KIT-Kalaignarkarunanidhi Institute of Technology
(AnAutonomousInstitution)
Coimbatore–641402.
Department of Electrical and Electronics Engineering
PG – POWER SYSTEMS ENGINEERING
Conceptual Frame work
(For Students admitted from the Academic Year 2023-2024 and onwards)

Semester	Level of Course	Hours / Week	No of Courses	Range of Credits/ Courses	Total Credits
PART I					
A - Foundation Courses					
I	Foundation Courses **(FC)**	4	1	4	4
B - Professional Core Courses					
I to IV	Professional Core **(PC)**	3-4	11	2-4	34
C - Elective Courses					
I to IV	Professional Elective **(PE)**	3	5	3	15
D – Project Work					
III & IV	Project Work **(PW)**	12 -24	2	6-12	18
Total Credits					**71**
PART II - Career Enhancement Courses (CEC)					
II	Technical Seminar	2	1	2	2
Total Credits					**2**
Total Credits to be Earned					**73**

Approved by BoS Chairman

Curriculum and Scheme of Assessment

(For Students admitted from the Academic Year 2023-2024 and onwards)

Semester I										
Course Code	**Course Name**	**CT**	**Instructional Hours**					**Assessment**		
			CP	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**Total**
Theory										
M23MAT103	Applied Mathematics for Electrical Engineers	**FC**	4	3	1	0	**4**	40	60	100
M23PST101	Computer Aided Power System Analysis	**PC**	4	3	1	0	**4**	40	60	100
M23PST102	Power System Operation and Control	**PC**	3	3	0	0	**3**	40	60	100
M23PST103	Power Electronics Applications to Power Systems	**PC**	3	3	0	0	**3**	40	60	100
M23PST104	Systems Theory	**PC**	4	3	1	0	**4**	40	60	100
	Professional Elective-I	**PE**	3	3	0	0	**3**	40	60	100
Practical										
M23PSP101	Power System Laboratory-I	**PC**	4	0	0	4	**2**	60	40	100
Total credits to be earned							**23**			

Semester II										
Course Code	**Course Name**	**CT**	**Instructional Hours**					**Assessment**		
			CP	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**Total**
Theory										
M23PST201	Power System Dynamics	**PC**	3	3	1	0	**4**	40	60	100
M23PST202	Power System Automation	**PC**	3	3	0	0	**3**	40	60	100
M23PST203	Advanced Power System Protection	**PC**	3	3	0	0	**3**	40	60	100
M23PST204	Smart Grid Technologies	**PC**	3	3	0	0	**3**	40	60	100
	Professional Elective- II	**PE**	3	3	0	0	**3**	40	60	100
	Professional Elective- III	**PE**	3	3	0	0	**3**	40	60	100
Practical										
M23PSP201	Power System Laboratory – II	PC	4	0	0	4	**2**	60	40	100
M23CEP201	Technical Seminar	CEC	4	0	0	4	**2**	100	-	100
Total credits to be earned							**23**			

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Semester III										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory										
M23CST101	Research Methodology and IPR	PC	3	3	0	0	3	40	60	100
	Professional Elective-IV	PE	3	3	0	0	3	40	60	100
	Professional Elective-V	PE	3	3	0	0	3	40	60	100
Practical										
M23PSP301	Project Work-Phase I	PW	12	0	0	12	6	40	60	100
Total credits to be earned							15			

Semester IV										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Practical										
M23PSP401	Project Work - Phase II	PW	24	0	0	24	12	40	60	100
Total credits to be earned							12			

TOTAL NO.OF CREDITS: 73

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FOUNDATIONCOURSES(FC)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
M23MAT104	Applied Mathematics for Electrical Engineers	**FC**	4	3	1	0	**4**	**40**	60	100

PROFESSIONAL CORE (PC)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
M23PST101	Computer Aided Power System Analysis	**PC**	4	3	1	0	**4**	40	60	100
M23PST102	Power System Operation and Control	**PC**	3	3	0	0	**3**	40	60	100
M23PST103	Power Electronics Applications to Power Systems	**PC**	3	3	0	0	**3**	40	60	100
M23PST104	Systems Theory	**PC**	4	3	1	0	**4**	40	60	100
M23PSP101	Power System Laboratory-I	**PC**	4	0	0	4	**2**	60	40	100
M23PST201	Power System Dynamics	**PC**	4	3	1	0	**4**	40	60	100
M23PST202	Power System Automation	**PC**	3	3	0	0	**3**	40	60	100
M23PST203	Advanced Power System Protection	**PC**	3	3	0	0	**3**	40	60	100
M23PST204	Smart Grid Technologies	**PC**	3	3	0	0	**3**	40	60	100
M23PSP201	Power System Laboratory–II	**PC**	4	0	0	4	**2**	60	40	100
M23CST101	Research Methodology and IPR	**PC**	3	3	0	0	**3**	40	60	100

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PROFESSIONALELECTIVES(PE)										
Elective–I										
Semester I										
Course Code	**Course Name**	**CT**	**Instructional Hours**					**Assessment**		
			CP	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**Total**
M23PSE101	Restructured Power System	**PE**	3	3	0	0	**3**	40	60	100
M23PSE102	Principles of Sustainable Green Energy Development	**PE**	3	3	0	0	**3**	40	60	100
M23PSE103	Electric Vehicle Technologies	**PE**	3	3	0	0	**3**	40	60	100
M23PSE104	Industrial Power System Analysis and Design	**PE**	3	3	0	0	**3**	40	60	100
M23PSE105	Optimization Techniques to Power System Engineering	**PE**	3	3	0	0	**3**	40	60	100
M23PSE106	Flexible AC Transmission System	**PE**	3	3	0	0	**3**	40	60	100

Elective–II										
Semester II										
Course Code	**Course Name**	**CT**	**Instructional Hours**					**Assessment**		
			CP	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**Total**
M23PSE201	Distributed Generation and Micro-grid	**PE**	3	3	0	0	**3**	40	60	100
M23PSE202	Power Electronics for Renewable Energy System	**PE**	3	3	0	0	**3**	40	60	100
M23PSE203	Battery Management System	**PE**	3	3	0	0	**3**	40	60	100
M23PSE204	Electrical Transients in Power System	**PE**	3	3	0	0	**3**	40	60	100
M23PSE205	Soft Computing Techniques	**PE**	3	3	0	0	**3**	40	60	100
M23PSE206	HVDC Transmission	**PE**	3	3	0	0	**3**	40	60	100

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Elective - III										
Semester II										
Course Code	**Course Name**	**CT**	**Instructional Hours**					**Assessment**		
			CP	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**Total**
M23PSE207	IOT Applications in Smart Grid	**PE**	3	3	0	0	**3**	40	60	100
M23PSE208	Solar Energy Storage System	**PE**	3	3	0	0	**3**	40	60	100
M23PSE209	Power Converters for Electric Vehicle	**PE**	3	3	0	0	**3**	40	60	100
M23PSE210	Electrical Distribution System	**PE**	3	3	0	0	**3**	40	60	100
M23PSE211	Neural Network and Deep Learning	**PE**	3	3	0	0	**3**	40	60	100
M23PSE212	EHV Power Transmission	**PE**	3	3	0	0	**3**	40	60	100

Elective -IV										
Semester III										
Course Code	**Course Name**	**CT**	**Instructional Hours**					**Assessment**		
			CP	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**Total**
M23PSE301	AI for Smart Grid System	**PE**	3	3	0	0	**3**	40	60	100
M23PSE302	Wind Energy Conversion System	**PE**	3	3	0	0	**3**	40	60	100
M23PSE303	Intelligent Vehicle Technologies	**PE**	3	3	0	0	**3**	40	60	100
M23PSE304	Power System Reliability	**PE**	3	3	0	0	**3**	40	60	100
M23PSE305	Computational Intelligent Technique to Power System	**PE**	3	3	0	0	**3**	40	60	100
M23PSE306	High Voltage Insulation Systems	**PE**	3	3	0	0	**3**	40	60	100

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Elective - V										
Semester III										
Course Code	**Course Name**	**CT**	**Instructional Hours**					**Assessment**		
			CP	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**Total**
M23PSE307	Cyber Security in Power System	**PE**	3	3	0	0	**3**	40	60	100
M23PSE308	Energy Management Auditing	**PE**	3	3	0	0	**3**	40	60	100
M23PSE309	Grid to Vehicle and Vehicle to Grid Technologies	**PE**	3	3	0	0	**3**	40	60	100
M23PSE310	Power System State Estimation and Security Assessment	**PE**	3	3	0	0	**3**	40	60	100
M23PSE311	Computer Relaying Wide Area Measurement System	**PE**	3	3	0	0	**3**	40	60	100
M23PSE312	Electromagnetic Interference and Compatibility in System Design	**PE**	3	3	0	0	**3**	40	60	100

PROJECTWORK(PW)										
Course Code	**Course Name**	**CT**	**Instructional Hours**					**Assessment**		
			CP	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**Total**
M23PSP301	Project Work- Phase I	**PW**	12	0	0	12	**6**	40	60	100
M23PSP401	Project Work- Phase II	**PW**	24	0	0	24	**12**	40	60	100

CAREER ENHANCEMENT COURSE (CEC)										
Course Code	**Course Name**	**CT**	**Instructional Hours**					**Assessment**		
			CP	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**Total**
M23CEP201	Technical Seminar	CEC	4	0	0	4	2	100	-	100

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M.E.	M23CST101- RESEARCH METHODOLOGY AND IPR	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the basics of research formulation and design
2.	To learn the concept of data collection and sources.
3.	To study about data analytics and report writing.
4.	To learn the concept of IPR.
5.	To understand about the benefits and registration of patent.

UNIT-I	RESEARCH DESIGN	9
Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.		

UNIT-II	DATA COLLECTION AND SOURCES	9
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.		

UNIT-III	DATA ANALYSIS AND REPORTING	9
Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.		

UNIT-IV	INTELLECTUAL PROPERTY RIGHTS	9
Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Biodiversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.		
UNIT-V	**PATENTS**	**9**
Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filing, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents.		
Total Instructional hours:45		

Approved by BoS Chairman

Course Outcomes: Students will be able to	
CO1	Outline the concept of research formulation and design.
CO2	Demonstrate the process of data collection and sources.
CO3	Make use of the data analysis methods and report writing.
CO4	Apply the basics of IPR and its functions.
CO5	Make use of the benefits and registration of patent.

Reference Books	
1.	The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013
2.	Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012).
3.	Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
4.	David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.

Approved by BoS Chairman

M.E.	M23PSE301-AI FOR SMART GRID SYSTEM	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the AI Techniques and characteristics.
2.	To learn the different search strategies in AI.
3.	To understand the representation and facts in logic.
4.	To understand the necessity and concept and architectures of smart grid.
5.	To understand the working principle of measuring instruments.

UNIT-I	INTRODUCTION	9
Introduction to AI – Need for Smart Grid-The problem, assumption, AI technique- Agent, Intelligent agent, Defining the problem as a state space search, production systems, problem characteristics, production systems characteristics, issue in the design of search programs.		

UNIT-II	SEARCHING TECHNIQUES	9
Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations - Constraint Satisfaction Problems – Constraint Propagation - Backtracking Search		

UNIT-III	KNOWLEDGE REPRESENTATION ISSUES AND PREDICATE LOGIC	9
First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation - Categories and Objects – Events - Mental Events and Mental Objects - Reasoning Systems for Categories -Reasoning with Default Information		

UNIT-IV	SMART GRID	9
Functions – Opportunities – Benefits and challenges, Difference between conventional & Smart Grid, Concept of Robust & Self-Healing Grid, Smart Grid Architecture -Models - Standards, and Road map for Smart Grid in India.		

UNIT-V	APPLICATIONS OF AI IN SMART GRID	9
Smart grid and its features-AI and Its Development- Applications analysis of AI in smart Grid-The challenges of Applying AI to smart Grid - Case studies		
Total Instructional hours:45		

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Course Outcomes: Students will be able to	
CO1	Apply the AI Techniques and characteristics.
CO2	Build appropriate search algorithms for problem solving.
CO3	Organize the basics of logic and representation.
CO4	Model the architecture of smart Grid.
CO5	Utilize the application of AI in smart Grid.

Reference Books	
1.	Stuart Russell and Peter Norvig, “Artificial Intelligence – A Modern Approach”, Fourth Edition, Pearson Education, 2021
2.	Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Fourth Edition, 2020
3.	Jianjiao "Applications prospects of Artificial Intelligence in Smart Grid"Earth and Environmental science doi:10.1088/1755-1315/510/2/022012
4.	N.Deepak Khemani, “Artificial Intelligence”, Tata McGraw Hill Education, 2013
5.	Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu and Akihiko Yokoyama, “Smart Grid: Technology and Applications”, Wiley, 2012.
6.	Ali Keyhani, "Design of Smart Power Grid Renewable Energy System", IEEE Press, John Wiley & Sons, INC, New Jersey,2011.
7.	Clark W. Gellings,"The Smart Grid: Enabling Energy Efficiency and Demand Response", Taylor and Francis Group, CRC Press, 2009.

Approved by BoS Chairman

M.E.	M23PSE302-WIND ENERGY CONVERSION SYSTEM	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduce the concept of wind energy conversion systems.
2.	To acquire knowledge about wind turbines in WECS.
3.	To understand basic concepts of wind energy conversion systems.
4.	To describe the fixed and variable speed systems in WECS.
5.	To study grid connected system in WECS.

UNIT-I	INTRODUCTION	9
Introduction - Origin of Winds- Nature and Classification of Wind Turbines - Site selection considerations - Components of Wind Energy Conversion System (WECS) -Wind Turbine Aerodynamics- Schemes of electrical generation- wind power efficiency - Applications of wind Energy.		

UNIT-II	WIND TURBINES	9
HAWT-VAWT-Power Developed-Thrust- Efficiency- Rotor selection- Rotor design considerations-Tip speed ratio-No. of Blades-Blade profile- Power Regulation-yaw control-Pitch angle control-stall control-Schemes for maximum power extraction- Grid-Tied Wind Turbine - Magnus Turbine.		

UNIT-III	WIND ENERGY CONVERSION SYSTEMS	9
Introduction-Generator Selection for WECS -Turbine Selection - Self - Excited Induction Generators - Permanent Magnet Synchronous Generators- Synchronous Generator-Squirrel Cage Induction Generator.		

UNIT-IV	FIXED AND VARIABLE SPEED SYSTEMS	9
Model of Wind Speed- Model wind turbine rotor - Drive Train Model-Generator model for Steady state and Transient stability analysis- Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator- DFIG - PMSG -Variable speed generators modelling.		

UNIT-V	GRID CONNECTED SYSTEMS	9
Stand-alone and Grid Connected WECS system-Grid connection Issues-Machine side &Grid side controllers- Effects of Wind Speed and Grid Condition (System Integration) -Environmental Aspects - Wind Energy Program in India- WECS in various countries.		
		Total Instructional hours:45

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Course Outcomes: Students will be able to	
CO1	Analyze the basics of wind energy conversion system
CO2	Analyze the performance of wind turbines.
CO3	Select suitable generators and turbines for WECS.
CO4	Examine the fixed and variable speed systems in WECS.
CO5	Analyze the function of grid connect system along with environment.

Reference Books	
1.	Earnest Joshua, "Wind Power Technology", third edition, PHI Learning Pvt. Ltd., New Delhi, 2019.
2.	Tony Burton, David Sharpe, Nick Jenkins, Ervin Bossanyi, Michael Graham "Wind Energy Handbook" John Wiley & Sons Ltd, Third Edition,2021.
3.	S.N.Bhadra, D.Kastha and S.Banerjee, "Wind Electrical Systems", Oxford University Press,2009.
4.	Bin Wu, Yongqiang Lang, Navid Zargari, Samir Kouro,"Power conversion and control of wind energy systems",2011.
5.	Ion Boldea, "Variable speed generators", Taylor & Francis group, 2006.
6.	L.L.Fresis, " Wind Energy Conversion Systems", Prentice Hall, 1990.

Approved by BoS Chairman

M.E.	M23PSE303 – INTELLIGENT VEHICLE TECHNOLOGIES	L	T	P	C
		3	0	0	3

UNIT-I	INTRODUCTION TO INTELLIGENT VISION SYSTEM	9
Vision Based Driver Assistance System –Vehicle optical Sensor- Laser Radar- Non-Contact ground velocity detecting Sensor- Road Surface Recognition Sensor- Vehicle Sensors for Electronic Toll Collection System- Components of a Vision Sensor System- Driver Assistance on Highways –Lane Recognition-Traffic Sign Recognition-Driver Assistance in Urban Traffic-Stereo Vision- Shape base analysis- Pedestrian Recognition		

UNIT-II	VEHICLE INFORMATION SYSTEM AND INTELLIGENT TRANSPORTATION	9
Intelligent Transportation System (ITS) – Vision for ITS Communications- Multimedia communication in a car- Current ITS Communication Systems and Services- Vehicle to Vehicle Communication Systems- Road to Vehicle Communication Systems- Inter Vehicle Communication- Intra Vehicle Communication- VANETS-Devices- Optical Technologies- Millimeter Wave technologies		

UNIT-III	ADAPTIVE CONTROL TECHNIQUES FOR INTELLIGENT VEHICLE	9
Adaptive Control Overview - Automatic Control of Highway Traffic and Moving Vehicles-Gain Scheduling- Model Reference Adaptive Control- Self-Tuning Adaptive Control System Model- System Identification Basics- Recursive Parameter Estimation- Estimator Initialization- Design of Self-Tuning Controllers- Generalized Minimum Variance (GMV) Control- Pole Placement Control- Model Predictive Control Overview and Examples.		

UNIT-IV	DECISIONAL ARCHITECTURES FOR AUTONOMOUS VEHICLES	9
Control Architectures- Motion Autonomy- Deliberative Architectures - Reactive Architectures- Hybrid Architecture Overview- Overview of Sharp Architecture- Models of Vehicles- Reactive Trajectory following Parallel Parking- Platooning- Main Approaches to Trajectory Planning - Non-Holonomic Path Planning.		

UNIT-V	AUTONOMOUS VEHICLE AND CASE STUDIES	9
DARPA Challenge Case Study- ARGO Prototype Vehicle- The Gold System- The inverse Perspective Mapping- Lane Detection- Obstacle Detection - Pedestrian Detection- Software systems architecture- Computational Performances- Functionalities- Data acquisition System- Processing System- ADAS Overview.		
		Total Instructional hours:45

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Course Outcomes: Students will be able to	
CO1	Identify and explain the various intelligent sensor technologies and different driver assistant systems.
CO2	Analyze sensors needed for vehicular communications and the deployment of intelligent vehicles.
CO3	Develop the adaptive control techniques for an autonomous vehicle.
CO4	Construct the architecture of intelligent transportation system.
CO5	Design the model of autonomous vehicles needed in road applications

Reference Books	
1.	Nicu Bizon,Lucian D Ascalescu And Naser Mahdavit Abatabaei "Autonomous Vehicles Intelligent Transport Systems And Smart Technologies", Nova Publishers-2014.
2.	William B Ribbens, "Understanding Automotive Electronics", 7th edition, Butter worth Heinemann Woburn, 2012.
3.	Richard Bishop, "Intelligent Vehicle Technology and Trends", Artech House, 2005.
4.	L.Vlacic, M.Parent, F.Harahima,"Intelligent Vehicle Technologies", SAE International, 2001.
5.	LjuboVlacic, Michel Parent and Fumio Harashima,"Intelligent Vehicle Technologies", Butterworth- Heinemann publications, Oxford, 2001.

Approved by BoS Chairman

M.E.	M23PSE304 - POWER SYSTEM RELIABILITY	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduces the objectives of load forecasting.
2.	To study the fundamentals of generation system, transmission system and distribution system reliability analysis.
3.	To illustrate the basic concepts of expansion planning.
4.	To Illustrate the concepts of expansion planning.
5.	To Illustrate the knowledge on the fundamental concepts of the distribution system planning.

UNIT-I	LOAD FORECASTING	9
Objectives of forecasting - Load growth patterns and their importance in planning - Load forecasting Based on discounted multiple regression technique-Weather sensitive load forecasting - Determination of annual forecasting-Use of AI in load forecasting- conclusion spinning capacity evaluation – Load forecast uncertainty		

UNIT-II	GENERATION SYSTEM RELIABILITY ANALYSIS	9
Probabilistic generation and load models- Determination of LOLP, LOLE and expected value of demand not served - Determination of reliability of ISO and interconnected generation systems.		

UNIT-III	TRANSMISSION SYSTEM RELIABILITY ANALYSIS	9
Average interruption rate method – The frequency and duration method - Deterministic contingency analysis-probabilistic load flow-Fuzzy load flow probabilistic transmission system reliability analysis-Determination of reliability indices like LOLP and expected value of demand not served.		

UNIT-IV	EXPANSION PLANNING	9
Basic concepts on expansion planning-procedure followed for integrate transmission system planning, current practice in India-Capacitor placer problem in transmission system and radial distributions system.		

UNIT-V	DISTRIBUTION SYSTEM PLANNING OVERVIEW	9
Introduction, sub transmission lines and distribution substations-Design primary and secondary systems-distribution system protection and coordination of protective devices. Distribution system reliability evaluation: Reliability analysis of radial systems with perfect and imperfect switching.		
		Total Instructional hours:45

Approved by BoS Chairman

Course Outcomes: Students will be able to	
CO1	Develop the ability to learn about load forecasting.
CO2	Analyze the reliability of ISO and interconnected systems.
CO3	Analyze the concepts of Contingency analysis and Probabilistic Load flow Analysis.
CO4	Apply the concepts of Expansion planning.
CO5	Apply the fundamental concepts of the Distribution system planning.

Reference Books	
1.	B.R. Gupta, Generation of Electrical Energy, S. Chand Publications 2017.
2.	Yan Xu, Yuan Chi, Heling Yuan, — Stability-Constrained Optimization for Modern Power System Operation and Planning, Wiley-IEEE Press, 2023.
3.	Roy Billinton, Rajesh Karki, “Reliability and Risk Evaluation of Wind Integrated Power Systems” Springer Publication 2013.
4.	Richard E. Brown, Electric Power Distribution Reliability, CRC Press, 2017.
5.	T. Gonen, Electrical Power Distribution Engineering, McGraw Hill Book Company, 2014.

Approved by BoS Chairman

M.E.	M23PSE305-COMPUTATIONAL INTELLIGENT TECHNIQUE TO POWER SYSTEM	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To enhance the security of the power system through the study of various assessment techniques.
2.	To introduce the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience.
3.	To provide the mathematical background for carrying out the optimization associated with neural network learning
4.	To learn various evolutionary Algorithms.
5.	To become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems.
6.	To introduce case studies utilizing the above and illustrate the Intelligent behavior of programs based on soft computing

UNIT-I	INTRODUCTION	9

Introduction to intelligent systems- Soft computing techniques- Conventional Computing versus Soft Computing - Classification of meta-heuristic techniques - Application domain - Discrete and continuous problems - Single objective and multi-objective problems Expert Systems : Concepts and theory - Knowledge representation techniques - Structure of a rule based expert system - Forward and backward chaining inference techniques.

UNIT-II	ARTIFICIAL NEURAL NETWORKS AND ASSOCIATIVE MEMORY	9

Artificial Neuron and its model- activation functions- Neural network architecture- single layer and multilayer feed forward networks- McCulloch Pitts neuron model- perceptron model- Adaline and Madaline- back propagation learning methods. Counter propagation network- architecture- functioning & characteristic - Hopfield/ Recurrent network configuration- case study.

UNIT-III	FUZZY SYSTEMS	9

Basic fuzzy set operation and approximate reasoning - Membership Functions and Fuzzy sets - Fuzzy rules - Fuzzy inference -Defuzzification methods- Building a fuzzy expert system. Fuzzy modeling and control schemes for nonlinear systems-case study-Self organizing fuzzy logic control.

UNIT-IV	GENETIC ALGORITHM	9

Concepts of Evolutionary computing - Genetic Algorithm (GA) versus Conventional Optimization Techniques - Genetic representations and selection mechanisms; Genetic operators- Various types of crossover and mutation operators –Application of GA to Optimization problems with discrete and continuous variables - Single objective and multi-objective problems-case study.

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UNIT-V	HYBRID CONTROL TECHNIQUES AND APPLICATIONS	9
Fuzzification and rule base using ANN–Neuro fuzzy systems-ANFIS – Fuzzy Neuron - Optimization of membership function and rule base using Genetic Algorithm –Overview of Support Vector Machine and Particle Swarm Optimization - Case study – Familiarization of NN, FLC and ANFIS solver.		
		Total Instructional hours:45

Course Outcomes: Students will be able to	
CO1	Build the basic architectures of Neural Networks and Fuzzy sets.
CO2	Construct ANN architectures, algorithms and know their limitations.
CO3	Analyze the different operations on fuzzy sets.
CO4	Develop ANN and fuzzy logic-based models and control schemes for nonlinear systems.
CO5	Identify the suitable hybrid intelligent techniques to real world problem.

Reference Books	
1.	Michael Gr. Voskoglou, “Fuzzy Sets Fuzzy Logic and Their Applications”, MDPI, 2020.
2.	K.Y. Lee and M.A. El-Sharkawi, “Modern Heuristic Optimization Techniques: Theory and Applications to Power Systems”, Wiley-IEEE Press, 2008.
3.	S N Sivanandam., S N Deepa, “Principles of Soft Computing”, Wiley India Pvt. Ltd., 2nd Ed., 2011.
4.	David E.Goldberg, “Genetic Algorithms in Search, Optimization, and Machine Learning”, Pearson Education, 2009.
5.	Zimmermann H.J. "Fuzzy set theory and its applications" Springer international edition, 2011.
6.	Timothy J. Ross, “Fuzzy Logic with Engineering Applications” Wiley India, 2008.
7.	D.P.Kothari, “ Power system optimization”, PHI Learning Pvt. Ltd, 2010

Approved by BoS Chairman

M.E.	M23PSE305 – HIGH VOLTAGE INSULATION SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To gain the knowledge on behavior of dielectrics under Static fields.
2.	To gain the knowledge on behavior of dielectrics under alternating fields.
3.	To study the breakdown mechanism of Gaseous dielectrics.
4.	To study the breakdown mechanism of Liquid and Solid dielectrics.
5.	To enable the students to become familiar with application of dielectric materials for power equipment.

UNIT-I	PROPERTIES OF DIELECTRICS IN STATIC FIELDS	9
Static dielectric constant – Polarization and dielectric constant – atomic interpretation of the dielectric constant of mono-atomic gases –dependence of permittivity on various factors– internal field in solids and liquids – static dielectric constant of solids – properties of ferroelectric materials – spontaneous polarization – Piezoelectricity.		

UNIT-II	BEHAVIOR OF DIELECTRICS IN ALTERNATING FIELDS	9
Frequency dependence of the electronic polarizability – ionic polarization as a function of frequency – complex dielectric constant of non-dipolar solids – dipolar relaxation – dielectric losses.		

UNIT-III	BREAKDOWN MECHANISMS IN GASEOUS DIELECTRICS	9
Behaviour of gaseous dielectrics in electric fields – gaseous discharges – different ionization processes – effect of electrodes on gaseous discharge – Townsend's theory, Streamer theory – electronegative gases, gaseous discharges in non-uniform fields – alternate Green gases and mixture of gases-breakdown in vacuum insulation.		

UNIT-IV	BREAKDOWN MECHANISMS IN SOLID AND LIQUID DIELECTRICS	9
Solid Dielectrics-Intrinsic breakdown of solid dielectrics – electromechanical breakdown-Streamer breakdown, thermal breakdown - electrochemical breakdown – tracking and treeing – thermal and electrical ageing and partial discharges - classification of solid dielectrics, composite insulation. Liquids dielectrics- conduction and breakdown in pure and commercial liquids, Dissolved gas analysis - Cryogenic Insulation-Biodegradable oils.		

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UNIT-V	LIFE ESTIMATION AND APPLICATION OF INSULATING MATERIALS	9
Life estimation- Application of insulating materials in power equipment and recent advancements- environment friendly and recyclable insulation.		
		Total Instructional hours:45

Course Outcomes: Students will be able to	
CO1	Analyze the characteristics and behavior of dielectrics under Static fields.
CO2	Analyze the characteristics and behavior of dielectrics in alternating fields.
CO3	Demonstrate the performance of gaseous dielectrics.
CO4	Demonstrate the behavior of liquid and solid dielectrics.
CO5	Select the suitable insulation for an electrical power equipment.

Text Books	
1.	Kuffel, E., Zaengl, W.S. and Kuffel J., “High Voltage Engineering Fundamentals”, Elsvier India Pvt. Ltd, 2005
2.	M.S Naidu, V.Kamaraj, “High Voltage Engineering”, Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, 2004.
3.	Dieter Kind and Hermann Karner, “High Voltage Insulation Technology”, 1985. (Translated from German by Y. Narayana Rao, Friedr. Vieweg&Sohn, Braunschweig),
4.	Adrinaus, J.Dekker, “Electrical Engineering Materials”, Prentice Hall of India Pvt. Ltd., New Delhi, 1979.
5.	Alston, L.L, “High Voltage Technology”, Oxford University Press, London, 1968 (B.S Publications, First Indian Edition 2006).
6.	V.Y.Ushakov, “Insulation of High Voltage Equipment”, Springer ISBN.3-540-20729-5, 2004.
7.	R.E.James and Q.Su, “Condition Assessment of High Voltage Insulation in Power System Equipment”, IET publications,London,U.K,2008.

Approved by BoS Chairman

M.E.	M23PSP301 - PROJECT WORK – PHASE I	L	T	P	C
		0	0	12	6

Course Objectives	
1.	Outline the project scope, objectives, and requirements.
2.	Develop a clear project plan outlining tasks, timelines, and resources needed.
3.	Plan thorough research and analysis to gather necessary information and data.
4.	Develop initial project deliverables such as proposals, concept designs, or feasibility studies.
5.	Categorize research activities leading to innovative solutions for industrial and societal problems.

COURSE DESCRIPTION

Project work shall be carried out by each individual student under the supervision of a faculty of this department. A student may however, in certain cases, be permitted to work for the project in association with other departments or in an Industrial/Research Organization, on the recommendation of the Head of the Department. In such cases, the project work shall be jointly supervised by a faculty of the Department and an Engineer / Scientist from the organization. The student shall meet the supervisor periodically and attend the periodic reviews for evaluating the progress.

Project work will be carried out in two phases, Phase-I during the third semester and Phase-2 during the final semester. Phase-I shall be pursued for a minimum of 12 periods per week. In each phase, there will be three reviews for continuous internal assessment and one final review and viva voce at the end of the semesters. The Project Report prepared according to approved guidelines and duly signed by the supervisor(s) and the Head of the Department shall be submitted to the concerned department.

Total Instructional hours:180

Course Outcomes: Students will be able to	
CO1	Identify the project area, understand the problem thoroughly and provide an appropriate solution.
CO2	Compare a systematic literature survey which helps to build the knowledge in the chosen field by using the existing journal references.
CO3	Develop a mathematical model for the system under study.
CO4	Evaluate and get proficiency over the software for simulation and analysis.
CO5	Elaborate the findings of the phase I work in conferences/journals.

Approved by BoS Chairman

M.E.	M23PSE307 - CYBER SECURITY IN POWER SYSTEM	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduce the control techniques for power system.
2.	To analyze the concepts & applications of EMS, SCADA.
3.	To identify the digital attacks and provide security for power system.
4.	To Illustrate the concepts of online anonymity.
5.	To understand the concept of smart grid & usage of smart meters.

UNIT-I	INTRODUCTION TO POWER SYSTEMS CONTROL	9
Characteristics of Power Generating Units and Economic Dispatch-Unit Commitment (Spinning Reserve, Thermal, Hydro and Fuel Constraints)- Solution techniques of Unit Commitment-Generation Scheduling with Limited Energy-Energy Production Cost – Cost Models, Budgeting and Planning, Practical Considerations-Interchange Evaluation for Regional Operations, Types of Interchanges-Exchange Costing Techniques-literature survey on Development of Smart grid.		

UNIT-II	ENERGY MANAGEMENT SYSTEMS (EMS) & SCADA	9
Energy Management Centers and Their Functions-Architectures-recent Developments. Introduction to Supervisory Control and Data Acquisition-SCADA Functional requirements and Components-General features, Functions and Applications - RTU (Remote Terminal Units) Connections-Power Systems SCADA and SCADA in Power System Automation- Fuel cell - modeling and basic architecture of wind generation systems – PV- Batteries.		

UNIT-III	DIGITAL & IT SECURITIES	9
Introduction-Types of Attacks-Digital Privacy-Online Tracking-Privacy Laws-Types of Computer Security risks (Malware, Hacking, Pharming, Phishing, 0Ransomware, Adware and Spyware, Trojan, Virus, Worms, WIFI Eavesdropping, Scareware, Distributed denial of Service Attack, Rootkits, Juice Jacking)-Antivirus and Other Security solution-Password Secure online browsing-Email Security-Social Engineering-Secure WIFI settings-Track yourself online-Cloud storage security-IOT security-Physical Security Threads.		

UNIT-IV	ONLINE ANONYMITY	9
Online Anonymity -Anonymous Networks, Protocols –http - https- FTP Tor Network- I2P Network-Freenet-Darknet-Anonymous OS – Tails-Secure File Sharing-VPN-Proxy Server Connection Leak Testing-Secure Search Engine- Web Browser Privacy Configuration - Anonymous Payment.		

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UNIT-V	SMART GRID & SMART METERS	9
Smart grid: Introduction-Representative Architecture-Components-Microgrid-Smart grid Communications and Measurement Technology- Renewable energy resources-Small and micro hydropower - Demand response and Demand side management-Computational tools for smart grid design-Interoperability-standards-Advanced metering infrastructure (AMI) and a meter data management system (MDMS) are basic smart grid components-Case study.		
		Total Instructional hours:45

Course Outcomes: Students will be able to	
CO1	Analyze the control techniques for power system.
CO2	Apply the concepts & applications of EMS, SCADA.
CO3	Identify the digital attacks and provide security for power system.
CO4	Explain the concepts & applications the online anonymity.
CO5	Explain the concept of smart grid & usage of smart meters.

Text Books	
1.	John R. Vacca, Computer and Information Security Handbook, Morgan Kaufmann 3rd edition, 2017.
2.	Eric D. Knapp & Joel Thomas Langill, Industrial Network Security: Securing Critical Infrastructure, Network for Smart Grid, SCADA and other Industrial Control Systems, Syngress, 2015.
3.	Allen J. Wood, Bruce F. Wollenberg, Power Generation, Operation and Control, Wiley-Interscience, 2013
4.	Chen, Jiming; Cheng, Peng, Cyber security for industrial control systems: from the viewpoint of close-loop, CRC Press, 2016
5.	Yang Xu, Hong Xia, Nuclear Power Plants: Innovative Technologies for Instrumentation and Control Systems: The Third International Symposium on Software Reliability, Industrial Safety, Cyber Security and Physical Protection of Nuclear Power Plant (ISNPP), Springer Singapore, 2019

Approved by BoS Chairman

M.E.	M23PSE308 – ENERGY MANAGEMENT AUDITING	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the concepts behind energy management and auditing.
2.	To impart the process of energy audit concept.
3.	To provide knowledge about various electrical equipment's energy audit.
4.	To discuss the benefits of energy conservation.
5.	To emphasize the different energy management techniques.

UNIT-I	INTRODUCTION	9
Energy Scenario & Conservation -Demand Forecasting Techniques- Integrated Optimal Strategy for Reduction of T&D Losses - DSM Techniques and Methodologies- Loss Reduction in Primary and Secondary Distribution System and Capacitors.		

UNIT-II	ENERGY AUDIT	9
Energy Management – Role of Energy Managers - Energy Audit concepts – Metering. Basic elements and measurements - Mass and energy balances - Scope of energy auditing in industries.		

UNIT-III	ENERGY AUDIT OF ELECTRICAL EQUIPMENT	9
Evaluation of energy conservation opportunities and environmental management-Preparation and presentation of energy audit reports - Case studies for Induction motors, Transformers, Cables, Lighting, AC systems, Pumps, Capacitor banks and potential energy savings.		

UNIT-IV	ENERGY CONSERVATION	9
Energy conservation in HVAC systems and thermal power plants, Wind, Hydro and Solar power plants, Fan and Lighting Systems - Different light sources and luminous efficiency - Energy conservation in electrical devices and systems- Economic evaluation of energy conservation measures.		

UNIT-V	INSTRUMENTATION	9
Evaluation and instrumentation techniques for renewable energy systems (solar thermal, photovoltaic and wind energy); energy management devices; micro controller-based systems.		
		Total Instructional hours:45

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Course Outcomes: Students will be able to	
CO1	Identify the need and significance of energy audit and management
CO2	Utilize the basic concept of energy audit process in industries
CO3	Identify the equipment for energy audit in power system
CO4	Assess the benefits of energy conservation for energy audit and energy Management.
CO5	Analyze the need and type of instruments for different energy management techniques.

Reference Books	
1.	Anil Kumar, ,Om Prakash ,Chauhan Prashant Singh“Energy Management: Conservation and Audits, CRC Press, 2020.
2.	Amlan Chakrabarti- Energy Engineering and management, PHI, 2018.
3.	Barney L. Capehart, Wayne C. Turner, William J. Kennedy, “Guide to Energy Management”, CRC press, Taylor & Francis group, Eighth Edition, 2016.
4.	S.C. Bhatia and Sarvesh Devraj, “Energy Conservation”, Woodhead Publishing India Pvt. Ltd, 2016.
5.	Craig B. Smith, “Energy Management Principles”, Pergamon Press, 2015.
6.	Barney L. Capehart, Wayne C. Turner and William J. Kennedy, "Guide to Energy Management", Seventh Edition, The Fairmont Press Inc., 2012.

Approved by BoS Chairman

M.E.	M23PSE309 - GRID-TO-VEHICLE AND VEHICLE-TO-GRID TECHNOLOGIES	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the principles and components of grid-to-vehicle and vehicle-to-grid technologies.
2.	To discuss the potential benefits and challenges associated with grid-to-vehicle and vehicle-to-grid technologies.
3.	To discuss the technical aspects associated with grid-to-vehicle and vehicle-to-grid technologies.
4.	To analyze the impact of electric vehicle charging on the electrical grid.
5.	To understand the integration of V2G and G2V with renewable energy sources.

UNIT-I	HISTORY AND STATUS OF V2G and G2V	9
Overview of Electric Vehicles- Defining V2G and G2V -Historical Development – Current trends- Actors and Roles of V2G and G2V.		

UNIT-II	POTENTIAL BENEFITS AND CHALLENGES	9
Benefits: Technical – Economic -Environment and Health- Benefits in motion, Challenges: Technical – Economic-Regulatory and Political.		

UNIT-III	TECHNICAL ASPECTS	9
Power Converters and Inverters for V2G and G2V- Various communication standards in Electric Vehicles		

UNIT-IV	GRID IMPACTS AND ENERGY MANAGEMENT	9
Impact of V2G and G2V on grid stability and reliability – Energy Management Systems and Various control algorithms.		

UNIT-V	CASE STUDIES AND IMPLEMENTATION	9
Real world case studies of V2G and G2V projects – Integration of V2G and G2V with renewable energy sources.		
		Total Instructional hours:45

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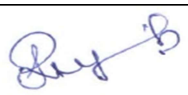
Course Outcomes: Students will be able to	
CO1	Compare the fundamental principles and concepts of Vehicle-to-Grid (V2G) and Grid-to-Vehicle (G2V) technologies.
CO2	Analyze the potential benefits and challenges associated with the implementation of V2G and G2V technologies for energy and transportation systems.
CO3	Explain emerging trends, technological advancements, and research developments in the field of V2G and G2V technologies.
CO4	Evaluate the role of V2G and G2V technologies in optimizing energy management, enhancing grid stability, and reducing carbon emissions.
CO5	Analyze case studies, discuss real-world applications, and engage in hands-on projects related to V2G and G2V technologies.

References	
1.	Lance noel, Gerardo Zarazua de Rubens, Johannes Kester, “Energy,Climate and the environment” , E-book, 2019.
2.	Vehicle to Grid and Grid to Vehicle Technologies, A book chapter published by “Energies”, MDPI, 2021.
3.	Mojumder, M.R.H.; Ahmed Antara, F.; Hasanuzzaman, M.; Alamri, B.; Alsharef, M. Electric Vehicle-to-Grid (V2G) Technologies: Impact on the Power Grid and Battery. Sustainability, vol.14, 2022.
4.	Hoang N.T.Nguyen, Cishen Zhang, Md. Apel Mahmud, “ Optimal Coordination of G2V and V2G to support power grids with high penetration of renewable energy , IEEE Transactions on Transportation Electrification, Vol.1, No.2, pp 188-195,2015.



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M.E.	M23PSE310 - POWER SYSTEM STATE ESTIMATION AND SECURITY ASSESSMENT	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduce the state estimation on DC network.
2.	To impart in-depth knowledge on power system state estimation.
3.	To gain knowledge of alternative formulations of WLS state estimation.
4.	To get insight of network observability and bad data identification.
5.	To gain knowledge on Power System Security Assessment.

UNIT - I	INTRODUCTION TO STATE ESTIMATION	9
Need for state estimation – Measurements – Noise - Measurement functions – Measurement Jacobian– Weights - Gain matrix - State estimation as applied to DC networks - Comparison of Power flow and State Estimation problems - Energy Management System.		

UNIT - II	WEIGHTED LEAST SQUARE ESTIMATION	9
Building network models - Maximum likelihood estimation - Measurement model and assumptions - WLS State Estimation Algorithm - Measurement functions - Measurement Jacobian matrix - Gain matrix - Cholesky decomposition and performing forward and backward substitutions - Decoupled formulation of WLS State estimation - DC State estimation model - Role of Phasor Measurement Units (PMU) in state estimation.		

UNIT - III	ALTERNATIVE FORMULATION OF WLS STATE ESTIMATION	9
Weakness of normal equation formulation, Orthogonal factorization, Hybrid method, Method of Peters and Wilkinsons, Equality constraints WLS State estimation, Augmented matrix approach, Blocked formulation and comparison of techniques.		

UNIT - IV	NETWORK OBSERVABILITY AND BAD DATA DETECTION IDENTIFICATION	9
Network and graphs, Network matrices, loop equations, Methods Observability analysis, Numerical Method based on Nodal Variable formulation and branch variable formulation, Topological Observability analysis, Determination of critical measurements – Role of PMU in network observability. Properties of measurement residuals - Classification of measurements - Bad data detection and identification using Chi-squares distribution and normalized residuals - Bad data identification - Largest normalized residual test and Hypothesis testing identification. bad data detection using PMU.		

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UNIT - V	POWER SYSTEM SECURITY ASSESSMENT	9
Introduction to Security Assessment -Static Security Assessment-Summary of Different Types of Static Security Indices-Methods for Assessing Power System Security-Methods for Assessing Power System Security-Dynamic Security Assessment-Future Trends to Assessing Dynamic Security-Issues Related to Integration of Renewable Energies-Security Enhancement-Issues and Methods to Solve SCOPF Problem-Deal with the Challenges for Enhancing Dynamic Security.		
		Total Instructional hours: 45

Course Outcomes: Students will be able to	
CO1	Explain the various concepts implied in State estimation and its need in DC networks.
CO2	Apply State estimation algorithms in modelling of transmission lines.
CO3	Compare the different types of formulation techniques of State estimation.
CO4	Analyze network observability and identify the bad data detection using different methods.
CO5	List the different types of assessing power system security and solve the issues.

Reference Books	
1.	Ali Abur and Antonio Gomez Exposito ,“Power System State Estimation Theory and Implementation”, Marcel Dekker, Inc., New York . Basel, 2004.
2.	J J Grainger and W D Stevension, “ Power System Analysis”, McGraw-Hill, Inc., 2017
3.	A Monticelli, “State Estimation in Electric Power Systems”, Kluwer Academic Publishers,1999.
4.	Mukhtar Ahmad, “Power System State Estimation”, Lap Lambert Acad Publishers,2013.
5.	Felix L. Chernousko, “ State Estimation for Dynamic Systems”, CRC Press, 1993
6.	Naim Logic, “Power System State Estimation” , LAP Lambert Acad. Publ., 2010.
7.	Power System Security Assessment and Enhancement: A Bibliographical Survey.

Approved by BoS Chairman

M.E.	M23PSE311 - COMPUTER RELAYING AND WIDE AREA MEASUREMENT SYSTEM	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To discriminate conventional relays and computer relays.
2.	To comprehend the operating values of a computer relays.
3.	To provide exposure to wide area measurement systems through the computer hierarchy in the substation, system relaying and control.
4.	To inculcate knowledge on phasor measurement unit and its application to power system.
5.	To enhance the conventional power system studies with wide area measurement techniques.

UNIT-I	INTRODUCTION	9
Historical background - Expected benefits - Computer relay architecture - Analog to digital converters - Anti-aliasing filters - Substation computer hierarchy - Fourier series Exponential fourier series - Sine and cosine fourier series – Phasor.		

UNIT-II	FILTERS IN COMPUTER RELAYING	9
Walsh functions - Fourier transforms - Discrete fourier transform - Random processes - Filtering of random processes - Kalman filtering - Digital filters - Windows and windowing - Linear phase Approximation - Filter synthesis – Wavelets - Elements of artificial intelligence.		

UNIT-III	COMPUTATION OF PHASORS	9
Introduction - Phasor representation of sinusoids - Fourier series and Fourier transform and DFT Phasor representation - Phasor Estimation of Nominal Frequency Signals - Formulas for updating phasors – non-recursive updates - Recursive updates - Frequency Estimation.		

UNIT-IV	PHASOR MEASUREMENT UNITS	9
Generic PMU - The global positioning system - Hierarchy for phasor measurement systems - Functional requirements of PMUs and PDCs - Transient Response of: Phasor Measurement Units, of instrument transformers, filters. Transient response during electromagnetic transients and power swings.		

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UNIT-V	PHASOR MEASUREMENT APPLICATIONS	9
State Estimation - History, Operator's load flow - Weighted least square: least square, Linear weighted least squares, Nonlinear weighted least squares - Static state estimation - State estimation with Phasors measurements - Linear state estimation – Protection system with phasor inputs: Differential and distance protection of transmission lines - Adaptive protection - Adaptive out-of-step protection.		
		Total Instructional hours:45

Course Outcomes: Students will be able to	
CO1	Demonstrate knowledge of fundamental theories, principles and practice of computer relaying, Wide area measurement system
CO2	Analyze the power system with computer relaying and Wide area measurement system
CO3	Validate the recent relaying technologies which work towards smart grid
CO4	Design wide area measurement systems for Smart grid.
CO5	Compare the performance of modern relaying schemes and measurement techniques with the conventional one.

Text Books	
1.	Antonello Monti, Carlo Muscas, FerdinandaPonci,"Phasor Measurement Units and Wide Area Monitoring Systems" Academic Press, 09-Jun-2016
2.	Stanley H. Horowitz, Arun G. Phadke, "Power System Relaying", John Wiley & Sons, 25-Oct-2013.
3.	A.G. Phadke, J.S. Thorp, "Computer Relaying for Power Systems", John Wiley and Sons Ltd., Research Studies Press Limited, 2nd Edition, 2009.
4.	A.G. Phadke, J.S. Thorp, "Synchronized Phasor Measurements and Their Applications", Springer, 2008

Approved by BoS Chairman

M.E.	M23PSE312-ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY IN SYSTEM DESIGN	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To outline the EMI/EMC problems and provide information for solutions to mitigate EMI through system level design as per prescribed standards.
2.	To impart comprehensive insight about the current EMC standards and about various measurement techniques.
3.	To understand the solution methods in PCB.

UNIT-I	EMI ENVIRONMENT	9
EMI/EMC concepts and definitions - Sources of EMI- conducted and radiated EMI- Practical Experiences and Constraints – An Overview of EMI and EMC – Analytical examples – Celestial Electromagnetic Noise – Lightning discharge – ESD - EMP.		

UNIT-II	OPEN AREA TEST SITES, MEASUREMENT OF RI AND CI	9
Open area Test site and measurements – Measurement precautions, errors and site imperfections – Terrain roughness imperfections, normalized site attenuation – Antenna factor measurement – RI measurements – Anechoic chamber – TEM cell – Reverberating chamber – GTEM – Comparison. CI measurement - characterization of conduction currents and voltages – conducted EM noise on power supply lines – Conducted EMI from equipment, immunity, detectors and measurement.		

UNIT-III	EMI MITIGATION	9
Grounding – Shielding – Electrical Bonding – EMI Filters – characteristics – Power line filter design, installation and evaluation – EMI suppression cables - Connectors – gaskets – isolation transformers – opto isolators – transient and surge suppression devices – EMC accessories.		

UNIT-IV	SIGNAL INTEGRITY AND EMC STANDARDS	9
SI problems – analysis – issues in design – modeling and simulation. Standards for EMI / EMC – BS, FCC, CISPR, IEC, EN – IEEE/ANSI standards - Military standards - MIL STD 461E/462 – VDE standards – EMI/EMC standards in Japan-comparison.		

UNIT-V	EMC DESIGN OF PCBs	9
PCB Traces impedance - Routing, Control, Power Distribution Decoupling - Zoning, Motherboard Designs and Propagation Delay Performance Models.		
		Total Instructional hours:45

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Course Outcomes: Students will be able to	
CO1	Illustrate the basics of EMI/ EMC
CO2	Demonstrate the EMI measurements, Diagnose and solve basic electromagnetic compatibility problems.
CO3	Identify the EMI mitigation technologies that able to design filters
CO4	Classify various standards for EMC
CO5	Design the Cable routing & connection and understand the Interconnection Techniques for EMI free system in PCB.

Reference Books	
1.	Yang Zhao, Wei Yan, Jun Sun, Mengxia Zhou, Zhaojuan Meng, “Electromagnetic Compatibility Principles and Applications”, Springer Singapore, 2021.
2.	Paolo Stefano Crovetti, “Electromagnetic Interference and Compatibility”, Electronics, 2021.
3.	C.Saranya, “Electromagnetic Interference and Compatibility”, AR Publications, 2018.
4.	S.Janani, R. Ramesh Kumar, “Electro Magnetic Interference and Compatibility”, Sruthi Publishers, 2013.

Approved by BoS Chairman

M.E.	M23PSP401- PROJECT WORK PHASE II	L	T	P	C
		0	0	24	12

Course Objectives	
1.	Plan do an individual project work which may involve design, modelling, simulation and/or fabrication.
2.	Identify project resources effectively to ensure efficient progress.
3.	Analyze a problem both theoretically and practically.
4.	Experiment the implemented solutions for effectiveness and functionality.
5.	Categorize research activities leading to innovative solutions for industrial and societal problems.

COURSE DESCRIPTION

Project work shall be carried out by each individual student under the supervision of a faculty of this department. A student may however, in certain cases, be permitted to work for the project in association with other departments or in an Industrial/Research Organization, on the recommendation of the Head of the Department. In cases, the project work shall be jointly supervised by a faculty of the Department and an Engineer / Scientist from the organization. The student shall meet the supervisor periodically and attend the periodic reviews for evaluating the progress.

Project work will be carried out in two phases, Phase-I during the third semester and Phase-2 during the final semester. Phase-II shall be pursued for 24 periods per week. In phase II also, there will be three reviews for continuous internal assessment and one final review and viva voce at the end of the semesters. The Project Report prepared according to approved guidelines and duly signed by the supervisor(s) and the Head of the Department shall be submitted to the concerned department.

Total Instructional hours:360

Course Outcomes: Students will be able to	
CO1	Develop the creativity of the projects in electric power systems.
CO2	Apply modern engineering tools for simulation, analysis and solution.
CO3	Evaluate and compare the new practices, principles, and techniques in electric power systems.
CO4	Take part in International Conference/Seminar Presentation/Technical Discussion.
CO5	Analyze the findings of the project and communicate to journals for publication.

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