**3**	**1**	**3**	**3**	**1**
CO3	**3**	**2**	**2**	**3**	**2**	**2**
CO4	**3**	**2**	**2**	**3**	**2**	**2**
CO5	**3**	**2**	**2**	**3**	**2**	**2**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. I Semester		
Code: C2104	POWER CONVERTERS AND DRIVES LAB	L	T	P
Credits: 1.5		-	-	3

Course Objectives:

To acquire knowledge about the computational methods in load flow analysis and short circuit analysis.

Course Objectives: Apply the concepts of power electronic converters for various applications of DC and AC machines. Design the power converter to meet a specific load requirement.

List of Experiments

Hardware Experiments:

1. Speed Measurement and closed loop control using PMDC motor.
2. Speed control of thyristor based 1HP DC motor with closed loop control.
3. Speed control of three Phase input, thyristor based 3 HP DC motor with closed loop control.
4. Speed control of cyclo converter based AC Induction motor.
5. Performance of single phase fully controlled converter with inductive load.

Simulation Experiments

1. Simulation of Switching an Inductive Circuit Using a Breaker.
2. Simulation of detailed model of three phase programmable source, measurement of V-I and sequence analyzer.
3. Simulation of Single Phase Series Compensated Network.
4. Simulation of DC/DC and DC/AC PWM Converter.
5. Simulation of Space Vector PWM Converter.

COs	CO Statements	Blooms Level	
CO1	Determine the characteristic performance of PMDC and DC motors with closed loop control.	Apply	L3
CO2	Investigate the speed performance of an AC Induction motor.	Analyze	L4
CO3	Analyze the switching performance of single phase fully	Analyze	L4

	controlled converter.		
CO4	Design Single Phase Series Compensated Network and Switching an Inductive Circuit Using a Breaker by simulink	Create	L6
CO5	Design PWM & Space vector PWM Converters by simulink	Create	L6

CO-PO Mapping

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**2**	**1**	**3**	**3**	**3**	**-**
CO2	**3**	**1**	**2**	**2**	**3**	**-**
CO3	**2**	**1**	**3**	**3**	**2**	**-**
CO4	**3**	**1**	**2**	**2**	**3**	**-**
CO5	**2**	**1**	**3**	**3**	**3**	**-**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. I Semester		
Code: C0A04	**ENGLISH FOR RESEARCH PAPER WRITING**	**L**	**T**	**P**
Credits: Nil		**2**	**-**	**-**

Prerequisites: Nil

Course Objectives: The objective of the course is to provide the knowledge on structuring paragraphs, paraphrasing and preparation of research documents related to abstract, literature review, methods and results.

Module I: 6 Periods

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

Module II: 7 Periods

Clarifying Who Did What, Highlighting Your Findings, Hedging and criticizing, paraphrasing and plagiarism, sections of a paper, abstracts. Introduction.

Module III: 6 Periods

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

Module IV: 6 Periods

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

Module V: 7 Periods

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

References:

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

Course Outcomes

COs	CO Statements	Blooms Level	
CO1	Structure the sentences and paragraphs	Evaluate	L5
CO2	Elaborate the various sections of research papers	Elaborate	L2
CO3	Explore the check list in research documents	Apply	L3
CO4	Apply the key skills to coin the title, abstract, introduction and literature review	Apply	L3
CO5	Inspect the skills required for preparing experimental results and discussions.	Analyze	L4

CO-PO Mapping

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**-**	**2**	**-**	**-**	**2**	**1**
CO2	**-**	**2**	**-**	**-**	**2**	**1**
CO3	**-**	**2**	**-**	**-**	**2**	**1**
CO4	**-**	**2**	**-**	**-**	**2**	**1**
CO5	**-**	**2**	**-**	**-**	**2**	**1**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. II Semester		
Code: C2105	DIGITAL PROTECTION OF POWER SYSTEM	L	T	P
Credits: 3		3	-	-

Prerequisites: Switch Gear and Protection

Course Objectives:

To distinguish all kinds of circuit breakers and relays for protection of Generators, Transformers and feeder bus bars from over voltages and other hazards. To generalize neutral grounding for overall protection. To illustrate the phenomenon of over voltages and its classification.

MODULE I: Static Relays and Comparators 10 Periods

Static Relays: Advantages of static relays - Basic construction of static relays - Level detectors - Replica impedance – Mixing circuits - General equation for two input phase and amplitude comparators - Duality between amplitude and phase comparators.

Amplitude Comparators: Circulating current type and opposed voltage type - Rectifier bridge comparators, Direct and Instantaneous comparators.

MODULE II: Phase Comparators and Static over Current Relays 9 Periods

Phase Comparators: Coincidence circuit type - Block spike phase comparator, Techniques to measure the period of coincidence. Phase comparators - Integrating type, Rectifier and Vector product type.

Static over Current Relays: Instantaneous over-current relay - Time over - Current relays - Basic principles – Definite time and Inverse definite time over-current relays.

MODULE III: Static Differential and Distance Relays 10 Periods

A: Static Differential Relays: Analysis of Static Differential Relays – Static Relay schemes – Duo bias transformer differential protection – Harmonic restraint relay.

B: Static Distance Relays: Static impedance – Reactance – MHO and angle impedance relay - Sampling comparator – Realization of reactance and MHO relay using sampling comparator.

MODULE IV: Multi Input Comparators and Power Swings 10 Periods

Multi-Input Comparators: Conic section characteristics - Three input amplitude comparator – Hybrid comparator - Switched distance schemes – Poly phase distance schemes - Phase fault scheme – Three phase scheme – Combined and ground fault scheme.

Power Swings: Effect of power swings on the performance of distance relays – Power swing analysis - Principle of out of step tripping and blocking relays - Effect of line and length and source impedance on distance relays.

MODULE V: Microprocessor based Protective Relays 9 Periods

(Block diagram and flowchart approach only) - Over current relays – Impedance relays - Directional relay - Reactance relay. Generalized mathematical expressions for distance relays -

Measurement of resistance and reactance – MHO and offset MHO relays - Realization of MHO characteristics - Realization of offset MHO characteristics - Basic principle of Digital computer relaying.

TEXT BOOKS

1. Badri Ram and D.N.Vishwakarma, **"Power System Protection and Switch Gear"**, Tata McGraw Hill Publications, New Delhi, 1995.
2. T.S.MadhavaRao, **"Static Relays"**, Tata McGraw Hill Publications, New Delhi, 2nd Edition, 1989.

REFERENCES

1. Bhavesh Bhalja, R.P. Maheshwari and Nilesh G. Chothani, **"Protection and Switchgear"**, Oxford University Press, 2012.
2. C.Christopoulos and A. Wright, **"Electrical Power System Protection"**, Springer International Publisher, 2nd Edition, 1999.

E-RESOURCES

1. http://www.mytech-info.com/2016/07/types-of-comparator.html
2. http://www.springer.com/energy/systems%2C+storage+and+harvesting/journal/41601
3. http://nptel.ac.in/courses/108101039/26

Course Outcomes

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

COs	CO Statements	Blooms Level	
CO1	Comprehend the construction and operation of static relays and amplitude comparators.	Understand	L2
CO2	Understand the construction and operation of Phase Comparators and Static over current relays.	Understand	L2
CO3	Apply the differential & static relays for protection schemes.	Apply	L3
CO4	Illustrate the protection system by using Multi-Input comparators, effects of power swings and protection against the power swings	Apply	L3
CO5	Design microprocessor based relays to protect the system against different faults.	Evaluate	L5

CO-PO Mapping

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	Program Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	-	3	2	2	-
CO2	3	-	2	2	3	-
CO3	2	-	3	2	2	-
CO4	3	-	2	2	3	-
CO5	2	-	3	2	2	-

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. II Semester		
Code: C2106	EHVAC TRANSMISSION	L	T	P
Credits: 3		3	-	-

Prerequisites: High Voltage Engineering, Transmission and Distribution and Electromagnetic Fields

Course Objectives:

To identify the different aspects of Extra High Voltage A.C and D.C Transmission design and Analysis. To understand the importance of modern developments of E.H.V and U.H.V transmission systems. To demonstrate EHV ac transmission system components, protection and insulation level for over voltages.

MODULE I: Introduction to EHVAC 10 Periods

E.H.V.A.C. Transmission line trends and preliminary aspect standard transmission voltages – power handling capacity and line losses- Estimation at line and ground parameters-Bundle conductor systems-Inductance and Capacitance of E.H.V. lines – positive, negative and zero sequence impedance – Line Parameters for Modes of Propagation.

MODULE II: Electrostatic field and voltage gradients 9 Periods

Electrostatic field and voltage gradients – calculations of electrostatic field of AC lines – effect of high electrostatic field on biological organisms and human beings - surface voltage gradients and maximum gradients of actual transmission lines – voltage gradients on sub conductor.

MODULE III: Over Voltages in EHV lines 10 Periods

Power Frequency Voltage control and over-voltages in EHV lines: No load voltage – charging currents at power frequency-voltage control – shunt and series compensation – static VAR compensation.

MODULE IV: Corona in E.H.V. lines 10 Periods

Power loss and audible noise (AN) – corona loss formulae – charge voltage diagram – generation, characteristics - limits and measurements of AN – relation between 1-phase and 3-phase AN levels .

Radio interference (RI) - corona pulses generation, properties, limits – frequency spectrum – modes of propagation – excitation function – measurement of RI, RIV and excitation functions .

MODULE V: Design of EHV lines 9 Periods

Design of EHV lines based on steady state and transient limits - EHV cables and their characteristics.

TEXT BOOKS

1. R. D. Begamudre ,**"EHVAC Transmission Engineering"**, New Age International (p) Ltd. 3rd Edition.

2. K.R. Padiyar, **"HVDC Power Transmission Systems"**, New Age International (p) Ltd. 2nd revised Edition, 2012.

REFERENCES

1. S. Rao, **"EHVAC and HVDC Transmission Engg. Practice"**, Khanna publishers.
2. Arrillaga.J, **,** 2nd Edition (London) peter Peregrines, IEE, 1998.
3. Padiyar.K.R, **" FACTS Controllers in Power Transmission and Distribution"** , New Age International Publishers, 2007.
4. Hingorani H G and Gyugyi. L, **"Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems",** New York, IEEE Press, 2000.

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1. Web course on "Advances in UHV Transmission and Distribution" by Professor Prof. Subbba Reddy Indian Institute of Science, available on NPTEL at https://nptel.ac.in/courses/108108099
2. Web link on "AC Transmission Line Losses" http://large.stanford.edu/courses/2010/ph240/harting1/
3. Web link on "Corona Effect & Discharge in Transmission Lines & Power System" https://www.electricaltechnology.org/2018/02/corona-effect-discharge-transmission-lines-power-system.html
4. Web link on "Analysing Series and Shunt Compensation " https://www.ukessays.com/essays/engineering/analysing-series-and-shunt-compensation-engineering-essay.php
5. Open access conference paper link on "Analysis of current characteristics of corona discharge in high voltage transmission" https://iopscience.iop.org/article/10.1088/1755-1315/440/3/032040/pdf

COURSE OUTCOMES

COs	CO Statements	Blooms Level	
CO1	**Estimate** choice of voltage for transmission, line losses and power handling capability and to **determine** the resistance/reactive line parameters with reference to EHVAC transmission.	Evaluate	K5
CO2	**Calculate** the electrostatic field of EHV AC lines and **analyze** the effect of high electrostatic fields on humans, plants and animals.	Analyze	K4
CO3	**Compare** the power frequency voltage control methods used in EHVAC transmission lines.	Analyze	K4
CO4	**Calculate** the Corona power loss, Audible Noise and Radio Interference levels for single phase and three phase EHV lines.	Apply	K3
CO5	**Analyze** by applying the statistical procedures for line designs, scientific and engineering principles in power systems.	Analyze	K4

CO-PO MAPPING

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**2**	**-**	**2**	**2**	**3**	**-**
CO2	**3**	**-**	**2**	**3**	**2**	**2**
CO3	**3**	**-**	**3**	**2**	**2**	**-**
CO4	**2**	**-**	**2**	**3**	**2**	**-**
CO5	**3**	**-**	**3**	**3**	**3**	**1**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. II Semester		
Code: C2107	POWER SYSTEM OPERATION AND DEREGULATION	L	T	P
Credits: 3		3	-	-

Prerequisites: Network Analysis, Power System Operation and Control, Power System Analysis

Course Objectives:

The course introduces the concept of OPF with security constraints. To describe modeling of load frequency control of a power system. To get awareness on reactive power control of a power system.

MODULE I: State Estimation in Power Systems **10 Periods**

Introduction- Power system state estimation- Maximum likelihood Weighted Least squares estimation-Matrix formulation- State estimation of AC network- State estimation by orthogonal decomposition. Detection and identification of Bad measurements- Estimation of quantities not being measured- Network Observability and pseudo measurements

MODULE II: Power System Security **9 Periods**

Introduction –Factors affecting power system security-Contingency analysis -Detection of network problems-Linear sensitivity analysis-AC power flow methods-contingency selection-concentric relaxation-Bounding area method

MODULE III: Optimal Power Flow **10 Periods**

A: Introduction – OPF Formulation, Gradient method-Newton's method - Economic load dispatch, Optimal reactive power dispatch, Economic emission dispatch, Security constrained OPF.

B: OPF Solution techniques – Lagrange multiplier method – Linear programming OPF – Interior point method.

MODULE IV: Power System Deregulation **10 Periods**

Introduction- motivation for restructuring of power systems- Electricity market entities model-benefits of deregulation-terminology-deregulation in Indian power sector-Operations in power markets-power pools-transmission networks and electricity markets.

MODULE V: Available Transfer Capability **9 Periods**

Introduction methods: of determination of ATC - ATC calculation considering the effect of contingency analysis-Transmission open access and pricing-cost components of transmission system- transmission pricing methods-Incremental cost based transmission pricing.

TEXT BOOKS

1. P.Venkatesh, B.V.Manikandan, S.Charles Raja and A.Srinivasan**, "Electrical Power Systems: Analysis, Security, Deregulation"**, PHI Learning Pvt. Ltd., 2012.
2. A.J.Wood and B.F.Woollenberg, **" Power Generation Operation and Control",** Wiley-Interscience publication, 2nd Edition, 1996.

REFERENCES

1. P.S.R. Murty, **"Electrical Power Systems",** Butterworth-Heinemann Publishers, 2017.
2. Subir Ray**, "Electrical Power Systems: Concept, Theory and Practice",** PHI Learning Pvt. Ltd., 2014.
3. Hussain Shareef, **"Modern Power Tracing Methods for Deregulated Power Systems",** LAP Lambert Academic Publishing, 2011.
4. Xiao-ping zhang **"Restructured Electric Power System"wiley publications 2013**

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1. https://neos-guide.org/content/optimal-power-flow
2. https://albertaviews.ca/electricity-deregulation/
3. http://nptel.ac.in/courses/108101005/
4. Power system restructuring and deregulation - EPFL

Course Outcomes

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

1. Analyze state estimation of Power system by using different measurements.
2. Analyze the Power system security - Contingency analysis.
3. Estimate the optimal scheduling of power plants.
4. Investigate the importance of restructuring and deregulation in Indian Power sector.
5. Compute Available Transfer Capability (ATC) and the cost of transmission.

COs	CO Statements	Blooms Level	
CO1	Analyze state estimation of Power system by using different measurements	Analyze	L4
CO2	Analyze the Power system security -Contingency analysis.	Analyze	L4
CO3	Estimate the optimal scheduling of power plants.	Evaluate	L5
CO4	Investigate the importance of restructuring and deregulation in Indian Power sector	Apply	L3
CO5	Compute Available Transfer Capability (ATC) and the cost of transmission.	Evaluate	L5

CO-PO Mapping

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**-**	**2**	**1**	**3**	**-**
CO2	**3**	**-**	**3**	**2**	**3**	**-**
CO3	**3**	**-**	**2**	**3**	**3**	**-**
CO4	**2**	**-**	**3**	**2**	**2**	**-**
CO5	**3**	**-**	**2**	**2**	**2**	**-**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. II Semester		
Code: C2121	**RESTRUCTURED POWER SYSTEMS**	**L**	**T**	**P**
Credits: 3	(Professional Elective - III)	**3**	**-**	**-**

Prerequisites: Electrical Power Systems

Course Objectives: To Introduce the restructuring of power industry and market models. To impart knowledge on fundamental concepts of congestion management. To analyze the concepts of locational marginal pricing and financial transmission rights. To Illustrate about various power sectors in India.

MODULE I: Introduction to Restructuring of Power Industry 10 Periods

Introduction: Deregulation of power industry, Restructuring process, Issues involved in deregulation, Deregulation of various power systems – Fundamentals of Economics: Consumer behavior, Supplier behavior, Market equilibrium, Short and long run costs, Various costs of production – Market models: Market models based on Contractual arrangements, Comparison of various market models, Electricity vis – a – vis other commodities, Market architecture, Case study.

MODULE II: Transmission Congestion Management 10 Periods

Introduction: Definition of Congestion, reasons for transfer capability limitation, Importance of congestion management, Features of congestion management – Classification of congestion management methods – Calculation of ATC - Non – market methods – Market methods – Nodal pricing – Inter zonal and Intra zonal congestion management – Price area congestion management – Capacity alleviation method.

MODULE III: Locational Marginal Prices and Financial Transmission Rights 10 Periods

A: Mathematical preliminaries: - Locational marginal pricing– Lossless DCOPF model for LMP calculation – Loss compensated DCOPF model for LMP calculation – ACOPF model for LMP calculation – Financial Transmission rights – Risk hedging functionality - Simultaneous feasibility test and revenue adequacy.

B: FTR issuance process: FTR auction, FTR allocation – Treatment of revenue shortfall – Secondary trading of FTRs – Flow gate rights – FTR and market power - FTR and merchant transmission investment.

MODULE IV: Ancillary Service Management and Pricing of Transmission Network 9 Periods

Introduction of ancillary services – Types of Ancillary services – Classification of Ancillary services – Load generation balancing related services – Voltage control and reactive power support devices – Black start capability service - How to obtain ancillary service –Co-optimization of energy and reserve services - International comparison Transmission pricing – Principles – Classification – Rolled in transmission pricing methods – Marginal transmission pricing paradigm – Composite pricing paradigm – Merits and demerits of different paradigm.

MODULE V: Reforms in Indian Power Sector 9 Periods

Introduction – Framework of Indian power sector – Reform initiatives - Availability based tariff – Electricity act 2003 – Open access issues – Power exchange – Reforms in the near future.

TEXT BOOKS

1. Mohammad Shahidehpour, Muwaffaq Alomoush, Marcel Dekker, "**Restructured Electrical Power Systems: Operation, Trading and Volatility**" Pub., 2001
2. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen," **Operation of Restructured Power Systems**", Kluwer Academic Pub., 2001.
3. Fundamentals of Power System economics Daniel Kirschen and Goran Strbac, John Wiley & Sons Ltd, 2004.

REFERENCES

1. Sally Hunt," **Making Competition Work in Electricity**", , John Willey and Sons Inc. 2002
2. Steven Stoft," **Power System Economics: Designing Markets for Electricity**", John Wiley & Sons, 2002.
3. Making competition work in electricity Sally Hunt, John Wiley & Sons, Inc., 2002
4. Operation of restructured power systems Kankar Bhattacharya, Jaap E. Daadler, Math H.J Bollen, Kluwer Academic Pub., 2001.

E-RESOURCES :

1. https://archive.nptel.ac.in/courses/108/101/108101005/
2. https://onlinelibrary.wiley.com/doi/pdf/10.1002/9780470608555.fmatter
3. https://link.springer.com/chapter/10.1007/978-981-15-2256-7_29
4. https://www.sciencedirect.com/science/article/abs/pii/S0045790617309849
5. https://crescent.education/wp-content/uploads/2019/02/RESTRUCTURED-POWER-SYSTEMS.pdf

Course Outcomes:

After completion of the course, students will be able to:

CO's	CO Statement	Blooms Level	
CO1	Comprehend the process involved in restructuring of power industry.	Understand	L2
CO2	Classify different types of congestion management methods.	Evaluate	L5
CO3	Analyse different models of Locational Marginal Prices (LMP).	Apply	L5
CO4	Recognize the types of ancillary services.	Analyze	L4
CO5	List the requirements to reform the Indian power sector.	Understand	L2

CO-PO Mapping

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	2	2	2	3	2
CO2	2	2	2	2	2	2
CO3	2	2	1	2	2	3
CO4	3	2	1	1	2	2
CO5	3	2	3	1	2	3

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. II Semester		
Code: C2122	**INDUSTRIAL LOAD MODELLING AND CONTROL** (Professional Elective - III)	**L**	**T**	**P**
Credits: 3		**3**	**-**	**-**

Prerequisites: Nil

Course Objectives: To understand the energy demand scenario. To understand the modeling of load and its ease to study load demand industrially. To know Electricity pricing models. To Study Reactive power management in Industries.

MODULE I: Industrial Electric Energy Scenario 10 Periods

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

MODULE II: Electricity Pricing 10 Periods

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

MODULE III: Reactive Power Management 10 Periods

A: Reactive power management in industries - controls-power quality impacts - application of filters Energy saving in industries

B: Selection of Schemes Optimal Operating Strategies - Peak load saving - Integrated Load management for Industries

MODULE IV: Optimal Operation of Loads 9 Periods

Cooling and heating loads - load profiling - Modeling- Cool storage - Types-Control strategies - Optimal operation - Problem formulation- Case studies.

MODULE V: Power Pooling 9 Periods

Captive power units – Operating and control strategies - Power Pooling- Operation models - Energy banking - Industrial Cogeneration.

TEXT BOOKS

1. I.J.Nagarath and D.P.Kothari, "**Modern Power System Engineering**., Tata McGraw Hill publishers, NewDelhi, 1995.

REFERENCES

1. C.O. Bjork " **Industrial Load Management - Theory, Practice and Simulations**", Elsevier, the Netherlands,1989.
2. C.W. Gellings and S.N. Talukdar,. "**Load management concepts"**. IEEE Press, New York,

1986, pp. 3-28.
3. Y. Manichaikul and F.C. Schweppe ," **Physically based Industrial load**", IEEE Trans. on PAS, April 1981.

Course Outcomes
At the end of the course, students will be able to

CO's	CO Statement	Blooms Level	
CO1	Recognize about load control techniques in industries and its application	Apply	L3
CO2	Analyse different types of industrial processes and optimize the process using tools like LINDO and LINGO	Analyze	L4
CO3	Apply load management to reduce demand of electricity during peak time	Apply	L3
CO4	Apply different energy saving opportunities in industries	Apply	L3
CO5	Comprehend the concept of power pooling	Understand	L2

CO-PO Mapping

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**2**	**-**	**3**	**3**	**3**	**2**
CO2	**3**	**-**	**2**	**2**	**2**	**2**
CO3	**2**	**-**	**3**	**2**	**2**	**2**
CO4	**3**	**-**	**2**	**2**	**3**	**2**
CO5	**2**	**-**	**3**	**3**	**3**	**2**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. II Semester		
Code: C2123	**POWER SYSTEM DYNAMICS**	**L**	**T**	**P**
Credits: 3	(Professional Elective - III)	**3**	**-**	**-**

Prerequisites: Nil

Course Objectives:

To impart the basics of dynamic characteristics of power system equipment. Analyze the Dynamic performance of power systems, System stability and controls.

MODULE I: BASIC CONCEPTS 10 Periods

Power system stability, states of operation and system security - system dynamics – problems, system model analysis of steady state stability and transient stability - simplified representation of Excitation control.

MODULE II: MODELING OF SYNCHRONOUS MACHINE 9 Periods

Synchronous machine – park's Transformation-analysis of steady state performance, per unit quantities-Equivalent circuits of synchronous machine-determination of parameters of equivalent circuits.

MODULE III: EXCITATION SYSTEM 10 Periods

A: Excitation system modeling-excitation systems block Diagram - system representation by state equations- Dynamics of a synchronous generator connected to infinite bus - system model Synchronous machine model-stator equations.

B: Rotor equations - Synchronous machine model with field circuit - one equivalent damper winding on q axis (model 1.1) - calculation of Initial conditions.

MODULE IV: ANALYSIS OF SINGLE MACHINE SYSTEM 10 Periods

Small signal analysis with block diagram - Representation Characteristic equation and application of Routh- Hurwitz criterion- synchronizing and damping torque analysis-small signal model - State equations.

MODULE V: APPLICATION OF POWER SYSTEM STABILIZERS 9 Periods

Basic concepts in applying PSS - Control signals - Structure and tuning of PSS - Washout circuit - Dynamic compensator analysis of single machine infinite bus system with and without PSS.

TEXT BOOKS

1. K R Padiyar, **"Power System Dynamics : Stability and Control",** B.S. Publications, 2006.
2. R. Ramanujam, **"Power System Dynamics : Analysis and Simulation"**, PHI Publications, 2009.

REFERENCES

1. P.M. Anderson and A.A. Fouad, **"Power system control and stability",** IEEE Press, 2002.
2. Prabha Kundur, **" Power System Stability And Control**", McGraw Hill Education Publisher, 1st Edition, 2006.
3. El-Shimy Mohamed, **"Dynamic Security of Interconnected Electric Power Systems - Volume 1"**, LAP Lambert Academic Publishing, 2015.

E-RESOURCES

1. ewh.ieee.org/soc/pes/psdpc/
2. http://magazine.ieee-pes.org/
3. nptel.ac.in/courses/108101004/

Course Outcomes

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

COs	CO Statement	Blooms Level	
CO1	Analyze the steady state and transient stability	Analyze	**L4**
CO2	Analyze the Modeling of power system components and synchronous machine	Analyze	**L4**
CO3	Analyze the Modelling of the excitation system of the synchronous machine.	Analyze	**L4**
CO4	Analyze the power system under single and multiple contingency.	Analyze	**L4**
CO5	Evaluate various components of power system stabilizers	Evaluate	**L5**

CO-PO Mapping

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**-**	**2**	**2**	**3**	**-**
CO2	**2**	**-**	**3**	**2**	**2**	**-**
CO3	**3**	**-**	**2**	**3**	**2**	**-**
CO4	**2**	**-**	**3**	**2**	**2**	**-**
CO5	**3**	**-**	**2**	**3**	**3**	**-**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. II Semester		
Code: C2124	HYBRID ELECTRIC VEHICLES (Professional Elective – III)	L	T	
Credits: 3		3	-	

Prerequisites: IC Engines, DC Machines and Transformers and AC Machines.

Course Objectives: To present a comprehensive overview of Electric and Hybrid Electric Vehicles

MODULE I Introduction to Hybrid Electric Vehicles 10 Periods

History of hybrid and electric vehicles, social and environmental importance of hybrid and elec vehicles, impact of modern drive-trains on energy supplies. Conventional Vehicles: Basics of vehi performance, vehicle power source characterization, transmission characteristics, and mathemati models to describe vehicle performance.

MODULE II Hybrid Electric Drive-trains 10 Periods

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power fl control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drive-trains: Basic conc of electric traction, introduction to various electric drive-train topologies, power flow control electric drive-train topologies, fuel efficiency analysis.

MODULE III Electric Propulsion unit & Energy Storage 10 Periods

A: Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives

B: Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electr Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and i analysis, Hybridization of different energy storage devices.

MODULE IV Sizing the drive system 9 Periods

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing t propulsion motor, sizing the power

MODULE V Communications, supporting subsystems 9 Periods

Communications, supporting subsystems: In vehicle networks- CAN, Energy Management Strateg Introduction to energy management strategies used in hybrid and electric vehicles, classification of differ energy management strategies, comparison of different energy management strategies

Text Book:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003

References:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
2. Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.

E-RESOURCES:

1. https://en.wikipedia.org/wiki/Digital_library
2. https://ieeexplore.ieee.org/document/4168013/

3. www.ieahev.org/
4. web.mit.edu/evt/links.html

COURSE OUTCOMES:

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

COs	CO Statement	Blooms Level	
CO1	Distinguish the performance and characteristics of conventional and electric vehicles	Analyze	**L4**
CO2	Choose a suitable drive scheme for developing an electric hybrid vehicle depending on resources	Apply	**L3**
CO3	Develop basic schemes of electric vehicles and hybrid electric vehicles.	Evaluate	**L5**
CO4	Propose proper energy storage system for vehicle applications	Evaluate	**L5**
CO5	Outline various communication protocols and technologies used in vehicle networks	Analyze	**L4**

CO-PO Mapping

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**-**	**3**	**3**	**1**	**-**
CO2	**3**	**-**	**2**	**3**	**3**	**-**
CO3	**1**	**-**	**3**	**2**	**3**	**-**
CO4	**3**	**-**	**2**	**3**	**1**	**-**
CO5	**2**	**-**	**3**	**3**	**3**	**-**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. II Semester		
Code: C2125	AI TECHNIQUES IN POWER SYSTEMS	L	T	P
Credits: 3	(Professional Elective - IV)	3	-	-

PREREQUISITES: Power System Analysis, Power System Operation and Control

Course Objectives:

To cater the knowledge of soft commanding methodologies, such as artificial neural networks, Fuzzy logic and genetic Algorithms. To expose the students to the concepts of feed forward neural networks and about feedback neural networks. To understand about genetic algorithm, genetic operations and genetic mutations.

MODULE I: Artificial Neural Networks **10 Periods**

Introduction-Models of Neural Network - Architectures – Knowledge representation – Artificial Intelligence and Neural networks–Learning process – Error correction learning – Hebbian learning –Competitive learning – Supervised learning – Unsupervised learning– Reinforcement learning- learning tasks.

9 Periods

MODULE II: ANN Paradigms

Multi – layer perceptron using Back propagation Algorithm- Self – organizing Map – Radial Basis Function Network – Functional link, network – Hopfield Network.

MODULE III: Fuzzy Logic **10 Periods**

A: Introduction – Fuzzy versus crisp – Fuzzy sets - Membership function – Basic Fuzzy set operations – Properties of Fuzzy sets

B Cartesian**:** Fuzzy Product –Operations on Fuzzy relations. Fuzzy logic – Fuzzy Quantifiers-Fuzzy Inference-Fuzzy Rule based system-Defuzzification methods.

MODULE IV: Genetic Algorithms **10 Periods**

Introduction-Encoding –Fitness Function-Reproduction operators-Genetic Modeling –Genetic operators-Crossover-Single – site crossover-Two point crossover –Multi point crossover-Uniform crossover – Matrix crossover-Crossover Rate-Inversion & Deletion –Mutation operator –Mutation –Mutation Rate-Bit-wise operators-Generational cycle-convergence of Genetic Algorithm.

MODULE V: Applications Of AI Techniques **9 Periods**

Load forecasting –Economic load dispatch – Load frequency control – Single area system and two area system – Small Signal Stability (Dynamic stability), Reactive power control – speed control of DC and AC Motors.

TEXT BOOKS

1. S.Rajasekaran and G.A.V.Pai, **"Neural Networks, Fuzzy Logic & Genetic Algorithms"**, PHI, New Delhi, 2003.

REFERENCES

1. P.D.Wasserman, Van Nostrand Reinhold, **"Neural Computing Theory & Practice",** New York, 1989.
2. Bart Kosko, **"Neural Network & Fuzzy System",** Prentice Hall, 1992.
3. G.J.Klir and T.A.Folger, **"Fuzzy Sets,Uncertainty and Information",** PHI, Pvt.Ltd,1994.
4. D.E.Goldberg, Addison Wesley, **"Genetic Algorithms",** 1999.

E-RESOURCES

https://aitopics.org/
https://www.electricalindia.in/artificial-intelligence-an-advanced-approach-in-power-systems/
https://digital-library.theiet.org/content/books/po/pbpo022e
https://www.atlantis-press.com/article/25866338.pdf
https://ieeexplore.ieee.org/document/659867

Course Outcomes

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

CO's	CO Statement	Blooms Level	
CO1	Apply learning process, and learning techniques to artificial neutron models	Apply	L3
CO2	Apply back propagation algorithm, self organizing map to radial networks and Hopfield Network	Apply	L3
CO3	Apply the fuzzy concept to Fuzzy Logic Controller and Analyze the analogy between fuzzy and crisp sets, basic fuzzy set operations, rule based systems and Defuzzification methods	Analyze	L4
CO4	Apply the fitness function, Mutation, Crossover and reproduction operators to Genetic Algorithm	Apply	L3
CO5	Apply the Intelligence techniques to Real Power Systems and Analyze the system performance	Analyze	L4

CO-PO Mapping

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	Program Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	-	3	3	-
CO2	3	1	1	2	3	-
CO3	2	2	1	3	2	-
CO4	2	1	-	2	3	-
CO5	3	3	2	3	2	-

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. II Semester		
Code: C2126	MODERN CONTROL THEORY	L	T	P
Credits: 3	(Professional Elective - IV)	3	-	-

Prerequisites: Control Systems

Course Objectives: To explain the concepts of basic and modern control system for the real time analysis and design of control systems. To explain and apply concepts of state variables analysis. To analyze non linear systems. To apply the comprehensive knowledge of optimal theory for Control Systems.

MODULE I: Mathematical Preliminaries 10 Periods

Fields, Vectors and Vector Spaces–Linear combinations and Bases–Linear Transformations and Matrices – Scalar Product and Norms – Eigen-values, Eigen Vectors and a Canonical form representation of Linear operators – The concept of state – State Equations for Dynamic systems – Time invariance and Linearity – Non-uniqueness of state model – State diagrams for Continuous-Time State models.

MODULE II: State Variable Analysis 10 Periods

Linear Continuous time models for Physical systems–Existence and Uniqueness of Solutions to Continuous-Time State Equations – Solutions of Linear Time Invariant Continuous-Time State Equations – State transition matrix and its properties. General concept of controllability – General concept of Observability – Controllability tests for Continuous-Time Invariant Systems – Observability tests for Continuous-Time Invariant Systems – Controllability and Observability of State Model in Jordan Canonical form – Controllability and Observability Canonical forms of State model.

MODULE III: Non Linear Systems 10 Periods

A:Introduction–Non Linear Systems - Types of Non-Linearities–Saturation–Dead-Zone - Backlash – Jump Phenomenon etc;– Singular Points – Introduction to Linearization of nonlinear systems, Properties of Non-Linear systems – Describing function–describing function analysis of nonlinear systems

B: Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase-plane analysis of nonlinear control systems.

MODULE IV: Stability Analysis 9 Periods

Stability in the sense of Lyapunov, Lyapunov's stability and Lypanov's instability theorems - Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method – Generation of Lyapunov functions – Variable gradient method – Krasooviski's method. State feedback controller design through Pole Assignment – State observers: Full order and Reduced

order.

MODULE V: Optimal Control 9 Periods

Introduction to optimal control - Formulation of optimal control problems–calculus of variations – fundamental concepts, functional, variation of functional – fundamental theorem of theorem of Calculus of variations – boundary conditions – constrained minimization – formulation using Hamiltonian method – Linear Quadratic regulator.

TEXT BOOKS

1. M.Gopal , **"Modern control system theory",** New Age International , 1984
2. Nagrath and Gopal, **"Control System Engineering"**, New Age International,4th Edition, 2006.

REFERENCES

1. Kirck, **"Optimal control"** , Dover Publications
2. A. NagoorKani , **"Advanced Control Theory"**, RBA Publications, 1999.
3. Ogata.K ," **Modern Control Engineering"**, Prentice Hall, 1997.

E-RESOURCES

1. http://nptel.ac.in/courses/108101037/
2. https://www.electrical4u.com/state-space-analysis-of-control-system/

Course Outcomes

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

COs	CO Statements	Blooms Level	
CO1	Apply the mathematical analysis for state model and state diagrams.	Apply	L3
CO2	Understand the concepts of state variables analysis.	Understand	L2
CO3	Understand the concepts of Non Linear Systems.	Understand	L2
CO4	Analyze the concept of stability of nonlinear systems.	Analyze	L4
CO5	Analyze the concept of Optimal control problems.	Analyze	L4

CO-PO Mapping

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**2**	**-**	**3**	**2**	**2**	**-**
CO2	**3**	**-**	**2**	**2**	**3**	**-**
CO3	**2**	**-**	**3**	**2**	**2**	**-**
CO4	**3**	**-**	**2**	**2**	**3**	**-**
CO5	**2**	**-**	**3**	**2**	**2**	**-**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. II Semester		
Code: C2127	POWER SYSTEM RELIABILITY AND PLANNING	L	T	P
Credits: 3	(Professional Elective-IV)	3	-	-

Prerequisites: Power system reliability Engineering and applications.

Course Objectives:

To develop the generation system model and recursive relation for capacitive model Building. To evaluate the equivalent transitional rates, cumulative probability and cumulative Frequency.

MODULE I: Generating System Reliability Analysis–I 10 Periods

Generation system model – capacity outage probability tables – Recursive relation for capacitive model building – sequential addition method – unit removal – Evaluation of loss of load and energy indices – Examples.

MODULE II: Generating System Reliability Analysis–II 9 Periods

Frequency and Duration methods – Evaluation of equivalent transitional rates of identical and non-identical units – Evaluation of cumulative probability and cumulative frequency of non-identical generating units – 2- level daily load representation - merging generation and load models – Examples.

MODULE III: Operating Reserve Evaluation 9 Periods

A: Basic concepts - risk indices – PJM methods – security function approach – rapid start and hot reserve units – Modeling using STPM approach.

B: Bulk Power System Reliability Evaluation: Basic configuration – conditional probability approach – system and load point reliability indices – weather effects on transmission lines – Weighted average rate and Markov model – Common mode failures.

MODULE IV: Inter Connected System Reliability Analysis 10 Periods

Probability array method – Two inter connected systems with independent loads – effects of limited and unlimited tie capacity - imperfect tie – Two connected Systems with correlated loads – Expression for cumulative probability and cumulative frequency.

Distribution System Reliability Analysis – I (Radial configuration): Basic Techniques – Radial networks –Evaluation of Basic reliability indices, performance indices– load point and system reliability indices – customer oriented, loss and energy oriented indices – Examples.

MODULE V: Distribution System Reliability Analysis - II 10 Periods

Basic techniques – inclusion of bus bar failures, scheduled maintenance – temporary and transient failures – weather effects – common mode failures –Evaluation of various indices – Examples.

Substations and Switching Stations: Effects of short-circuits - breaker operation – Open and Short-circuit failures –Active and Passive failures – switching after faults – circuit breaker model – preventive maintenance – exponential maintenance times.

TEXT BOOKS

1. Roy Billinton and Ronald N. Allan, **"Reliability Evaluation of Power Systems"**, Plenum press, New York and London, 2nd Edition, 1996.

   2.J. Endrenyi,**"Reliability Modeling in Electric Power Systems"**, John Wiley and Sons, 1st Edition, 1978.

REFERENCES

1. D. Elmakias, **"Computational Methods in Power system Reliability"**, Springer-Verlag.

E-RESOURCES

1. technav.ieee.org/tag/8149/power-system-reliability
2. ieeexplore.ieee.org/document/7042739/
   nptel.ac.in/syllabus/108101039/
3. https://www.sciencedirect.com/science/article/abs/pii/037877969500976X
   https://www.researchgate.net/publication/37881951_The_economics_of_power_system_reliability_and_planning_theory_and_case_study

Course Outcomes:

After completion of the course, students will be able to:

COs	CO Statements	Blooms Level	
CO1	Estimate the loss of load and energy indices for generation systems model	Evaluate	L5
CO2	Illustrate merging generation and load models	Apply	L3
CO3	Apply various indices for distribution systems and evaluation of Bulk Power System Reliability.	Apply	L3
CO4	Apply various indices for distribution systems and evaluation of Bulk Power System Reliability.	Apply	L3
CO5	Analyze the parallel configuration of distribution systems and operation of substations and switching stations	Analyze	L4

CO-PO Mapping

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**1**	**2**	**2**	**2**	**-**
CO2	**2**	**-**	**3**	**2**	**2**	**-**
CO3	**3**	**-**	**2**	**2**	**3**	**-**
CO4	**3**	**-**	**3**	**2**	**3**	**-**
CO5	**3**	**-**	**3**	**2**	**2**	**-**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. II Semester		
Code: C2128	DISTRIBUTED GENERATION AND MICROGRID	L	T	P
Credits: 3	(Professional Elective-IV)	3	-	-

Prerequisites: Power System, Power plant engineering, Power system operation and control

Course Objectives:

To understand various aspects of micro grid design to meet the needs of a utility viz Meeting a utility's objectives, Helping to adopt new technologies into the grid, Creating a framework for knowledgeable power engineers to operate the grid more effectively and to address the issues and challenges that remain to be solved.

MODULE – I INTRODUCTION 10 Periods

Conventional power generation: advantages and disadvantages, Energy crises, Non-conventional energy (NCE) resources: review of Solar PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass, and tidal sources.

MODULE – II DISTRIBUTED GENERATIONS (DG) 9 Periods

Concept of distributed generations, topologies, selection of sources, regulatory standards/ framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Energy storage elements: Batteries, ultra capacitors, flywheels. Captive power plants.

MODULE – III IMPACT OF GRID INTEGRATION 9 Periods

Requirements for grid interconnection, limits on operational parameters,: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues.

MODULE – IV MICROGRIDS 8 Periods

Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids, communication infrastructure, modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques.

MODULE – V POWER QUALITY ISSUES IN MICROGRIDS 8 Periods

Power quality issues in microgrids- Modelling and Stability analysis of Microgrid, regulatory standards, Microgrid economics, Introduction to smart microgrids.

TEXT BOOKS

1. Voltage Source Converters in Power Systems: Modeling, Control and Applications,AmirnaserYezdani, and Reza Iravani, IEEE John Wiley Publications,2009.
2. Power Switching Converters: Medium and High Power, Dorin Neacsu, CRC Press, Taylor &

Francis, 2006.

3. Solar Photo Voltaics, Chetan Singh Solanki, PHI learning Pvt. Ltd., New Delhi,2009.
4. Wind Energy Explained, theory design and applications,J.F. Manwell, J.G. McGowan Wiley publication,2002.
5. Biomass Regenerable Energy,D. D. Hall and R. P. Grover, John Wiley, New York, 1987. 6Renewable Energy Resources, John Twidell and Tony Weir, Tyalor and Francis Publications, 2005.

E-RESOURCES

1. technav.ieee.org/tag/8149/power-system-reliability
2. ieeexplore.ieee.org/document/7042739/

Course Outcomes

After completion of the course, students will be able to:

COs	CO Statements	Blooms Level	
CO1	Understand exploration of renewable energy sources	Understanding	L2
CO2	Explore Understand philosophy of distributed generation	Evaluate	L5
CO3	Apply various issues of DG with grid integration	Apply	L3
CO4	Analyze the concept of micro grid	Analyze	L4
CO5	Elaborate various power quality issues in Microgrids	Evaluate	L5

CO-PO Mapping

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	Program Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	-	2	2	3	2
CO2	2	-	3	2	2	2
CO3	2	-	2	2	3	2
CO4	2	-	3	2	3	1
CO5	3	-	3	2	2	1

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. II Semester		
Code: C2108	POWER SYSTEMS COMPUTATION LAB -II	L	T	P
Credits: 1.5		-	-	3

Course Objectives:

To acquire knowledge about the computational methods in economic load dispatch and unit commitment.

List of Experiments:

1. Symmetrical Fault Analysis in a Power System
2. Economic Dispatch with Neglecting Losses and Generator Limits
3. Economic Dispatch with Losses and No Generator Limits
4. Economic Dispatch using Lambda-Iteration Method in a Power System
5. Unit Commitment by Brute Force Method in a Power System
6. Line outage distribution factors in a Power System
7. Load Frequency Dynamics of Single Area System
8. Load Frequency Dynamics of Two Area System
9. Small Signal and Transient Stability Analysis of Single-Machine Infinite Bus System
10. Small Signal and Transient Stability Analysis of Multi Machine Power System

Course Outcomes

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

	CO Statement	Blooms Level	
CO1	Estimate the fault current for three phase fault	Evaluate	L5
CO2	Estimate the optimal power generation by using economic load dispatch with and without loss	Evaluate	L5
CO3	Estimate the line outage distribution factor	Evaluate	L5
CO4	Analyze the Load Frequency Dynamics of single and two area systems	Analyze	L4
CO5	Analyze the Small Signal and Transient Stability Analysis for SMIBS and MMIBS systems	Analyze	L4

CO-PO Mapping

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**2**	**2**	**3**	**2**	**2**
CO2	**3**	**2**	**2**	**3**	**3**	**2**
CO3	**3**	**2**	**2**	**3**	**2**	**2**
CO4	**2**	**3**	**1**	**3**	**2**	**1**
CO5	**3**	**2**	**1**	**3**	**2**	**1**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. II Semester		
Code: C2109	POWER SYSTEM PROTECTION LAB	L	T	P
Credits: 1.5		-	-	3

Course Objectives:

To enhance the knowledge of power system protection by studying the characteristics of various relays. To emphasis the performance of transmission line model and transformer.

List of Experiments:

1. Determination of Equivalent circuit of a 3-Winding Transformer.
2. Determination of Sequence Impedances of a Cylindrical Rotor Synchronous Machine.
3. Determination of Sequence Impedances of Three Phase Transformer
4. Characteristics of Over Current Relays
   i) IDMT Electromagnetic Relay (7051 A).
5. Characteristics of Percentage biased Differential Relay.
   i) Electromagnetic Relay (7054 A).
6. Characteristics of Microprocessor based Over Voltage Relay (7053 B).
7. Characteristics of Under Voltage (UV) Microprocessor based Relay (7052 B).
8. Characteristics of Static Negative sequence Relays (7055B).
9. Performance and Testing of Transformer Protection System.
10. Performance and Testing of Transmission Line Model.

Course Outcomes

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

CO's	CO Statement	Blooms Level	
CO1	Determine the equivalent circuit of three winding transformer.	Apply	L3
CO2	Determine the sequence impedance of synchronous machine and three phase transformer.	Apply	L3
CO3	Determine the characteristics of various relays.	Apply	L3
CO4	Emphasis the performance of transmission line model	Analyze	K4
CO5	Emphasis the performance of transformer.	Analyze	K4

CO-PO Mapping

CO-PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**-**	**3**	**2**	**3**	**-**
CO2	**2**	**-**	**2**	**2**	**2**	**-**
CO3	**3**	**-**	**3**	**2**	**3**	**-**
CO4	**2**	**-**	**2**	**2**	**2**	**-**
CO5	**3**	**-**	**3**	**2**	**2**	**-**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. II Semester		
Code: C0A05	**VALUE EDUCATION**	**L**	**T**	**P**
Credits: Nil		**2**	**-**	

Prerequisites: Nil

Course Objectives: The course deals about value of education and self- development, Imbibe good values in students and know about the importance of character.

MODULE I: **6 Periods**

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

MODULE II: **7 Periods**

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

MODULE III: **6 Periods**

A:Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline, Punctuality,

B: Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour.

MODULE IV: **7 Periods**

Universal brotherhood and religious tolerance, True friendship Happiness Vs suffering, love for truth, Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature.

MODULE V: **6 Periods**

Character and Competence -Holy books vs Blind faith, Self-management and Good health Science of reincarnation, Equality, Nonviolence ,Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively.

References:

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

Course Outcomes:

After completion of the course, students will be able to:

COs	CO Statements	Blooms Level	
CO1	Understand self-development and moral values	Understanding	L2
CO2	Explore the importance of character and cultivation of values	Evaluate	L5
CO3	Apply the personality development methods	Apply	L3
CO4	Analyze the association and cooperation principles	Analyze	L4
CO5	Elaborate the principles of religions and good health science	Evaluate	L5

CO- PO Mapping

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	-	-	-	-	2	2
CO2	-	-	-	-	2	2
CO3	-	-	-	-	2	2
CO4	-	-	-	-	2	2
CO5	-	-	-	-	2	2

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. III Semester		
Code: C2129	**POWER SYSTEM TRANSIENTS**	**L**	**T**	**P**
Credits: 3	(Professional Elective-V)	**3**	**-**	**-**

Prerequisites: Nil

Course Objectives: The course introduces the fundamentals of lighting overvoltage, switching over voltages and travelling waves.

MODULE I: LIGHTNING OVERVOLTAGES 10 Periods

Mechanism and parameters of lightning flash, protective shadow, striking distance, electro geometric model for lightning strike, Grounding for protection against lightning – Steady-state and dynamic tower-footing resistance, substation grounding Grid, Direct lightning strokes to overhead lines, without and with shield Wires.

MODULE II: SWITCHING AND TEMPORARY OVERVOLTAGES 9 Periods

Switching transients – concept – phenomenon – system performance under switching surges, Temporary over voltages – load rejection – line faults – ferro resonance, VFTO.

MODULE III: TRAVELLING WAVES ON TRANSMISSION LINE 10 Periods

A: Circuits and distributed constants, wave equation, reflection and refraction – behavior of travelling waves at the line terminations.

B: Lattice Diagrams – attenuation and distortion – multi-conductor system and multi velocity waves.

MODULE IV: INSULATION CO-ORDINATION 9 Periods

Classification of over voltages and insulations for insulation co-ordination – Characteristics of protective devices, applications, location of arresters – insulation coordination in AIS and GIS.

MODULE V: COMPUTATION OF POWER SYSTEM TRANSIENTS 10 Periods

Modeling of power apparatus for transient studies – principles of digital computation – transmission lines, cables, transformer and rotating machines – Electromagnetic Transient program – case studies: line with short and open end, line terminated with R, L, C, transformer, typical power system case study: simulation of possible over voltages in a high voltage substation.

TEXT BOOKS

1. Pritindra Chowdhari, "**Electromagnetic transients in Power System**", John Wiley and Sons Inc., Second Edition, 2009.
2. Allan Greenwood, "**Electrical Transients in Power System**", Wiley & Sons Inc. New York, 2012.

REFERENCES

1. Klaus Ragaller, "**Surges in High Voltage Networks**", Plenum Press, New York, 1980.
2. Rakosh Das Begamudre, "**Extra High Voltage AC Transmission Engineering**", (Second edition) Newage International (P) Ltd., New Delhi, 2006.
3. Naidu M S and Kamaraju V, "**High Voltage Engineering**", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.

Course Outcomes

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

COs	**CO Statements**	**Blooms Level**	
CO1	Apply protection techniques against lightning overvoltage.	Apply	L3
CO2	Analyse switching and temporary overvoltage	Analyze	L4
CO3	Analyse behaviour of travelling waves in the transmission lines	Analyze	L4
CO4	Choose protective devices according to insulation coordination	Apply	L3
CO5	Analyze the power system under transient condition.	Analyze	L4

CO- PO Mapping

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**-**	**2**	**2**	**3**	**-**
CO2	**2**	**-**	**3**	**3**	**2**	**-**
CO3	**2**	**-**	**3**	**2**	**2**	**-**
CO4	**2**	**-**	**2**	**3**	**2**	**-**
CO5	**3**	**-**	**2**	**2**	**2**	**-**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. III Semester		
Code: C2130	**FACTS AND CUSTOM POWER DEVICES**	**L**	**T**	**P**
Credits: 3	(Professional Elective-V)	**3**	**-**	**-**

Prerequisites: Power Electronics, Power semiconductor Devices

Course Objectives: The course introduces the fundamentals of FACTS Controllers, Importance of controllable parameters and types of FACTS controllers & their benefits.

MODULE I: Facts Concepts **10 Periods**

Transmission interconnections power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters, basic types of FACTS controllers, benefits from FACTS controllers.

MODULE II: Voltage Source Converters **9 Periods**

Single phase, three phase full wave bridge converters, 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.

MODULE III: Static Shunt Compensation **10 Periods**

A: Objectives of shunt compensation, mid-point voltage regulation voltage instability prevention, improvement of transient stability, Power oscillation damping, Methods of controllable VAR generation, variable impedance type static VAR generators, switching converter type VAR generators, hybrid VAR generators.

B: 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 compensator control.

MODULE IV: Static Series Compensators **10 Periods**

Concept of series capacitive compensation, improvement of transient stability, power oscillation damping, and functional requirements of GTO thyristor controlled series capacitor (GSC), thyristor switched series capacitor (TSSC), and thyristor controlled series capacitor (TCSC), Control schemes for GSC, TSSC and TCSC.

MODULE V: Unified Power Flow Controller **9 Periods**

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. Introduction to Interline Power Flow Controller.

TEXT BOOKS

1. N.G. Hingorani and L. Guygi, **"Understanding FACTS Devices",** IEEE Press Publications, 2000.

2. K.R. Padiyar., **" FACTS Controllers in Power Transmission and Distribution**", New Age International Publishers, 2007.
3. Robert J. Herrick, Editor in Chief **"Understanding FACTS",** IEEE Press Editorial Board,2000.

REFERENCES

1. Xiao-Ping Zhang, Christian Rehtanz and Bikash Pal, **"Flexible AC Transmission Systems: Modelling and Control (Power Systems)",** Springer publisher, 2nd Edition, 2012 **.**
2. Rajiv K. Varma R. Mohan Mathur, **"Thyristor-Based FACTS Controllers for Electrical Transmission Systems",** Wiley Publishers, 2011.
3. Nisha Tamta and Ashwini Arya, **"Modelling of Facts Controllers in Power System Networks",** LAP Lambert Academic Publishing, 2012.
4. T J E Miller, **"Static Reactive Power Compensation",** John Wiley and Sons, Newyork, 1982.

E-RESOURCES

1. http://www.electronicshub.org/flexible-ac-transmission-systemfacts/
2. http://www.powerqualityworld.com/2011/09/statcom-static-synchronous-compensator.html
3. https://www.youtube.com/watch?v=6u6twyQYFNM
4. https://ieeexplore.ieee.org/book/5264253
5. https://www.wiley.com/en-us/Understanding+FACTS

Course Outcomes

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

COs	**CO Statements**	**Blooms Level**	
CO1	Analyze the importance of controllable parameters and basic concepts of FACTS controllers	Apply	L3
CO2	Apply the concepts of Voltage source converters and Current Source Converters.	Evaluate	L5
CO3	Apply the static shunt compensation by using different VAR generators and SVC & STATCOM for various functions.	Analyze	L4
CO4	Understanding the Power and control circuits of Series Controllers GCSC, TSSC and TCSC.	Understanding	L2
CO5	Analyzing UPFC device and power flow analysis	Understanding	L2

CO- PO Mapping

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**-**	**3**	**2**	**3**	**-**
CO2	**3**	**-**	**2**	**2**	**2**	**-**
CO3	**2**	**-**	**3**	**2**	**3**	**-**
CO4	**3**	**-**	**2**	**2**	**2**	**-**
CO5	**3**	**-**	**3**	**3**	**3**	**-**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. III Semester		
Code: C2131	**GAS INSULATED SYSTEMS**	**L**	**T**	**P**
Credits: 3	(Professional Elective - V)	**3**	**-**	**-**

Prerequisites: Nil

Course Objectives: To impart the GIS concepts and principles, to compare between Air Insulated Substation and GIS. To understand the design and constructional aspects of GIS.

MODULE I: Introduction to GIS and Properties of Sf_6 10 Periods

Characteristics of GIS- Introduction to SF_6 - Physical properties-Chemical properties - Electrical properties-Specification of SF_6 gas for GIS application - Handling of SF_6 gas before use - Safe handling of Sf_6 gas in electrical equipment - Equipment for handling the SF_6 Gas - SF_6 and environment.

MODULE II: Layout of GIS Stations 9 Periods

Advancement Of GIS Station - Comparison With Air Insulated Substation - Economics Of GIS - User Requirements For GIS - Main Features For GIS - Planning And Installation Components Of A GIS Station

MODULE III: Design and Construction of GIS Station 10 Periods

A: Introduction - Rating of GIS components - Design Features - Estimation of different types of Electrical Stresses -Design Aspects of GIS components

B: Insulation Design for Components- Insulation Design for GIS - Thermal Considerations in the Design of GIS - Effect of very Fast Transient Over-voltages (VFTO) on the GIS design - Insulation Coordination systems - Gas handling and Monitoring System Design.

MODULE IV: Fast Transient Phenomena In GIS 9 Periods

Introduction- Disconnect or Switching in Relation to Very fast Transients-Origin of VFTO-Propagation and Mechanism of VFTO-VFTO Characteristics- Effects of VFTO-Testing of GIS for VFTO.

MODULE V: Special Problems in GIS and GIS Diagnostics 10 Periods

Introduction - particles their effects and their control- Insulating Spacers and their Reliability - SF_6 Gas Decomposition - Characteristics of imperfections in insulation - Insulation Diagnostic methods - PD Measurement and UHF Method.

TEXT BOOKS

1. M. S. Naidu , **"Gas Insulated Substations",** IK International Publishing House.

REFERENCES

1. Hermann J. Koch, "**Gas Insulated Substations**", Wiley-IEEE Press, 2014.
2. S. A. Boggs, F. Y. Chu and N. Fujimoto, **"Gas-insulated substations: technology and practice"**, Pergamon Press, 1986.

E-RESOURCES

1. http://electrical-engineering-portal.com/gas-insulated-substations-gis
2. https://www.electricity-today.com/overhead-td/gas-insulated-switchgear-options-for-substations
3. https://www.youtube.com/watch?v=q025e5dW32c

Course Outcomes

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

COs	CO Statements	Blooms Level	
CO1	Analyze the properties of SF6 gas and its functioning	Analyze	L4
CO2	Analyze the features and layout of GIS systems	Analyze	L4
CO3	Observe constructional design features of GIS design	Understanding	L2
CO4	Analyze the Fast Transient Phenomena in Gas	Analyze	L4
CO5	Discriminate the Problems and design diagnostic methods of GIS	Create	L5

CO- PO Mapping

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**2**	**-**	-	**2**	**2**	**-**
CO2	**2**	**-**	-	**2**	**2**	**-**
CO3	**2**	**-**	-	**2**	**2**	**-**
CO4	**2**	**-**	-	**2**	**2**	**-**
CO5	**2**	**-**	-	**2**	**2**	**-**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. III Semester		
Code: C2132	ELECTRIC VEHICLE CHARGING TECHNIQUES	L	T	P
Credits: 3	(Professional Elective - V)	3	-	-

Prerequisite: Electric and Hybrid Vehicles, Power Electronics, Smart Grid Technologies Course

Objectives:

To understand the charging infrastructure for EV's

To explore the working of grid connected with EV's

MODULE – I AN OVERVIEW OF EV CHARGING INFRASTRUCTURE 10 Periods

Orients the reader to EV charging infrastructure, providing a brief introduction to technical concepts of electric vehicle supply equipment, AC and DC charging, power ratings, and charging standards.

MODULE – II LOCATION PLANNING AND LAND ALLOCATION 9 Periods

Covers the location and site planning aspects for EV charging, by framing the principles of location planning and demonstrating a methodology for spatial allocation of charging demand, and identifies enabling processes and policies to integrate public charging in urban planning.

MODULE – III CONNECTING EVs TO THE ELECTRICITY GRID 8 Periods

Focuses on supply of electricity for charging infrastructure, familiarizing readers with the regulations that govern electricity supply for EV charging, the role of DISCOMs in provision of EV charging connections, and the three methods of arranging for power supply for charging infrastructure

MODULE – IV ACHIEVING EFFECTIVE EV-GRID INTEGRATION 8 Periods

Zooms out from site-level considerations for supply of electricity to assess grid-level impacts, and then highlights the need for smart charging to minimize adverse impacts of EV charging loads on the grid.

MODULE – V MODELS OF EV CHARGING IMPLEMENTATION 9 Periods

Defines the typical roles within an implementation model for EV charging infrastructure and identifies three models in India – the government-driven model, the consumer-driven model and the charge point operator-driven model – for charging infrastructure implementation

TEXTBOOKS

1. Sulabh Sachan, P. Sanjeevikumar, Sanchari Deb, "Smart Charging Solutions for Hybrid and Electric Vehicles",Wiley Publications, March 2022.
2. Handbook of Electric Vehicle Charging Infrastructure Implementation Version-1

REFERENCES

1. Vahid Vahidinasab, Behnam Mohammadi-Ivatloo, "Electric Vehicle Integration via Smart Charging, Springer, 2022.
2. Alam, Mohammad Saad, Pillai, Reji Kumar, Murugesan, N, "Developing Charging Infrastructure and Technologies for Electric Vehicles", IGI Global

Course Outcomes

COs	CO Statements	Blooms Level	
CO1	Understand the planning and operational issues related to EV's charging.	Apply	L3
CO2	Determining the principles of location planning and demonstrating a methodology for spatial allocation of charging demand.	Determine	L3
CO3	Evaluating methods of the role of DISCOMs in provision of EV charging.	Analyze	L4
CO4	Understanding smart charging to minimize adverse impacts of EV charging loads on the grid	Understanding	L2
CO5	Demonstrating the model for EV charging infrastructure.	Demonstrate	L3

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. III Semester		
Code:	**Open Elective**	**L**	**T**	**P**
Credits: 3		**3**	**-**	**-**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. III Semester		
Code: C2110	**TECHNICAL SEMINAR**	**L**	**T**	**P**
Credits: 2		**-**	**-**	**4**

Course Objectives: To promote deeper understanding the basic concepts, physical mechanism behind the processes, participate in scientific analysis and comprehensive of scientific writing of verbal presentation. This course is to introduce post graduate student to ideas, methods and techniques that can improve the content and presentation of scientific seminars.

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

COs	CO Statements	Blooms Level	
CO1	Plan the technical documents to the standards	Apply	L3
CO2	Select oral presentation on technical and general topics	Evaluate	L5
CO3	Express ideas clearly with examples	Analyze	L4
CO4	Identify the research opportunities related to their area.	Apply	L3
CO5	Communicate effectively.	Understanding	L2

CO- PO Mapping

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**3**	**-**	**1**	**-**	**1**
CO2	**-**	**2**	**-**	**-**	**2**	**1**
CO3	**2**	**-**	**2**	**2**	**-**	**-**
CO4	**2**	**1**	**2**	**2**	**1**	**1**
CO5	**-**	**-**	**1**	**-**	**2**	**-**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. III Semester		
Code: C2111	**PROJECT / DISSERTATION PHASE - I**	**L**	**T**	**P**
Credits: 8	(Major Project)	**-**	**-**	**16**

Course Objectives: To utilize basic knowledge and advance techniques to make product/process using experimentation and/or simulation and expose to others as document and oral presentation.

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

COs	CO Statements	Blooms Level	
CO1	Summarize the work completed in the form of technical documents	Understanding	L2
CO2	Specify the techniques implemented or to be implemented	Understanding	L2
CO3	Explain the results obtained in Project Phase I	Analyze	L4
CO4	Summarize the ultimate finding of the project	Understanding	L2
CO5	Summarize the ultimate finding of the project	Understanding	L2

CO- PO Mapping

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**2**	**2**	**3**	**3**	**-**
CO2	**1**	**-**	**-**	**2**	**2**	**1**
CO3	**-**	**2**	**3**	**3**	**-**	**2**
CO4	**2**	**-**	**2**	**-**	**-**	**1**
CO5	**2**	**-**	**2**	**-**	**2**	**-**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. IV Semester		
Code: C2112	**PROJECT / DISSERTATION PHASE - II**	**L**	**T**	**P**
Credits: 16	(Major Project)	**-**	**-**	**32**

Course Objectives: To utilize science and engineering to make product/process using innovative techniques, predict the results and prepare technical documents.

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

COs	CO Statements	Blooms Level	
CO1	Identify project goals, constraints, deliverables, performance criteria, control needs and requirements.	Apply	L3
CO2	Implement concepts, tools and techniques to do quality projects.	Analyze	L4
CO3	Adapt projects in response to issues that arise internally and externally.	Create	L6
CO4	Interact with team and stakeholders in a professional manner, respecting differences, to ensure a collaborative project environment.	Analyze	L4
CO5	Utilize technology tools for communication, collaboration, information management, and decision support.	Applying	L3

CO- PO Mapping

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**2**	**2**	**3**	**3**	**-**
CO2	**-**	**-**	**-**	**2**	**2**	**1**
CO3	**-**	**2**	**3**	**3**	**-**	**-**
CO4	**2**	**-**	**-**	**2**	**-**	**1**
CO5	**-**	**-**	**2**	**-**	**2**	**1**

OPEN ELECTIVES

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. III Semester		
Code: C3228	**INDUSTRIAL SAFETY** (Open Elective)	**L**	**T**	**P**
Credits: 3		**3**	**-**	**-**

Prerequisites: Industrial Management

Course objectives: The objective of this course is to understand and maintain health and safety from various hazards and understand the different types of maintenance in industry.

Module-I: Industrial safety **10 Periods**

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

Module -II: Fundamentals of maintenance engineering: **9 Periods**

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

Module -III: Wear and Corrosion and their prevention: **9 Periods**

A: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, Screw down grease cup, Pressure grease gun,. Splash lubrication, Gravity lubrication, Wick feed lubrication, Side feed lubrication and Ring lubrication.

B: Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Module-IV: Fault tracing: **10 Periods**

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

Module -V: Periodic and preventive maintenance: 10 Periods

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

Text Books:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.

References:

1. Pump-hydraulic Compressors, Audels, McGraw Hill Publication.
2. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

E-Resources

1. https://www.safeopedia.com/definition/1052/industrial-safety
2. https://en.wikipedia.org/wiki/Industrial_safety_system

Course Outcomes

After completion of the course, students will be able to:

COs	CO Statements	Blooms Level	
CO1	Understand the basic concepts of industrial safety needs.	Understand	L2
CO2	Understand and identify various hazards in industry.	Understand	L2
CO3	Understand and avoid wear and tear during manufacturing process.	Understand	L2
CO4	Identify suitable fault finding activities.	Understand	L2
CO5	Use periodic and preventive maintenance in industry.	Applying	L3

CO- PO Mapping

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	Programme Outcomes(POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	-	-	1	-	-
CO2	1	-	3	-	-	-
CO3	-	2	-	2	-	-
CO4	-	-	-	-	1	-
CO5	-	-	1	-	-	-

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. III Semester		
Code: C0B20	**OPTIMIZATION TECHNIQUES** (Open Elective)	**L**	**T**	**P**
Credits: 3		**3**	**-**	**-**

Pre-requisite: Nil

Course Objectives:
To understand extremely important topics under the broad umbrella of optimization, this is synonymous with efficiency which is the underlying prime rationale for all scientific and technological advances and progress.

Module - I: Linear Programming **[10 Periods]**

Introduction and formulation of models; convexity; graphical &simplex method; Big-M Method, Two phase method; degeneracy, non-existent and unbounded solutions; duality in L.P. Dual simplex method, sensitivity analysis for cost and requirement vector; Revised simplex method; Transportation and Assignment problems.

Module - II: Integer Linear Programming **[10 Periods]**
Gomory's cutting plane method; branch and bound algorithm; travelling salesman problem; knapsack problem; linear C-1 problem.

Module - III: Dynamic Programming , CPM & PERT **[9 Periods]**
A: Belman's Principle of optimality; recursive relations; Solution of L.P. Problem; simple examples.
B: CPM & PERT

Module -IV: Non-Linear Programming **[9 Periods]**
Classical optimization methods; equality and inequality constraints; Lagrange multipliers; Kuhn-tucker conditions; quadratic forms; quadratic programming and Beale's methods.

Module -V: Search Methods **[10 Period]**
One dimensional optimization; Fibonacci search; multi dimensional search methods; uni-variate search; gradient methods; steepest descent/ascent methods; conjugate gradient method; Fletcher-reeves method; penalty function approach.

TEXT BOOKS

1) J.K. Sharma "**Operations Research Theory & Applications**", 4th Edition, Mc.Millan Publications
2) S.S.Rao -"**Engineering Optimization theory and Practice**", 4th Edition, J Wiley & Sons, New jersey

REFERENCES

1. K.V.Mital -"**Optimization methods in operations research and system analysis**", 3rd Edition, Newage International (P) Ltd., publishers.

2. H.A Taha "**Operations Research: An Introduction**" Prentice Hall Edition, 2016 reprint
3. Raul Poler et.al "**Operations Research Problems Statement and solutions**" Springer, 2014 reprint.

E Resources:

1. http://www.mhhe.com/engcs/industrial/hillier/etext/PDF/chap03.pdf (LPP)
2. http://ocw.nctu.edu.tw/upload/classbfs121001503719748.pdf (Transportation Problems)
3. http://shodhganga.inflibnet.ac.in/bitstream/10603/19544/12/7_chapter%201.pdf (Replacement Models)
4. https://www.math.ucla.edu/~tom/GameTheory/mat.pdf (Game Theory)
5. http://www.ime.unicamp.br/~andreani/MS515/capitulo12.pdf (Inventory Models)

Course Outcomes

After completion of the course, students will be able to:

COs	**CO Statements**	**Blooms Level**	
CO1	Find feasible solution to LPP by various methods.	Analyze	L4
CO2	Minimize the cost and time by using Travelling salesmen Problem.	Apply	L3
CO3	Understand various methods Dynamic programming.	Understand	L2
CO4	Understand the various concepts on Non-Linear programming.	Understand	L2
CO5	Understand the various concepts of Search methods.	Understand	L2

CO- PO Mapping

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**-**	**-**	**3**	**-**	**-**
CO2	**-**	**1**	**-**	**2**	**-**	**-**
CO3	**2**	**-**	**-**	**3**	**-**	**-**
CO4	**3**	**-**	**1**	**-**	**-**	**-**
CO5	**-**	**-**	**-**	**3**	**2**	**-**

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. III Semester		
Code: C1128	**WASTE TO ENERGY** (Open Elective)	**L**	**T**	**P**
Credits: 3		**3**	**-**	**-**

Prerequisites: Nil

Course Objective: The objective of this course is to introduce different Waste to Energy conversions and its innovative practices, explores the role of energy from waste in resource management and clean energy production.

MODULE I: Introduction **8 Periods**

Classification of waste as fuel - Agro based, Forest residue, Industrial waste - MSW - Conversion devices - Incinerators, gasifiers, digesters.

MODULE II: Biomass Pyrolysis **10 Periods**

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

MODULE III: Biomass Gasification **10 Periods**

A: Gasifiers - Fixed bed system - Downdraft and updraft gasifiers - Fluidized bed gasifiers - Design, construction and operation - Gasifier burner arrangement for thermal heating.

B: Gasifier engine arrangement and electrical power - Equilibrium and kinetic consideration in gasifier operation.

MODULE IV: Biomass Combustion **8 Periods**

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

MODULE V: Biogas **12 Periods**

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

REFERENCES

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

E - RESOURCES

1. https://www.eia.gov/energyexplained/?page=biomass_waste_to_energy
2. https://www.r-e-a.net/renewable-technologies/energy-from-waste
3. http://www.volund.dk/Waste_to_Energy/How_it_works

Course Outcomes:

After completion of the course, students will be able to:

COs	CO Statements	Blooms Level	
CO1	Understand the different types of wastes generated in an industry	Analyze	L4
CO2	Produce energy from various resources	Apply	L3
CO3	Convert urban waste to useful energy	Understand	L2
CO4	Assess the environmental impacts of various wastes.	Understand	L2
CO5	Understand the benefits of waste-to-energy conversion.	Understand	L2

CO- PO Mapping

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	Programme Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	-	-	3	-	-
CO2	-	-	2	-	1	-
CO3	3	-	-	2	-	-
CO4	-	-	1	1	-	-
CO5	3	3	-	-	3	-

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. IV Semester		
Code: C2112	Project/ Dissertation Phase-II	**L**	**T**	**P**
Credits: 16		**-**	**-**	**32**