SRI CHANDRASEKHARENDRA SARASWATHI VISWA MAHAVIDYALAYA
SCSVMV UNIVERSITY

(University Established under section 3 of UGC Act 1956)

Enathur, Kanchipuram – 631561

CURRICULUM AND SYLLABUS

ME – POWER SYSTEM ENGINEERING

FULL TIME PROGRAMME

CHOICE BASED CREDIT SYSTEM

(For Candidates admitted from the year 2023 onwards)

SRI CHANDRASEKHARENDRA SARASWATHI VISWA MAHAVIDYALAYA

Department of Electrical and Electronics Engineering

CURRICULUM

Vision:

- To develop effective and efficient Electrical Engineers endowed with conceptual clarity, ethicality and a visionary zeal

Mission:

- To provide quality teaching empowered with application skills.
- To mould leaders in Electrical Engineering with an all-around personality.
- To encourage faulty members and students in research, capable of finding solutions for theproblems in the society

Programme Educational Objectives:

- PEO 1: Prepare students to meet the demands of contemporary industrial requirements andsuccessfully engage them in appropriate careers.
- PEO 2: Connectivity in learning and professional improvement.
- PEO 3: Develop technical leadership qualities with ethicality.

Programme Outcomes:

- Ability to design Electrical and Electronics systems to meet the required specifications andstandards with realistic constraints
- An understanding of technique for intelligent monitoring and control of power systems.
- Ability to design, develop and test embedded systems for industrial control applications.
- Ability to use modern engineering tools like computer-based simulation software to analyze and solve Electrical and Electronics Engineering problems.
- Ability to understand the industrial problems and generate solutions.

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CURRICULUM

Semester: **I Semester** Year: **I Year**

S. No	Category	Code	Course Title	L	T	P	C	IA	EA	TA
1.	PC	MPSF191T10	Power System Analysis	3	0	0	3	40	60	100
2.	PC	MPSF191T20	Power System Dynamics	3	0	0	3	40	60	100
3.	PE 1	MPSF191E	▪ Smart grid ▪ High Power Converters ▪ Wind and Solar Systems ▪ High Voltage Power Transmission ▪ Power system planning and reliability	3	0	0	3	40	60	100
4.	PE 2	MPSF191E	▪ HVDC Transmission Systems ▪ Mathematical Methods for Power Engineering ▪ Power System Operation and Control ▪ High Voltage Switchgear ▪ Analysis of power converters	3	0	0	3	40	60	100
5.	PC LAB 1	MPSF191P50	Power System Steady State Analysis Lab	0	0	4	2	40	60	100
6.	PC LAB 1	MPSF191P60	Power System Dynamics Lab	0	0	4	2	40	60	100
			Total Credit:				16			

Semester: **II Semester** Year: **I Year**

S. No	Category	Code	Course Title	L	T	P	C	IA	EA	TA
1.	PC 3	MPSF192T10	Advanced power System protection	3	0	0	3	40	60	100
2.	PC 4	MPSF192T20	Power Quality Studies	3	0	0	3	40	60	100
3.	PE 3	MPSF192E	▪ Insulation Technology ▪ Advanced Power Electronicsand Drives ▪ Design of Sub Stations ▪ HVDC and FACTS	3	0	0	3	40	60	100
4.	PE 4	MPSF192E	▪ Power System Management and Deregulation ▪ SCADA Systems and Applications Managements ▪ Distributed generation and automatic control ▪ Power Apparatus Design ▪ Electric and Hybrid Vehicles	3	0	0	3	40	60	100
5.	PC LAB 3	MPSF192P50	Power System Protection and Power Quality Lab	0	0	4	2	40	60	100
6.	PC LAB 4	MPSF192P60	Power Electronics Applications to Power Systems Lab	0	0	4	2	40	60	100
			Total Credit:				16			

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Semester: **III Semester** Year: **II Year**

S. No	Category	Code	Course Title	L	T	P	C	IA	EA	TA
1.	PE 5	MPSF193E5	▪ AI Techniques to Power Systems ▪ Power System Transients ▪ Industrial Load Modeling and Control ▪ Advanced Digital signal processing ▪ Micro –grid operation and control ▪ Energy storage technology	3	0	0	3	40	60	100
2.	OE	MPSF193OE	▪ Research Methodology ▪ Industrial Safety ▪ Operations Research ▪ Cost Management ofEngineering Projects ▪ Composite Materials ▪ Waste to Energy	3	0	0	3	40	60	100
3.	-	MPSF193Z30	Phase – I Dissertation	0	0	20	10	40	60	100
							Total Credit:	16		

Semester: **IV Semester** Year: **II Year**

S. No	Category	Code	Course Title	L	T	P	C	IA	EA	TA
1.	-	MPSF193Z10	Phase-II Dissertation	0	0	32	16	40	60	100
							Total Credit:	16		

Total Credits: 64

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF191T10	Power System Analysis	1	3	50

Course Objective

- To introduce different techniques of dealing with sparse matrix for large scale power systems.
- To impart in-depth knowledge on different methods of power flow solutions.
- To perform optimal power flow solutions in detail.
- To perform short circuit fault analysis and understand the consequence of different type of Faults.

Unit 1: SOLUTION TECHNIQUE

Sparse Matrix techniques for large scale power systems: Optimal ordering schemes for preserving sparsity. Flexible packed storage scheme for storing matrix as compact arrays; Factorization by Bi factorization and Gauss elimination methods; Repeat solution using Left and Right factors and L and U matrices.

Unit 2: POWER FLOW ANALYSIS

Power flow model in real variable form; Newton's method for solution; Adjustment of P-V buses; Fast Decoupled Power Flow method; Sensitivity factors for P-V bus adjustment; Net Interchange power control in multi-area power flow analysis: Assessment of Available Transfer Capability (ATC) using Power Flow method; Continuation Power Flow method.

Unit 3: SHORT CIRCUIT ANALYSIS

Review of fault calculations using sequence networks for different types of faults. Bus impedance matrix (ZBUS) construction using Building Algorithm for lines with mutual coupling; Simple numerical problems. Computer method for fault analysis using ZBUS and sequence components. Derivation of equations for bus voltages, fault current and line currents, both in 012 frame and abc frame using the venin's Equivalent and ZBUS matrix for different faults.

Unit 4: OPTIMAL POWER FLOW

Introduction: Solution of Optimal Power Flow (OPF)-The gradient method, Newton's method, Linear Sensitivity Analysis; LP methods - with real power variables only - LP method with AC power flow variables and detailed cost functions; Security constrained Optimal Power Flow; Interior point algorithm; Bus Incremental costs.

Unit 5: VOLTAGE STABILITY ANALYSIS, STEADY-STATE

Transmission system aspects: SLIB system, maximum deliverable power, power-voltage relationship, generator reactive power requirement, network versus load P-V characteristics, Instability scenario, effect of compensation and series, shunt, SVC, V- Q curves, effect of adjustable transformer ratios.

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Course Outcome: *Optional*

CO:1. Optimal Ordering & Sparse Matrix Techniques

CO:2. Power Flow Methods, Available Transfer Capability

CO:3. Fault Analysis – Two Bus Construction

CO:4. Solution of Optimal Power Flow, Linear Programming Method

CO:5. Voltage Stability & Compensation Circuits

References:

[1]. T.V. Cutsem and C.Vournas, "Voltage Stability of Electric Power Systems", Kluwer Publishers, Paperback, 2006.

[2]. J.Wood and B.F.Wollenberg, "Power Generation Operation and Control", John Wiley and sons, New York, 2013

Text Books:

[1]. Stagg G W, El. Abiad A.H, "Computer Methods in Power System Analysis", McGraw Hill, Paperback – Illustrated, 1 January 2019.

[2]. Elgerd O.I., "Electrical Energy Systems Theory - An Introduction", Tata McGraw, Paperback, 2017.

[3]. Kundur.P., "P.S. Stability and Control", McGraw Hill, Paperback , 2006.

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF191T20	Power System Dynamics	1	3	50

Course Objective

- To impart knowledge on dynamic modeling of a synchronous machine and excitation system in detail.
- To describe the modeling of modeling of HVDC system in detail.
- To describe the modeling of FACTS controller system.
- To analyze the small ,transient and voltage stability.

Unit 1:SYNCHRONOUS MACHINES AND EXCITATION SYSTEMS MODELING

Physical description-Armature and field structure - Direct and quadrature axes -Basic equations of a synchronous machine - dq0 Transformation - Per unit representation - Per unit system for the stator quantities - Per unit stator voltage equations - Per unit rotor voltage equations - stator flux linkage equations - rotor flux linkage equations - Excitation system requirements-Elements of excitation system-Types of excitation system-- Control and protective functions- - modeling of excitation system components - modeling of complete excitation systems

Unit 2: MODELLING OF AC TRANSMISSION

Electrical characteristics - performance equations - natural or surge impedance loading – equivalent Circuit of transmission line - typical parameters - Performance requirements of power transmission Lines - voltage and current profile under no - load - voltage power characteristics - power transfer and Stability considerations - effect of line loss on V - P andQ - P characteristics - thermal limits - Load ability characteristics.

Unit 3: MODELLING OF HVDC AND FACTS CONTROLLERS

HVDC system configuration and components- modeling of HVDC systems- representation for power flow solutions - emerging FACTS controllers – static synchronous compensator - static synchronous series compensator - unified power flowcontroller

Unit 4: SMALL SIGNAL AND TRANSIENT STABILITY ANALYSIS

Small signal stability - state space representation - Eigen values- modal matrices-small signal stability of single machine infinite bus system - synchronous machine classical model representation- effect of field circuit dynamics-effect of excitation system-small signal stability of multi machine system -Transient stability-swing equation-equal area criterion-solution of swing equation-Numerical methods- Euler method-Runge-Kutte method-critical clearing time

Unit 5:VOLTAGE STABLITY ANALYSIS

Classification of voltage stability – basic concepts related to voltage stability – characteristics-transmission, generator and load-voltage collapse typical scenario-voltage factor that affect voltage stability-voltage stability analysis-prevention of voltage collapse.

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Course Outcome: *Optional*

- CO:1. Mathematical representation of synchronous machine per unit quantities, rotor voltage and flux linkage equations.
- CO:2. Basic elements and Types of excitation systems Control and protective functions.
- CO:3. Power transfer and stability considerations Load ability and thermal limit.
- CO:4. Modeling of Excitation systems, Synchronous machines, AC Transmission lines, Facts Devices and HVDC.
- CO:5. Per unit power and torque equation of synchronous machinesoutput Performance equations of transmission lines
- CO:6. Equivalent circuit of transmission line.

References:

[1]. Prabha S. Kundur, Om P. Malik,"Power System Stability and Control", McGraw-Hill education, second edition, 2022.
[2]. Van Cutsem, Vournas, C, "Voltage Stability of Electric Power Systems", Kluwer Academic Publisher, 1998.
[3]. Taylor.C.W, "Power system voltage stability", McGraw-Hill, 1994.
[4]. Kimbark.E.W, "Power System Stability", Vol. II, John Wiley Sons, 2007.

Text Books:

[1]. R.Ramanujam," Power System Dynamics: Analysis and Simulation, PHI Learning Private Limited, Second print, New Delhi, 2013.
[2]. J.Machowski, Bialek, Bumby, "Power System Dynamics and Stability", John wiley and sons, 3rd edition, 2020.
[3]. Vijay Vittal, James D. McCalley, Paul, P.M Anderson and A.A Fouad, "Power System Control and Stability", Iowa State University Press, Ames, Iowa, 3rd edition, 2019.
[4]. P. W. Sauer and M. A. Pai," Power System Dynamics and Stability", Stipes Publishing Co, 2007.

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF191E1	Smart Grid	1	3	50

Course Objective

- Understand concept of smart grid and its advantages over conventional grid.
- Know smart metering techniques.
- Learn wide area measurement techniques.
- Understanding the problems associated with integration of distributed generation & its solution through smart grid.

Unit 1:RECENT TRENDS IN INFORMATION &COMMUNICATION TECHNOLOGIES
Distributed services - Web services - Creation and deployment -Application development frameworks - XML-RPC -A XIS - SOAP communication models Service oriented architecture fundamentals.

Unit 2: SMART GRID FUNDAMENTALS
Smart grid structure - Interactive grid - Micro grid - Distributed resources modeling- Communication infrastructure- Sensing and control devices- Smart grid characteristics.

Unit 3: COMPONENTS AND STANDARDS
Smart grid components - Metering - Virtual power plants-Benefits and cost elements -Pricing regulations - Networking standards and integration -Analytics.

Unit 4: AUTOMATION TECHNOLOGIES
Control centre systems - Data management principles - Smart grid implementation standards and procedure - Operational issues - Modeling and control - Advanced metering infrastructure - Outage management - Distribution and substation automation – Customer inter actions

Unit 5: CASE STUDIES
Smart meters- Smart grid experimentation plan for load forecasting- Optimal placement of Phasor Measurement Units (PMU) - Coordination between cloud computing and smart power grids - Development of power system models and control and communication software.

Course Outcome: *Optional*

CO:1. Explain the fundamentals of smart power grids and its international &Indian scenarios.

CO:2. Calculate voltage and power loss for the given distribution system.

CO:3. Explain advanced metering infrastructure and demand side management.

CO:4. Describe the operation of transmission system with synchronous phasor measurement.

References:

[1]. Kirti Seth, Ashish Seth "Understanding Service-Oriented Architecture - Designing Adaptive Business Model for SMEs" , BPB Publications, 2020.
[2]. S.Banzal "XML Basics", Mercury Learning and Information, 2020.
[3]. Chris Thomas and Bruce Hamilton, "The Smart Grid and the Evolutionof the Independent System Operator", a whitepaper.
[4]. Taylor & Francis "Smart Grids Infrastructure, Technology, and Solutions", CRC Press,2016.

Online Resources:

[1]. www.nptl.co.in
[2]. www.electrical4u.com
[3]. www.oe.energy.gov/DocumentsandMedia/DOE_SG_Book_Single_Pages(1).pdf

Text Books:

[1]. Asmaa Abdallah, Xuemin Shen, "Security and Privacy in Smart Grid", Springer International Publishing, 2018.
[2]. Ruchi Doshi, Temitayo Fagbola, Mehul Mahrishi "Cloud Computing, Master the Concepts, Architecture and Applications with Real-world Examples and Case Studies" BPB Publications, 2019.

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF191E1	High Power Converters	1	3	50

Course Objective

- Understand the requirements of high power rated converters.
- Understand the different topologies involved for these converters.
- Able to understand the design of protection circuits for these converters.

Unit 1:
Power Electronic systems - An overview of PSDs - multi-pulse diode rectifier - multi pulse SCR rectifier.

Unit 2:
Phase shifting transformers - multilevel voltage source inverters: two level voltage source inverter - cascaded H bridge multilevel inverter -Diode clamped multilevel inverters - flying capacitor multilevel inverters

Unit 3:
PWM current source inverters - DC to DC switch mode converters.

Unit 4:
AC voltage controllers: Cyclo-converters - matrix converter, Power conditioners and UPS

Unit 5:
Design aspects of converters - protection of devices and circuits.

Course Outcome: *Optional*

CO:1. Concept and working of Rectifiers and Converters

CO:2. Concept and working of different types of Inverters

CO:3. Working of different types of DC converters fed DC Drives

CO:4. PWM Inverters

CO:5. Concept and working of AC-AC Converters

CO:6. Switched mode converters and UPS

CO:7. Design of converters

References:

[1]. B. K .Bose, "Power Electronics and A.C. Drives", Prentice Hall, 1986.
[2]. Bin Wu, "High power converters and drives", IEEE press, Wiley Enter science.

Text Books:

[1]. Mohan N. Undeland T. M. Robbins , " Power Electronics: Converter Applications and Design", Third Edition, John Wiley & Sons, 2003
[2]. Muhammad Rashid, "Power Electronics: Circuits, Devices and Applications", Fourth Edition, Pearson India, 2018.

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF191E1	Wind and Solar System	1	3	50

Course Objective

- To get exposure to wind and solar systems.
- To understand the factors involved in installation and commissioning of a Solar or Wind plant.
- Learning the dynamics involved when interconnected with power system grid.

Unit 1:
Historical development and current status - characteristics of wind power generation - network integration issues.

Unit 2:
Generators and power electronics for wind turbines - power quality standards for wind turbines - Technical regulations for interconnections of wind farm with power systems.

Unit 3:
Isolated wind systems- reactive power and voltage control - economic aspects - Impacts on power system dynamics - power system interconnection.

Unit 4:
Introduction of solar systems -merits and demerits – concentrators - various applications.

Unit 5:
Solar thermal power generation - PV power generation - Energy Storage device - Designing the solar system for small installations.

Course Outcome: *Optional*

CO:1. Wind power generation-Characteristics and network integration.

CO:2. Wind system-Generator and power Electronics, Technical Regulations

CO:3. Wind system-Impacts on power system dynamics

CO:4. Solar System introduction

CO:5. Solar power generation - methods

CO:6. Energy storage devices, Solar system for small installations.

References:

[1]. Bimal K.Bose, " Modern Power Electronics and AC Drives", Prentice Hall, 2001.
[2]. Muhammad Rashid , "Power Electronics Handbook" , 2023, ELSEVIER Hardback ISBN: 9780323992169.
[3]. Bin Wu, "High power converters and drives", IEEE press, Wiley Enter science 2011.

Online resources:

[1]. www.nptl.co.in

Text Books:

[1]. Thomas Ackermann, Editor, "Wind power in Power Systems", John Willy, 2005.
[2]. Siegfried Heier , "Grid Integration of Wind Energy Conversion Systems" 2006, John Willy and sons Ltd.
[3]. Djamila Rekioua, "Wind Power Electric Systems Modeling Simulation and Control", Springer Publisher, 2020

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF191E1	High Voltage Power Transmission	1	3	50

Course Objective

- To understand the concept, planning of DC power transmission and comparison with AC power transmission.
- To analyze HVDC converters.
- To study about the HVDC control.
- To analyze harmonics and design of filters. To model and analysis the DC system.

Unit 1: ENGINEERING ASPECTS OF EHV AC TRANSMISSION SYSTEM

Principles, configuration, special features of high voltage AC lines, power transfer ability, reactive power compensation, audible noise, corona bundle conductors, electric field, right of way, clearances in a tower, phase to phase, phase to ground, phase to tower, factors to be considered, location of ground wire, angle of protection, clearances, tower configuration. Principles of radio interference, origin of radio interference, method of propagation, factors to be considered in line design.

Unit 2: POWER SYSTEM TRANSIENTS

Introduction, circuit closing transients, sudden symmetrical short circuit of alternator, recovery transients due to removal of short circuit, traveling waves on transmission lines, wave equation, surge impedance and wave velocity, specifications of traveling waves, reflection and refraction of waves, typical cases of line terminations , equivalent circuit for traveling wave studies, forked lines, reactive termination, successive reflections, Bewley lattice diagram, attenuation and distortion, arcing grounds, capacitance switching, current chopping, lightning phenomenon, over voltages due to lightning, line design based on direct strokes, protection of systems against surges, statistical aspects of insulation co-ordination.

Unit 3: HVDC, GENERAL BACKGROUND

EHV A C versus HVDC Transmission, power flow through HVDC link, equation for HVDC power flow, effect of delay angle and angle of advance, bridge connections, waveform of six pulse and twelve pulse bridge converter, commutation, phase control, angle of extinction, control of DC voltage, connections of three phase six pulse and twelve pulse converter bridges, voltage and current waveforms.

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Unit 4: HVDC SWITCHING

Bipolar HVDC terminal, converter transformer connections, switching arrangements in DC yard for earth return to metallic return, HVDC switching system , switching arrangements in a bipolar HVDC terminal, sequence of switching operations, HVDC circuit breakers, DC current interruption, commutation principle, probable types and applications of HVDC circuit breakers, multi-terminal HVDC systems, parallel tapping, reversal of power, configurations and types of multi-terminal HVDC systems, commercial multi terminal systems.

Unit 5: PROTECTION IN HVDC

Faults and abnormal condition in bipolar, two terminal HVDC system, pole-wise segregation, protective zones, clearing of DC line faults and reenergizing, protection .of converters, transformer, converter valves, DC yards, integration of protection and controls, hierarchical levels of control, block diagram, schematic diagram, current control, power control, DC voltage control, commutation channel, master control, station control, lead station, trail station, pole control, equidistant firing control, synchronous HVDC link, asynchronous HVDC Link.

Course Outcome: *Optional*

CO1: Understand the basic Principles, configuration, special features of high voltage AC lines, power transfer ability, reactive power compensation, audible noise, corona bundle conductors, electric field, right of way etc.

CO2: To analyze the importance of recovery transients due to removal of short circuit, traveling waves on transmission lines, wave equation, surge impedance and wave velocity, specifications of traveling waves, reflection andrefraction of waves, typical cases of line terminations, equivalent circuit for traveling wave studies.

CO3: To understand the concepts of EHV A C versus HVDC Transmission, power flow through HVDC link, equation for HVDC power flow, effect of delay angle and angleof advance, bridge connections, waveform of six pulse and twelve pulse bridge converter, commutation, phase control.

CO4: To analyze the need for Bipolar HVDC terminal, converter transformer connections, switching arrangements in DC yard for earth return to metallic return, HVDC switching system, switching arrangements in a bipolar HVDC terminals.

CO5: To understand various Faults and abnormal condition in bipolar, two terminal HVDC system, pole-wise segregation, protective zones, clearing of DC line faultsand reenergizing, protection. of converters, transformer, converter valves, DC yards, integration of protection and controls.

References:

[1]. Brain.M. Weddy, B.J.Cory, "Electric Power Systems", John Wiely and Sons, Fifth edition, 2012
[2]. J.Duncan Glover, Thomas J. Overbye, Mulukutla S.Sarma, "Power System Analysis and Design", Cenage Learning, Sixth Edition, 2015.
[3]. Rakosh Das Begamudre, "EHV AC Transmission", New Age Publishers, 2006.
[4]. Kimbark E.W, "Direct Current Transmission Vol-I", Wiley Inter science, 1971.

Text Books:

[1]. Subir Ray,' An Introduction to High Voltage Engineering' PHI Learning Private Limited, New Delhi, Second Edition, 2013.
[2]. L.L. Alston, 'High Voltage Technology', Oxford University Press, First Indian Edition, 2011.
[3]. C.L. Wadhwa, 'High voltage Engineering', New Age International Publishers, Third Edition, 2010.
[4]. S. Rao, "HVAC and HVDC Transmission", Third Edition, Khanna Publisher, 1993.

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF191E1	Power System Planning and Reliability	1	3	50

Course Objective

- To study the fundamentals of Generation system, transmission system.
- To introduces the objectives of Load fore casting. Distribution system reliability analysis.
- To illustrate the basic concepts of Expansion planning.
- To understand the overview of distribution system planning.

Unit 1: LOAD FORECASTING
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

UNIT 2: GENERATION SYSTEM RELIABILITY ANALYSIS
Probabilistic generation and load models- Determination of LOLP and expected value of demand not served –Determination of reliability of ISO and interconnected generation

Unit 3: TRANSMISSION SYSTEM RELIABILITY ANALYSIS
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 4: EXPANSIONPLANNING
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 5: DISTRIBUTION SYSTEMPLANNINGOVERVIEW9
Introduction, sub transmission lines and distribution substations-Design primary and secondary systems-distribution system protection and coordination of protective devices

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Course Outcome: *Optional*

Students will be able to:

CO1: Develop the ability to learn about load forecasting.

CO2: learn about reliability analysis of ISO and interconnected systems.

CO3: Understand the concepts of Contingency analysis and Probabilistic Load flow analysis

CO4: Understand the concepts of Expansion planning

CO5: Understand the fundamental concepts of the Distribution system planning

References:

[1]. Roy Billinton, Ronald N. Allan, " Reliability Evaluation of Power System", Springer Publication, Second Edition, 1996.

[2]. Jamdade P G, Jamdade S G, "Power System Planning and Reliability", Tech-Neo Publications, 2020.

[3]. X. Wang, J.R. McDonald, "Modern Power System Planning", McGraw Education, 1993.

Text Books:

[1]. Turan Gonen ,"Electrical Power Distribution Engineering", CRC Press, Taylor & Francis Group, Third Edition, 2014.

[2]. B.R. Gupta, "Generation of Electrical Energy", S Chand Publication, Seventh Edition, 2017.

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF191E2	HVDC Transmission system	1	3	50

Course Objective:

- Understand state of the art HVDC technology.
- Learn the Methods to carry out modeling and analysis of HVDC system frontier-area power flow regulation.

Unit 1:DC POWER TRANSMISSION TECHNOLOGY

Introduction - Comparison of AC and DC transmission - Application of DC transmission - Description of DC transmission system - Planning for HVDC transmission - Modern trends in DC transmission - DC breakers - Cables, VSC based HVDC.

Unit 2: ANALYSIS OF HVDC CONVERTERS AND HVDC SYSTEM CONTROL

Pulse number, choice of converter configuration- Simplified analysis of Graetz circuit - Converter bridge characteristics - Characteristics of a twelve-pulse converter- General principles of DC link control- Converter control characteristics - System control hierarchy- Firing angle control - Current and extinction angle control Generation of harmonics and filtering- Power Control.

Unit 3: MULTITERMINAL DC SYSTEMS

Introduction - Potential applications of MTDC systems - Types of MTDC systems - Control andprotection of MTDC systems- Study of MTDC systems.

Unit 4: POWER FLOW ANALYSIS IN AC/DC SYSTEMS

Per unit system for DC Quantities - Modeling of DC links - Solution of DC load flow - Solution of AC-DC power flow – Case studies.

Unit 5: SIMULATION OF HVDC SYSTEMS

Introduction - System simulation: Philosophy and tools - HVDC system simulation - Modeling of HVDC systems for digital dynamic simulation - Dynamic interaction between DC and AC systems.

Course Outcome: *Optional*

CO:1. Explain the modern technology used in HVDC.

CO:2. Describe control strategies used in HVDC system with HVDCconverters

CO:3. Apply suitable method for power flow analysis in AC/DC systems

CO:4. Simulate simple HVDC system for the given specifications

References:

[1]. Erich Uhlmann, "Power Transmission by Direct Current", BS Publications, 2004.
[2]. V.K.Sood, "HVDC and FACTS controllers -Applications of Static Converters in Power System", Kluwer Academic Publishers, 2004.

Text Books:

[1]. K.R.Padiyar, "HVDC Power Transmission Systems", New Age International (P) Ltd., NewDelhi, 2002.
[2]. J.Arrillaga, "High Voltage Direct Current Transmission", IET Publishers, 1998.
[3]. Prabha S. Kundur, Om P.Malik, "Power System Stability and Control", Tata McGraw-Hill, Second Edition, 2022.

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF191E2	Mathematical Methods For Power Engineering	1	3	50

Course Objective

- To understand the relevance of mathematical methods to solve engineering problems.
- To understand how to apply these methods for a given engineering problem.

Unit 1:
Vector spaces - Linear transformations - Matrix representation of linear transformation - Eigen values and Eigen vectors of linear operator.

Unit 2:
Linear Programming Problems - Simplex Method – Duality - Non Linear Programming problems.

Unit 3:
Unconstrained Problems - Search methods - Constrained Problems.

Unit 4:
Lagrange method - Kuhn-Tucker conditions - Random Variables - Distributions.

Unit 5:
Independent Random Variables - Marginal and Conditional distributions - Elements of stochastic processes.

Course Outcome: *Optional*

CO:1. Understand the Vector spaces - Linear transformations - Matrix representation of linear transformation - Eigen values and Eigen vectors of linear operator.

CO:2. To analyze the importance of Linear Programming Problems - Simplex Method – Duality – Non-Linear Programming problems.

CO:3. To understand the concepts of Unconstrained Problems - Search methods - Constrained Problems.

CO:4. To remember the concepts of Lagrange method - Kuhn-Tucker conditions - Random Variables – Distributions.

CO:5. To understand the concepts of independent random variables - marginal and conditional distributions - elements of stochastic processes.

References:

[1]. A Papoulis, Kenneth Hoffman, “Probability, Random Variables and Stochastic Processes – 3re Edition”, McGraw Hill, 2002.
[2]. John B Thomas, “An Introduction to Applied Probability and Random Processes”, John Wiley, 2000
[3]. Hillier F S, Liebermann G J, “Introduction to Operations Research”, McGraw Hill, 2001
[4]. Simmons D M, “Non Linear Programming for Operations Research”, PHI, 1975

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[1]. Ray Kunze, “Linear Algebra- 2nd Edition”, PHI, 1992
[2]. Erwin Kreyszig, “Introductory Functional Analysis with Applications”, John Wiley & Sons, 2004.
[3]. Irwin Miller, Marylees Miller, John E. Freund’s, “Mathematical Statistics – 6th Edition”, PHI, 2002
[4]. J. Medhi, “Stochastic Processes”, New Age International, New Delhi, 1994

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Department of Electrical and Electronics Engineering

SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF191E2	Power System Operation and Control	1	3	50

Course Objective
▪ To understand the fundamentals of speed governing system and the concept of control areas. ▪ To provide knowledge about hydrothermal scheduling, Unit commitment and solution techniques ▪ To impart knowledge on the need of state estimation and its role in the day to day operation of power system.

Unit 1: LOAD FORECASTING

Introduction - Estimation of Average and trend terms –Estimation of periodic components Estimation of Stochastic components: Time series approach - Auto- Regressive Model, Auto- Regressive Moving - Average Models - Kalman Filtering Approach - On-line techniques for non stationary load prediction.

Unit 2: UNIT COMMITMENT

Constraints in unit commitment - Spinning reserve - Thermal unit constraints - Other constraints - Solution using Priority List method, Dynamic programming method - Forward DP approach - Lagrangian relaxation method.

Unit 3: GENERATION SCHEDULING

The Economic dispatch problem - Thermal system dispatching with network losses considered - TheLambda iteration method - Gradient method of economic dispatch - Economic dispatch with Piecewise Linear cost functions - Transmission system effects - A two generator system - coordination equations - Incremental losses and penalty factors-Hydro Thermal Scheduling using DP.

Unit 4: CONTROL OF POWER SYSTEMS

Review of AGC and reactive power control -System operating states by security control functions - monitoring, evaluation of system state by contingency analysis - Corrective controls (Preventive, emergency and restorative) - Energy control center - SCADA system - Functions - monitoring, Data acquisition and controls – EMS system.

Unit 5: STATE ESTIMATION

Maximum likelihood Weighted Least Squares Estimation: - Concepts -Matrix formulation Example for Weighted Least Squares state estimation ; State estimation of an AC network: development of method - Typical results of state estimation on an AC network - State Estimation by Orthogonal Decomposition algorithm - Introduction to Advanced topics : Detection and Identification of Bad Measurements , Estimation of Quantities Not Being Measured , Network Observability and Pseudo - measurements - Application of Power Systems State Estimation.

SYLLABUS

Course Outcome: *Optional*

CO:1. Methods of load forecasting.

CO:2. Concept of unit commitment Problem.

CO:3. Objectives and constraints in UC problem.

CO:4. Derive the coordination equation for ED problem.

CO:5. Explain the various operating states in power system.

CO:6. Explain the concept and methods of state estimation in power systems.

References:

[1]. Prabha S. Kundur, Om P. Malik,"Power System Stability and Control",McGraw-Hill education , second edition,2022

[2]. Allen J.Wood, Bruce.F.Wollenberg, "Power Generation Operation and Control", JohnWiley & Sons, third edition,2014.

Text Books:

[1]. O.I.Elgerd, Author Name 2, "³Electric Energy System Theory - an Introduction", - Tata McGraw Hill, New Delhi, 2002

[2]. Jeraldin Ahila ,"Power Systems Operations and Control", lakshmi publications, June 2018

[3]. S. Sivanagaraju ,"Power System Operation and Control", Dorling Kindersley, · 2009

[4]. Chakrabarti, Abhijit, Halder, Sunita,"Power System Analysis Operation And Control", Phi Learning Pvt. Ltd.,Fourth Edition 2022.

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Department of Electrical and Electronics Engineering

SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF191E2	High Voltage Switchgear	1	3	50

Course Objective

- The clearances between contacts in different insulating medium.
- The arching phenomenon in circuit breaker.
- The design techniques for different types of circuit breakers.

Unit 1: INTRODUCTION
Insulation of switchgear - Rated and tested voltage co-ordination between inner and external msulat1on. Insulation clearances in air, oil SF and vacuum, bushing insulation, solid insulating materials - Dielectric and mechanical strength consideration.

Unit 2: CIRCUIT INTERRUPTION
Switchgear terminology - Arc characteristics - direct and alternating current interruption - Arc quenching phenomena - Computer simulation of arc models- Transient re-striking voltage –RRRV Recovery voltage - Current chopping - Capacitive current breaking - Auto re-closing.

Unit 3: SHORT CIRCUIT CALCULATIONS AND RATING OF CIRCUIT BREAKERS
Types of faults in Power systems-short c1rcu1t current and short circuit MVA calculations for different types of faults-ratings of circuit breakers- symmetrical and asymmetrical ratings.

Unit 4: CIRCUIT BREAKERS
Classifications of circuit breakers-Design, construction and operating principles of bulk oil, minimum oil, air blast, SF" and vacuum circuit breakers- Comparison of different types of circuit breakers.

Unit 5: TESTING OF CIRCUIT BREAKERS
Type tests and routine tests - Short circuit testing - Synthetic testing of circuit breakers- Recent advancements in high voltage circuit breakers – Diagnosis.

SYLLABUS

Course Outcome: *Optional*

CO:1. Understand the basics of Insulation of switchgear - Rated and tested voltageco-ordination Between inner and external insulation. Insulation clearances in air oil SF and vacuum.
CO:2. To analyze the importance of Switchgear terminology - Arc characteristics -direct and Alternating current interruption - Arc quenching phenomena - Computer simulation of arc models.
CO:3. To understand the Types of faults in Power systems-short circuit current and short circuit MVA calculations for different types of faults-ratings ofcircuit breakers- symmetrical and Asymmetrical ratings.
CO:4. To analyze the need for Classifications of circuit breakers-Design, construction and operating principles of bulk oil, minimum oil, air blast, SF" and vacuumcircuit breakers
CO:5. To apply the different type tests and routine tests - Short circuit testing - Synthetic testing of circuit breakers- Recent advancements in high voltage circuit breakers – Diagnosis.

References:

[1]. Kuffel, E., Zaengl, W.S. and Kuffel J., “High Voltage Engineering Fundamentals”, Elsvier India Pvt. Ltd, 2005.

[2]. Flursscheim, C.H. (Editor), “Power Circuit Breaker-Theory and Design”, IEE Monograph Series 17, Peter Peregrinus Ltd., Southgate House, Stevenage, Herts, SC1 1HQ, England,1977.

[3]. Ananthakrishnan S and Guruprasad K.P., “Transient Recovery Voltage and Circuit Breakers”, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1999.

[4]. Funio Nakanishi, “Switching Phenomena in High Voltage Circuit Breakers”, Marcel Dekker Inc., New York, 1991.

Text Books:

[1]. Chunikhin A and Zhavoronkov M., "High Voltage Switchgear analysis and Design", Mir Publishers, MOSCOW, 1989.

[2]. Kuffel E., Zaengl, W.S., and Kuffel J., "High Voltage Engineering Fundamentals", Newness, second edition , Butterworth - Heinemann publishers, New Delhi, 2nd edition 2000

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Department of Electrical and Electronics Engineering

SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF191E2	Analysis of power converters	1	3	50

Course Objective

- To provide the mathematical fundamentals necessary for deep understanding of power operating modes.
- To provide the electrical circuit concepts behind the different working modes of power converter converters so as to enable deep understanding of their operation.
- To provide required skills to formulate and design inverters for generic load and for machine loads.
- To equip with required skills to derive the criteria for the design of power converters starting from basic fundamentals To analyze and comprehend the various operating modes of different configurations of power converters.

Unit 1: SINGLE PHASE AC-DC CONVERTER
Static Characteristics of power diode, SCR and GTO, half controlled and fully controlled converters with R-L, R-L-E loads and freewheeling diodes – continuous and discontinuous modes of operation - inverter operation –Sequence control of converters – performance parameters: harmonics, ripple, distortion, power factor – effect of source impedance and overlap-reactive power and power balance in converter circuits.

Unit 2: THREE PHASE AC-DC CONVERTER
Semi and fully controlled converter with R, R-L, R-L-E - loads and freewheeling diodes – inverter operation and its limit – performance parameters – effect of source impedance and overlap-12 pulse converter.

Unit 3: SINGLE PHASE INVERTERS
Introduction to self-commutated switches : MOSFET and IGBT - Principle of operation of half and full bridge inverters – Performance parameters – Voltage control of single phase inverters using various PWM techniques – various harmonic elimination techniques – Design of UPS-VSR operation.

Unit 4:THREE PHASE INVERTERS
180 degree and 120 degree conduction mode inverters with star and delta connected loads – voltage control of three phase inverters: single, multi pulse, sinusoidal, space vector modulation techniques – VSR operation-Application to drive system – Current source inverters.
.

Unit 5:MODERN INVERTERS

Multilevel concept – diode clamped – flying capacitor – cascaded type multilevel inverters - Comparison of multilevel inverters - application of multilevel inverters – PWM techniques for MLI – Single phase &Three phase Impedance source inverters – Filters.

.

Course Outcome: *Optional*

CO1: Ability to acquire and apply knowledge of mathematics in power converter analysis
CO2: Ability to model, analyze and understand power electronic systems and equipment
CO3: Ability to formulate, design and simulate phase controlled rectifiers for generic load and for machine loads
CO4: Ability to formulate, design, simulate switched mode inverters for generic load and for machine loads
CO5: Ability for device selection and calculation of performance parameters of power converters under various operating modes

References:

[1]. P.C.Sen, “Modern Power Electronics”, Wheeler Publishing Co,First Edition, New Delhi, 1998.
[2]. P.S.Bimbhra, “Power Electronics”, Khanna Publishers, Eleventh Edition, 2003.
[3]. Bin Wu, Mehdi Narimani, "High-power Converters and AC Drives", Wiley, 2nd Edition, 2017.

Text Books:

[1]. Rashid M.H., “Power Electronics Circuits, Devices and Applications ", Prentice Hall India, fourth Edition, New Delhi, 2014.
[2]. Jai P. Agrawal, “Power Electronics Systems”, Pearson Education, Second Edition, 2002.
[3]. Bimal.K.Bose “Modern Power Electronics and AC Drives”, Pearson Education, Second Edition, 2003.
[4]. Ned Mohan, T.M.Undeland and W.P.Robbins, “Power Electronics: converters, Application and design” John Wiley and sons. Wiley India edition, 2006.
[5]. Philip T. krein, “Elements of Power Electronics” Oxford University Press-1998

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Department of Electrical and Electronics Engineering

SYLLABUS

Course Code	Course Name	Semester	Credit
MPSF191P50	Power system steady State Analysis Lab	1	2

List of Experiments

1. Formation of Bus admittance and bus impedance matrix using mi power.
2. Power flow analysis: Gauss - Seidel, Newton Raphson methods, Fast decoupled power flowand Continuation power flow analysis
3. Contingency analysis: Generator shift factors and line outage distribution factors
4. Small signal stability analysis: SMIB and Multi machine configuration
5. Transient stability analysis of Multi – machine configuration
6. Economic dispatch with line flow constraints
7. Unit commitment: Priority-list schemes and dynamic programming
8. Co-ordination of over current and distance relays for radial line protection
9. Induction motor starting analysis
10. Analysis of switching surge.
11. State Estimation.
12. Load Frequency Control Using MATLAB-Simulink

Course Outcome: *Optional*

CO:1. Modeling of transmission lines and analysis of power flow analysis usingMIPOWER

CO:2. Calculate the fault current for various types of faults both symmetricaland unsymmetrical on the given power system MIPOWER

CO:3. Compute the optimal dispatch of the given power system usingMIPOWER

CO:4. Analyze the transient stability by applying different fault clearing time tothe circuit breakers of the given problem using MIPOWER

CO:5. Analysis of transient stability and load-frequency dynamics using MATLAB.s

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Department of Electrical and Electronics Engineering

SYLLABUS

Course Code	Course Name	Semester	Credit
MPSF191P60	Power System Dynamics Lab	1	2

List of Experiments

1. Steady state Analysis of Synchronous Machines Using PSCAD.
2. Steady state Analysis of Synchronous Machines connected to Infinite Bus Using PSCAD.
3. Steady state Analysis of Excitation Control Systems Using PSCAD.
4. Design of power system stabilizer using PSCAD
5. Modeling of SVC for power system studies
6. Modeling of TCSC for power system studies.
7. Modeling of STATCOM

Course Outcome: *Optional*

CO:1. Modeling of SVC for power system studies.

CO:2. Modeling of TCSC for power system studies

CO:3. Modeling of STATCOM.

CO:4. Steady state Analysis of Synchronous Machines Using PSCAD.

CO:5. Steady state Analysis of Synchronous Machines connected to Infinite Bus Using PSCAD

CO:6. Steady state Analysis of Excitation Control Systems Using PSCAD

CO:7. Design of power system stabilizer using PSCAD

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF192T10	Advanced power system protection	2	3	50

Course Objective

Students will be able to:

- Illustrate concepts of transformer protection
- Describe about the various schemes of Over current protection
- Analyze distance and carrier protection
- Familiarize the concepts of Bus bar protection and Numerical protection
- To understand the concepts of substation automation

Unit 1: OVER CURRENT & EARTH FAULTPROTECTION

Zones of protection – Primary and Backup protection – operating principles and Relay Construction. Time – Current characteristics-Current setting – Time setting-Over current protective schemes – Concept of Coordination - Protection of parallel / ring feeders - -Earth fault and phase fault protection - Combined Earth fault and phase fault protection scheme - scheme directional earth fault relay - Static over current relays – Numerical over - current protection- numerical coordination example for a radial feeder

.

Unit 2: TRANSFORMER PROTECTION

Types of transformers –Types of faults in transformers- Types of Differential Protection – High Impedance – External fault with one CT saturation – Actual behaviors of a protective CT - Circuit model of a saturated CT - Need for high impedance – Disadvantages - Percentage Differential Bias Characteristics – Vector group & its impact on differential protection - Inrush phenomenon – Zero Sequence filtering – High resistance Ground Faults in Transformers – Restricted Earth fault Protection - Inter-turn faults in transformers – Incipient faults in transformers - Phenomenon of over- fluxing in transformers – Transformer protection application chart

Unit 3: BUSBAR AND DISTANCE PROTECTION

Differential protection of busbars- external and internal fault - Supervisory relay-protection of three – Phase busbars - Numerical examples on design of high impedance busbar differential scheme –Biased Differential Characteristics –Comparison between Transformer differential & Busbar differential-Braw back of over – Current protection – Introduction to distance relay – Simple impedance relay – Reactance relay – Mho relays – Disadvantages – Quadrilateral Characteristics - Comparison of distance relay – Distance protection of a three – Phase line-reasons for inaccuracy of distance relay reach - Three stepped distance protection

Unit 4:GENERATORPROTECTION
Electrical circuit of the generator –Various faults and abnormal operating conditions – Stator Winding Faults – Protection against Stator (earth) faults – third harmonic voltage protection - Rotor fault – Abnormal operating conditions - Protection against Rotor faults – Potentiometer Method – injection method – Pole slipping – Loss of excitation – Protection against Mechanical faults; Numerical examples for typical generator protection schemes

Unit 5: SUBSTATION AUTOMATION
Introduction to Substation Automation – Topology – Hardware Implementation – Introduction to Digital Substation – Importance of Communications in Digital world – OSI Layer – Ethernet Communication – Introduction to Analog to Digital Transformation – Merging Units (MU) - Introduction to IEC 61850 – Advantages of IEC 61850.

Course Outcome: *Optional*

CO1: Understand the various schemes available in Transformer and Bus bar protection
CO2: Gain knowledge on over current protection.
CO3: Attain knowledge about Distance protection for transmission lines.
CO4: Understand the concepts of generator protection.
CO5: Attain basic knowledge on substation automation

References:

[1]. P.Kundur, "Power System Stability and Control", McGraw-Hill,1993.

[2]. Protective Relaying for Power System II Stanley Horowitz,IEEE press , New York,2008

[3]. Network Protection & Automation Guide, Edition May 2011 – Alstom Grid.

[4]. T.S.M. Rao, Digital Relay / Numerical relays, Tata McGraw Hill, New Delhi,1989

Text Books:

[1]. G. Paithankar and S.R Bhide, "Fundamentals of Power System Protection", Prentice-Hall of India,2003.
[2]. Badri Ram and D.N. Vishwakarma, "Power System Protection and Switchgear", Tata McGraw- Hill Publishing Company,2002.

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Department of Electrical and Electronics Engineering

SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF192T20	Power Quality Studies	2	3	50

Course Objective

- Understand the different power quality issues to be addressed.
- Understand the recommended practices by various standard bodies like IEEE, IEC, etc on voltage & frequency, harmonics.
- Understanding STATIC VAR Compensators.

Unit 1: INTRODUCTION
. Power Quality phenomena - Basic terminologies - various events in power quality - causes for reduction in power quality - power Quality standards.

Unit 2: VOLTAGE SAGS
Causes of voltage sags - magnitude and duration of voltage sags - effect on adjustable AC drives, DC drives, computers and consumer electronics - monitoring and mitigation of voltage sags.

Unit 3: INTERRUPTIONS
Origin of Long and short interruptions - influence on various equipments - reliability of power supply -basics reliability evaluation techniques - monitoring and mitigation of interruptions.

Unit 4: HARMONICS
Origin of harmonics - effect of harmonics on adjustable speed ac drives - harmonic reduction using PWM and harmonic injection.

Unit 5: MEASUREMENTS, POWER QUALITY CONDITIONERS
Interpretation and analysis of power quality measurements - Active filters as power quality conditioners Basic concept of unified power quality conditioners.

Course Outcome: *Optional*

CO:1. Understand the severity of power quality problems in distribution system
CO:2. Understand the difference between failure, outage and Interruptions.
CO:3. Analyze the voltage sag and swell based power quality problem in Single phase and three phase system.
CO:4. Identify the Power Quality problems in Industry power systems.

References:

[1]. Power Quality in Power Systems and Electrical Machines, Mohamed A.S.Masoan Ewald.F.Fuchs, Second Edition, 2015, Academic Press, Elsevier.

[2]. Power System Harmonics, Arillaga and Watson N.R, Second Edition, John Willey and sons, 2003.

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[1]. Electric Power Systems Quality. Roger C.Dugan & Mark F.F Mcgranaghan 2020 Edition , MC Graw Hill Publication.

[2]. Understanding Power Quality Problems, Math.H.J.Bollen.Wiley India Pvt.Ltd, 2011.

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Department of Electrical and Electronics Engineering

SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF192E3	Insulation Technology	2	3	50

Course Objective

To gain in-depth knowledge on behavior of dielectrics under static fields.

- To gain in-depth knowledge on behavior of dielectrics under alternating fields.
- To study the breakdown mechanism of Gaseous dielectrics.
- To study the breakdown mechanism of Liquid dielectrics.
- To study the breakdown mechanism of Solid dielectrics.
- To enable the students to become familiar with application of dielectric materials for power equipment.

Unit 1:PROPERTIES OF DIELECTRICS IN STATIC FIELDS
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 2: BEHAVIOUR OF DIELECTRICS IN ALTERNATING FIELDS
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 3: BREAKDOWN MECHANISMS IN GASEOUS DIELECTRICS
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.

Unit 4:.BREAKDOWN MECHANISMS IN SOLID DIELECTRICS
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.

Unit 5:BREAKDOWN MECHANISMS IN LIQUID DIELECTRICS
Liquids dielectrics- conduction and breakdown in pure and commercial liquids, Dissolved gas analysis - Cryogenic insulation-Biodegradable oils..

SYLLABUS

Course Outcome: *Optional*

Ability to gain the in-depth knowledge on behaviour of dielectrics under static fields.

CO1: Ability to gain the in-depth knowledge on behaviour of dielectrics under alternating fields.

CO2: Understand the breakdown mechanisms in gaseous dielectrics.

CO3: Understand the breakdown mechanisms in solid dielectrics.

CO4: Understand the breakdown mechanisms in liquid dielectrics.

CO5: Ability to become familiar with the application of dielectric materials for power equipment.

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References:

[1]. Adrinaus, J.Dekker, "Electrical Engineering Materials", Prentice Hall of India Pvt. Ltd., New Delhi, 1979. 2. Dieter Kind and Hermann Karner, "High Voltage Insulation Technology", 1985. (Translated from German by Y. Narayana Rao, Friedr. Vieweg&Sohn, Braunschweig,).

[2]. Kuffel, E., Zaengl, W.S. and Kuffel J., "High Voltage Engineering Fundamentals", Elsvier India Pvt. Ltd, 2005.

[3]. Alston, L.L, "High Voltage Technology", Oxford University Press, London, 1968 (B.S Publications, First Indian Edition 2006).

[4]. M.S Naidu, V. Kamaraj, "High Voltage Engineering", Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, 2004

Text Books:

[1]. V.Y.Ushakov, "Insulation of High Voltage Equipment", Springer ISBN.3-540-20729-5, 2004.

[2]. R.E. James and Q.Su,"Condition Assessment of High Voltage Insulation in Power System Equipment", IET publications,London,U.K,2008.

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Department of Electrical and Electronics Engineering

SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF192E3	Advanced Power Electronics and Drives	2	3	50

Course Objective

- To introduce the basic concept of power electronics.
- To study the AC to DC converters & DC to AC converters.
- To study the DC motor drives and Ac motor drives

Unit 1: INTRODUCTION
Basic Concept of Power Electronics, Different types of Power Electronic Devices – Diodes, Transistors and SCR, MOSFET, IGBT and GTO's.

Unit 2: AC TO DC CONVERTERS
Single Phase and three phase bridge rectifiers, half controlled and Fully Controlled Converters with R, RL, and RLE loads. Free Wheeling Diodes, Dual Converter, Sequence Control of Converters – inverter operation, Input Harmonics and Output Ripple, Smoothing Inductance.

Unit 3: DC TO AC CONVERTERS
Basics of Inverter – Classifications – VSI - single Phase Half and Full Bridge Inverters, three phase 180^o and 120^o Configurations – Basic current source inverters- Need for feedback diodes in anti parallel withswitches - Voltage Control and PWM strategies – single phase multilevel Inverter.

Unit 4: DC MOTOR DRIVES
Speed control of DC motors – Thyristor converter fed DC drives: Single, two and four quadrantoperations - Chopper Drives.

Unit 5: AC MOTOR DRIVES
Speed control of Induction motors – Stator control – stator voltage and frequency control, Rotor Control , Slip Power Recovery Schemes – Kramer and scherbius Drives - AC chopper, Inverter, cyclo converter fed induction motor drives. Introduction - Synchronous Motor drives

Course Outcome: *Optional*

CO:1. Analyses Single phase full converter with R, RL and RLE load.
CO:2. Analyze Three phase AC voltage regulator and Resonant DC to DC converter
CO:3. Obtain speed control of Microcontroller based VSI fed three phase Inductionmotor drive.
CO:4. Simulation of Single Phase Full Converter with different loads ,Single PhaseSemi Converter with different loads.
CO:5. Simulation of Buck, Boost, Buck-Boost Converter

References:

[1]. M. H. Rashid, Power Electronics: Circuits, Devices and Applications, Prentice Hall of India 3rdEdition, 2018.
[2]. P.C.Sen, Modern Power Electronics, S Chand & Co Ltd, 2nd edition 2005.
[3]. Vedam Subramaniyam, Electric Drives, Tata McGraw Hill Ltd,.2001.

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[1]. www.nptl.co.in

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[1]. Dr P S Bimbhra, “Power Electronics”, Khanna Publishers, New Delhi, Edition 2022.
[2]. G.K. Dubey , “Fundamentals of Electric Drives”, Narosa Publications, second edition, 2011 .
[3]. G.K.Dubey, S.R.Doradia, A.Joshi, R.M.Sinha, “Thyristerised Power Controllers”, New Age International, New Delhi 2004.

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Department of Electrical and Electronics Engineering

SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF192E3	Design of Substations	2	3	50

Course Objective:

- To provide in-depth knowledge on design criteria of Air Insulated Substation (AIS) and Gas To study the source and effect of fast transients in AIS and GIS.
- To study the substation insulation co-ordination and protection scheme.
- To obtain the knowledge about layout of AIS and GIS with proper Right of Way.
- Insulated Substation (GIS).

Unit 1: INTRODUCTION
Introduction – characteristics – comparison of Air Insulated Substation (AIS) and Gas Insulated Substation (GIS) – main features of substations, Environmental considerations, Planning and installation- GIB / GIL.

Unit 2: MAJOR EQUIPMENT AND LAYOUT OF AIS AND GIS
Major equipment – design features – equipment specification, types of electrical stresses, mechanical aspects of substation design- substation switching schemes- single feeder circuits; single or main bus and sectionalized single bus- double main bus-main and transfer bus- main, reserve and transfer bus- breaker-and-a- half scheme-ring b.

Unit 3: INSULATION COORDINATION OF AIS AND GIS
Introduction – stress at the equipment – insulation strength and its selection – standard BILs – Application of simplified method – Comparison with IEEE and IEC stand.

Unit 4: GROUNDING AND SHIELDING
Definitions – soil resistivity measurement – ground fault currents – ground conductor – design of substation grounding system – shielding of substations – Shielding by wires and masts.

Unit 5: FAST TRANSIENTS PHENOMENON IN AIS AND GIS
Introduction – Disconnect or switching in relation to very fast transients – origin of VFTO – propagation and mechanism of VFTO – VFTO characteristics – Effects of VFTO.

SYLLABUS

Course Outcome: *Optional*

CO1: Ability to understand the fundamental components of AIS AND GIS.
CO2: Ability to understand the role of major equipment and layout of AIS AND GIS.
CO3: Ability to understand the insulation coordination of AIS and GIS.
CO4: Ability to understand the significance of grounding and shielding.
CO5: Ability to know about the effects of fast transients in Substation equation.

References:

[1]. Andrew R. Hileman, “Insulation coordination for power systems”, Taylor and Francis, 1999.
[2]. M.S. Naidu, “Gas Insulation Substations”, I.K. International Publishing House Private Limited, 2008.
[3]. Klaus Ragallar, “Surges in high voltage networks” Plenum Press,New York, 1980.
[4]. Power Engineer’s handbook, TNEB Association

Text Books:

[1]. Pritindra Chowdhuri, “Electromagnetic transients in power systems”, PHI Learning Private Limited, New Delhi, Second edition, 2004.
[2]. RUS Bulletin, “Design guide for rural substation”, United States Department of Agriculture, , 1724E-300, June 2001.
[3]. AIEE Committee Report, “Substation One-line Diagrams,” AIEE Trans. on Power Apparatus and Systems, August 1953 .
[4]. Hermann Koch , “Gas Insulated Substations”, Wiley-IEEE Press,2001

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF192E3	HVDC and FACTS	2	3	50

Course Objective

- To impart knowledge on the need for HVDC and FACTS.
- To impart in depth knowledge the operation, modelling and control of thyristor based FACTS controllers.
- To have an in-depth knowledge on the operation, modelling and control of LCC based HVDC link.
- To have an in-depth knowledge on the operation, modelling and control of VSC based HVDC link and FACTS controllers.
- To analyze the interaction of AC- DC systems through Power flow an

Unit 1: INTRODUCTION

Review of basics of power transmission networks-control of power flow in AC transmission line-Analysis of uncompensated AC Transmission line- Passive reactive power compensation: Effect of series and shunt compensation at the mid-point of the line on power transfer- Need for FACTS controllers- types of FACTS controllers-Review of basics of LCC and VSC HVDC system.

Unit 2: THYRISTOR BASED FACTS

Configuration of SVC- voltage regulation by SVC- Modelling of SVC for power flow analysis-Stability studies- Applications: transient stability enhancement and power oscillation damping of SMIB system with SVC connected at the mid-point of the line-Concepts of Controlled Series Compensation – Operation of TCSC- Analysis of TCSC – Modelling of TCSC for power flow and stability studies.

Unit 3: ANALYSIS OF LCC HVDC CONVERTERS AND HVDC SYSTEM CONTROL

Pulse number, choice of converter configuration – Simplified analysis of Graetz circuit Converter bridge characteristics – characteristics of a twelve pulse converter- detailed analysis of converters. General principles of DC link control – Converter control characteristics – System control hierarchy - Firing angle control – Current and extinction angle control – Generation of harmonics and filtering - power control – Higher level controllers.

Unit 4: VOLTAGE SOURCE CONVERTER BASED FACTS AND HVDC CONTROLLERS

Static synchronous compensator (STATCOM) - Static synchronous series compensator (SSSC) Operation of STATCOM and SSSC-Power flow control with STATCOM and SSSC- Modelling of STATCOM and SSSC for power flow and transient stability studies –operation of Unified and Interline power flow controllers (UPFC) - Modelling of UPFC and IPFC for power flow and transient stability studies- Applications VSC based HVDC: Operation, Modelling for steady state and dynamic state.

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Unit 5: POWER FLOW ANALYSIS OF AC/DC SYSTEMS Per unit system for DC Quantities - Modelling of DC links - Solution of DC load flow-Solution of ACDC power flow: Sequential and Simultaneous methods.

References:

[1]. P. Kundur, "Power System Stability and Control", McGraw-Hill, 2006.
[2]. K.R.Padiyar, "HVDC Power Transmission Systems", New Age International (P)Ltd., New Delhi, 2002.
[3]. Mohan Mathur, R., Rajiv. K. Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley& Sons, Inc.
[4]. K.R.Padiyar," FACTS Controllers in Power Transmission and Distribution", New Age International(P) Ltd., Publishers, New Delhi, Reprint 2008.

Text Books:

[1]. J.Arrillaga, , "High Voltage Direct Current Transmission", Peter Pregrinus, London, 1983.
[2]. Erich Uhlmann, " Power Transmission by Direct Current", BS Publications,2004.
[3]. V.K.Sood, HVDC and FACTS controllers – Applications of Static Converters in Power System, APRIL 2004 , Kluwer Academic Publishers.
[4]. A.T.John, "Flexible AC Transmission System", Institution of Electrical and Electronic Engineers (IEEE), 1999.
[5]. Narain G.Hingorani, Laszio. Gyugyl, "Understanding FACTS Concepts and Technology of Flexible AC Transmission System", Standard Publishers, Delhi 2001.

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF192E4	Power System Management and Deregulation	2	3	50

Course Objective

- To study the various role of various entities in restructured power system.

Unit 1: FUNDAMENTALS AND ARCHITECTURE OF POWERMARKETS

Regulation of Electric utilities: Introduction-Unbundling-Wheeling- Reform Motivations-Fundamentals of Deregulated Markets - Types (Future, Day-ahead and Spot) - Participating in Markets (Consumer and Producer Perspective) - bilateral markets - pool markets. Independent System Operator (ISO)- components-types of ISO - role of ISO - Lessons and Operating Experiences of Deregulated Electricity Markets in various Countries (UK, Australia, Europe, US, Asia).

Unit 2: TECHNICAL CHALLENGES

Total Transfer Capability - Limitations - Margins - Available transfer capability (ATC) – Procedure - Methods to compute ATC - Static and Dynamic ATC - Effect of contingency analysis - Case Study. Concept of Congestion Management - Bid, Zonal and Node Congestion Principles - Inter and Intra zonal congestion - Generation Rescheduling - Transmission congestion contracts – Case Study.

Unit 3: TRANSMISSION NETWORKS AND SYSTEM SECURITY SERVICES

Transmission expansion in the New Environment - Introduction - Role of transmission planning - Physical Transmission Rights Limitations- Flow gate - Financial Transmission Rights – Losses – Managing Transmission Risks - Hedging - Investment. Ancillary Services - Introduction- Describing Needs Compulsory and Demand – side provision – Buying and Selling Ancillary Services-Standards.

Unit 4: MARKET PRICING

Transmission pricing in open access system - Introduction - Spot Pricing - Uniform Pricing - Zonal Pricing-Locational Marginal Pricing - Congestion Pricing - Ramping and Opportunity Costs. Embedded cost based transmission pricing methods (Postage stamp, Contract path and MW- mile) - Incremental cost based transmission pricing methods (Short run marginal cost, Long run marginal cost) - Pricing of Losses on Lines and Nodes.

Unit 5: INDIAN POWER MARKET

Current Scenario - Regions - Restructuring Choices - State wise Operating Strategies - Salient features of Indian Electricity Act 2003 - Transmission System Operator - Regulatory and Policy development in Indian power Sector - Opportunities for IPP and Capacity Power Producer. Availability based tariff - Necessity - Working Mechanism - Beneficiaries - Day Scheduling Process - Deviation from Schedule - Unscheduled Interchange Rate - System Marginal Rate - Trading Surplus Generation - Applications.

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Course Outcome: *Optional*

CO1: To understand the need for deregulation, Unbundling-Wheeling- Reform motivations-Fundamentals of Deregulated Markets.

CO2: To analyze the importance of Total Transfer Capability - Limitations - Margins – Available transfer capability (ATC) – Procedure - Methods to compute ATC - Static and Dynamic ATC -Effect of contingency analysis.

CO3: To understand the applications of Role of transmission planning - Physical Transmission Rights Limitations- Flow gate - Financial Transmission Rights.

CO4: To analyze the need for Transmission pricing in open access system -Introduction – Spot Pricing - Uniform Pricing - Zonal Pricing- Locational Marginal Pricing - Congestion Pricing Ramping and Opportunity Costs. Embedded cost based transmission pricing methods.

CO5: To understand various Current Scenarios - Regions - Restructuring Choices - State wise Operating Strategies - Salient features of Indian Electricity Act 2003 – Transmission System Operator – Regulatory and Policy development in Indian power Sector - Opportunities for IPP and Capacity Power Producer.

References:

[1]. Steven Stoft, Author Name 2, "Power System Economics", Wiley - IEEE Press, 2002

[2]. Daniel S. Kirschen, Goran Strbac, "Fundamentals of Power System Economics", JohnWiley & Sons Ltd, 2004

[3]. Scholarly Transaction Papers and Utility websites.

[4]. Power System Deregulation ,LAP Lambert Academic Publishing, Pinni Srinivasa Varma, Year 2017

Text Books:

[1].Kankar Bhattacharya, Math H.J. Bollen, Jaap E. Daalder , "Operation of Restructured Power Systems", Kluwer Academic Publishers, 2001.

[2].LoiLeiLai, "Power system Restructuring and Regulation", JohnWileysons, 2001.

[3].Loi Lei Lai, "Power System Restructuring and De-regulation" ,Wiley, ,2001.

[4]..PV.Rama Krishna, "Power System Deregulation", Ramya Publisher; 1st edition, 2020.

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF192E4	SCADA Systems and Applications management	2	3	50

Course Objective

- To introduce the SCADA communication protocols
- To understand the basic concepts and components of SCADA
- To apply the SCADA technology to power systems for automation

  To emphasis the role of SCADA monitoring and control concepts.
- To provide knowledge about SCADA based energy management centre

Unit 1: INTRODUCTION TO SCADA

. SCADA overview, general features, SCADA architecture, SCADA Applications, Benefits, Remote Terminal Unit (RTU), Human- Machine Interface Units (HMI), Display Monitors/Data Logger Systems, Intelligent Electronic Devices (IED), Communication Network, SCADA Server, SCADA Control systems and Control panels.

Unit 2: SCADA COMMUNICATION

SCADA Communication requirements, Communication protocols: Past, Present and Future, Structure of a SCADA Communications Protocol, Comparison of various communication protocols, IEC61850 based communication architecture, Communication media like Fiber optic, PLCC etc. Interface provisions and communication extensions, synchronization with NCC, DCC, IOT, Cyber cell, Redundancy.

Unit 3: SCADA IN POWER SYSTEM AUTOMATION

Applications in Generation, Transmission and Distribution sector, Substation SCADA system Functional description, System specification, System selection such as Substation configuration, IEC61850 ring configuration, SAS cubicle concepts, gateway interoperability list, signal naming concept. System Installation, Testing and Commissioning, CASE STUDIES:SCADA Design for 66/11KV and 132/66/11KV or 132/66 KV any utility Substation and IEC 61850 based SCADA Implementation issues in utility Substations.

Unit 4:ENERGY MANAGEMENT CENTRE

Functions, production control and load management, economic dispatch, distributed centers and power pool management, energy management system and its role.

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Unit 5: SCADA MONITORING AND CONTROL

Online monitoring the event and alarm system, trends and reports, Blocking list, Event disturbance recording. Control function: Station control, bay control, breaker control and disconnect or control.

Course Outcome: *Optional*

CO1: Students will learn the SCADA system components and its significance.
CO2: Students will understand the need and advantages of communication protocols for SCADA
CO3: Students will get implementation knowledge about the application of SCADA to Power System
CO4: Students will get exposure to the best operating mechanism for Energy centre based on SCADA concepts
CO5: Students will understand the need and importance of monitoring and control logic for SCADA based power systems.

References:

[1]. William T. Shaw, "Cyber security for SCADA systems", PennWell Books, 2006.
[2]. David Bailey, Edwin Wright, "Practical SCADA for industry", Newnes, 2003.
[3]. Michael Wiebe, "A guide to utility automation: AMR, SCADA and IT systems for electric power", Penn Well, 1999.

Text Books:

[1]. Stuart A. Boyer, 'SCADA-Supervisory Control and Data Acquisition', Instrument Society of America Publications,USA,2004.
[2]. Gordon Clarke, Deon Reynders, 'Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems', Newnes Publications, Oxford, UK,2004.
[3]. William T. Shaw, 'Cybersecurity for SCADA systems', PennWell Books, 2006.
[4]. David Bailey, Edwin Wright, 'Practical SCADA for industry', Newnes, 2003.
[5]. Michael Wiebe, 'A guide to utility automation: AMR, SCADA, and IT systems for electric Power', PennWell, 1999.

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF192E4	Distributed Generation Control And Automation	2	3	50

Course Objective

Students will be able to:

- Learn about distributed generation (DG) and distribution automation gain knowledge about planning and designing of distribution system
- Understand the concepts of grid integration and control of DG
- Familiarize the concepts of economic aspects of DG
- Analyze the application of SCADA in automation

Unit 1: DISTRIBUTED GENERATION
Introduction, Distributed Generation Definition, Distributed generation advantages, challenges and needs, Distributed Generation Units- Micro turbines, Reciprocating Engines, Wind generators, Photovoltaic generators, Hydro generation, Fuel cells, Biomass and other technologies. Energy Storage-batteries, Flywheels, Ultra Capacitors.

Unit 2: GRID INTEGRATION AND CONTROL OF DG
Recent trends in power electronic DG interconnection. General power electronic DG interconnection topologies for various sources and control. Control of DG inverters, current control and DC voltage control for stand-alone and grid parallel operations. Protection of the converter, Control of grid interactive power converters, phase locked loops ,synchronization and phase locking techniques, current control, DC bus control during grid faults, converter faults during grid parallel and stand-alone operation.

Unit 3: ISSUES AND ECONOMIC ASPECTS OF DG
Intentional and unintentional islanding of distribution systems. Passive and active detection of unintentional islands, non-detection zones. Reactive power support using DG. Power quality improvement using DG, Power quality issues in DG environment. Economic aspects of DG- Generation cost, investment, tariffs analysis. Hybrid energy systems. Distributed generation in the Indian scenario – case studies.

Unit 4: IMPLEMENTATION OF SCADA IN AUTOMATION
Introduction to SCADA, Monitoring and supervisory functions, SCADA applications in Utility Automation, SCADA System Components, RTU, IED, PLC, Communication Network, SCADA Server, SCADA/HMI Systems, Various SCADA architectures, single unified standard architecture-IEC 61850, SCADA Communication, open standard communication protocols.

Unit 5:DISTRIBUTION AUTOMATION AND COMPONENTS
Distribution automation planning, communication, Wireless and wired Communications-DA Communication Protocols, Architectures and user interface, sensors, Supervisory Control and Data Acquisition Systems (SCADA), Case Studies.

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Course Outcome: *Optional*

Students will be able to

CO1:Describe the principle and operation of different distributed generation

CO2: Attain knowledge in grid integration of distributed generation and control and will enhance their capability of planning and designing of distribution system.

CO3:Analyze the impact of distributed generators on the performance of distribution system

CO4: Gain knowledge about SCADA in automation

CO5: Familiarize with the components of distribution automation

References:

[1]. H. Lee Willis & Walter G. Scott, "Distributed Power Generation, Planning & Evaluation" CRCPress, Taylor & Francis Group, 2000.

[2]. D.Mukherjee, and S.Chakrabarti, "Fundamentals of renewable energy systems", New Age International Pvt Ltd Publishers, 2007.

[3]. James Northcote-Green, Robert Wilson, "Control and Automation of Electrical Power Distribution Systems", CRC Press, New York, 2006.

[4]. W. Kramer, S. Chakraborty, B. Kroposki, and H. Thomas, "Advanced Power Electronic Interfaces for Distributed Energy Systems Part 1: Systems and Topologies",Technical Report NREL/TP-581-42672, 2008.

[5]. Godfrey Boyle,"Renewable energy:Power for a sustainable future", Oxford University Press, 2012.

[6]. IEEE Press: IEEE Recommended practice for Electric Power Distribution for Industrial Plants, IEEE, Inc., 1994

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF192E4	Power Apparatus Design	2	3	50

Course Objective

- Study the modeling analysis of rotating machine
- Learning electromagnetic energy conversion
- To know about rating of machines

Unit 1:
Principles of Design of Machines -Specific loadings, choice of magnetic and electric loadings - Real and apparent flux densities - temperature rise calculation - Separation of main dimension for DC machines - Induction machines and synchronous machines - Design of Transformers - General considerations - output equation - emf per turn - choice of flux density and current density - main dimensions - leakage reactance and conductor size - design of tank and cooling

Unit 2:
Specific loadings - choice of magnetic and electric loadings - Real and apparent flux densities - temperature rise calculation - Separation of main dimension for DC machines - Induction machines and synchronous machines - Heating and cooling of machines - types of ventilation - continuous and intermittent rating.

Unit 3:
General considerations - output equation - emf per turn - choice of flux density and current density - main dimensions - leakage reactance and conductor size - design of tank and cooling tubes - Calculation of losses, efficiency and regulation - Forces winding during short circuit.

Unit 4:
General considerations, output equation - Choice of specific electric and magnetic loadings – efficiency - power factor - Number of slots in stator and rotor - Elimination of harmonic torques.

Unit 5:
Design of stator and rotor winding - slot leakage flux - Leakage reactance - equivalent resistance ofsquirrel cage rotor - Magnetizing current, efficiency from design data - Types of alternators – comparison of specific loadings - output co-efficient - design of main dimensions - Introduction to Computer Aided Electrical Machine Design Energy efficient machines

Course Outcome: *Optional*

CO:1. Design of main dimensions and other major part of the transformer
CO:2. Design of main dimensions and other major part DC and AC rotatingmachines
CO:3. Procedure for the design of main dimensions and other major part of the transformer
CO:4. Procedure for the design of main dimensions and other major part of the AC and DC machines.

References:

[1]. Sawhney A.K, "A course in Electrical Machine Design", Dhanpat Rai& Sons, 5^{th}Edition.

[2]. Design of Electrical Apparatus – A. NagoorKani,CBS Publication,Published year January 2021.

Text Books:

[1]. Clayton A.E, "The Performance and Design of D.C. Machines", Sir I. Pitman & sons,Ltd

[2]. M.G. Say, "The Performance and Design of A.C. Machines", Pitman Design of Electrical Apparatus, AnuradhaPublications,January 2010.

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF192E4	Electric and Hybrid Vehicles	2	3	50

Course Objective

- To understand upcoming technology of hybrid system
- To understand different aspects of drives application.
- Learning the electric Traction.

Unit 1:
History of hybrid and electric vehicles - Social and environmental importance of hybrid and electric vehicles - Impact of modern drive-trains on energy supplies - Basics of vehicle performance - vehicle power source - Characterization Transmission characteristics - Mathematical models to describe vehicle performance.

Unit 2:
Basic concept of hybrid traction - Introduction to various hybrid drive-train topologies - Power flow control in hybrid drive-train topologies - Fuel efficiency analysis.

Unit 3:
Introduction to electric components used in hybrid and electric Vehicles - Configuration and control of DC Motor drives - Configuration and control of Introduction Motor drives - configuration and control of Permanent Magnet Motor drives - Configuration and control of Switch Reluctance Motor drives - drive system efficiency.

Unit 4:
Matching the electric machine and the internal combustion engine (ICE) - Sizing the propulsion motor - sizing the power electronics – Selecting the energy storage technology - Communications, supporting subsystems.

Unit 5:
Introduction to energy management and their strategies used in hybrid and electric vehicle - Classification of different energy management strategies - Comparison of different energy management strategies - Implementation issues of energy strategies

Course Outcome: *Optional*

CO:1. Basic concepts of hybrid and electric vehicles

CO:2. Basic concepts of hybrid traction, types of hybrid drive-train topologies,Power flow control in hybrid drive-train topologies.

CO:3. Analysis of fuel efficiency
CO:4. Study the configuration and control of Permanent Magnet Motordrives, Switch Reluctance Motor drives.
CO:5. Matching the electric machine and the internal combustionengine (ICE)
CO:6. Classification of different energy management strategies

References:

[1]. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles Fundamentals, Theory, and Design", 2005, CRC PRESS.
[2]. Tom Denton, "Electric and Hybrid Vehicles", 2nd Edition 2020 Edition , Taylor and Francis Publisher.
[3]. Iqbal Husain, "Electric and Hybrid Vehicles Design Fundamentals" 2021 Edition Taylor & Francis Publisher.

Online Resources

[1]. Swayam - NPTEL https://onlinecourses.nptel.ac.in/
[2]. Electrical for you https://www.electrical4u.com/

Text Books:

[1]. Chris Mi, and Abdul Masrur "Hybrid Electric Vehicles Principles And Applications With Practical Perspectives" 2nd Edition, 2017 JOHN WILEY Publication
[2]. Simona Onori, Lorenzo Serrao ,Giorgio Rizzoni, "Hybrid Electric Vehicles Energy Management Strategies" 2015 Edition, Springer Publisher .

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SYLLABUS

Course Code	Course Name	Semester	Credit
MPSF192P50	Power System Protection and Power Quality Lab	2	2

List of Experiments

Power System Protection Lab

List of Experiments:

1. Estimation of fault MVA of three phase symmetrical fault
2. Estimation of fault MVA of the three phase unsymmetrical system (L-L, L-G, L-L, L-L-G)
3. Study and testing of over current relay
4. Study and testing of earth fault relay
5. Over current protection of three phase AC machine
6. Study and testing of reverse power relay
7. Study and testing of impedance relay

Power Quality Lab

List of Experiments:

1. Simulation of power quality disturbance

   a. Voltage sag b. Voltage Swell
2. Simulation of total harmonic distortion measurements
3. Measurement of harmonic distortion using harmonic distortion calculator
4. Power factor improvement using single phase thyristor switched capacitor
5. Power factor improvement using single phase FC-TCR with ANN method.

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Course Outcome: *Optional*

CO:1. Study and testing of reverse power relay

CO:2. Simulation of power quality disturbance

CO:3.

I. Simulation of total harmonic distortion measurements
II. Power factor improvement using single phase thyristor switched capacitor
III. Power factor improvement using single phase FC-TCR with ANN method
IV. Study and testing of over current relay
V. Study and testing of earth fault relay
VI. Study and testing of impedance relay

CO:4.

I. Estimation of fault MVA of three phase symmetrical fault
II. Estimation of fault MVA of the three phase unsymmetrical system (L-L, L-G, L-L-G)
III. Over current protection of three phase AC machine

CO:5. Measurement of harmonic distortion using harmonic distortion calculator

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Course Code	Course Name	Semester	Credit
MPSF192P60	Power Electronics Applications To Power Systems Lab	2	2

List of Experiments

1. Single phase half and full converter with R, RL and RLE load
2. Three phase half and full converter with R, RL and RLE load
3. Analysis of Dual converter fed DC motor drive
4. Micro controller-based speed control of Chopper fed DC motor drive
5. IGBT based three phase inverters
6. IGBT based single phase PWM inverter
7. Simulation of Open Loop Control of Separately Excited DC Motor.
8. Simulation of Open Loop Control of DC Series Motor.
9. Simulation of Closed Loop Control of Separately Excited DC Motor.
10. Simulation of Single-Phase Half Converter with different loads.
11. Simulation of Single-Phase Full Converter with different loads.
12. Simulation of Single-Phase Semi Converter with different loads.

Course Outcome: *Optional*

CO:1. Understand the Basic structure, working and switching characteristics of Power semiconductor devices

CO:2. Principle and working of configuration of AC-DC controlled converters

CO:3. Working of different types of DC-AC Converters

CO:4. Apply different PWM methods and control strategies

CO:5. Speed control of different types of DC converters fed DC Drives

CO:6. Speed control of AC drives using different Converter configuration

CO:7. Slip power recovery scheme

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF193E5	AI Techniques to Power Systems	3	3	50

Course Objective

- Understanding fuzzy logic, ANN
- Understanding GA

Unit 1: INTRODUCTION TO NEURAL NETWORKS

Basics of ANN - perceptron - delta learning rule - back propagation algorithm - multilayer feed forward network - memory models - bi-directional associative memory - Hopfield network.

Unit 2: APPLICATIONS TO POWER SYSTEM PROBLEMS

Application of neural networks to load forecasting - contingency analysis - VAR control -economic load dispatch.

Unit 3: INTRODUCTION TO FUZZY LOGIC

Crispness - vagueness - fuzziness - uncertainty - fuzzy set theory fuzzy sets - fuzzy set operations - fuzzy measures - fuzzy relations - fuzzy function - structure of fuzzy logic controller - fuzzification models - data base - rule base - inference engine defuzzification module.

Unit 4: APPLICATIONS TO POWER SYSTEMS

Decision making in power system control through fuzzy set theory - use of fuzzy set models of LP in power systems scheduling problems - fuzzy logic-based power system stabilizer.

Unit 5: GENETIC ALGORITHM AND ITS APPLICATIONS TO POWER SYSTEMS

Introduction - simple genetic algorithm - reproduction - crossover - mutation - advanced operators in genetic search - applications to voltage control and stability studies.

Course Outcome: *Optional*

CO:1. Describe the role of various soft computing techniques in building intelligent systems.

CO:2. Explain the architecture and learning methodologies of Neural networks.

CO:3. Apply neural network for modeling and control of the given power system problem.

CO:4. Explain fuzzy logic operations, relations and inference system.

CO:5. Apply fuzzy logic control techniques for the given power system problem.

CO:6. Apply genetic algorithm to solve the stability studies.

SYLLABUS

References:

[1]. Zimmerman.H.J, “Fuzzy Set Theory and its Applications”, Kluwer Academic Publishers,1994
[2]. IEEE tutorial on “A Application of Neural Network to Power Systems”,1996.
[3]. Loi Lei Lai, “Än Intelligent System Applications in Power Engineering”, John Wiley & Sons Ltd.,1998.
[4]. Elaine Rich and Kevin Knight “Artificial Intelligence”, 5th Edition, Tata McGraw-Hill, 2018.

Text Books:

[1]. James A. Freeman, Skapura.B.M, “Neural Networks - Algorithms Applications and Programming Techniques”, Addison Wesley, 1990.
[2]. George Klir, Tina Folger.A, ÄFuzzy sets, Uncertainty and Information, Prentice Hall of India.
[3]. Stuart Russel and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 5th Edition, Prentice Hall, 2020

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF193E5	Power System Transients	3	3	50

Course Objective

- To gain knowledge in sources of transients like lightning, switching and temporary overvoltage
- To model power system components and estimate the overvoltage’s in power system
- To analyze travelling wave phenomena against different overvoltage’s
- To compute transient overvoltage using Electromagnetic Transient Program (EMTP)
- To coordinate the insulation of power system and protective devices.

Unit 1: LIGHTNING OVERVOLTAGES
Classification of over voltages- 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.

Unit 2: SWITCHING AND TEMPORARY OVERVOLTAGES
Switching transients – concept – phenomenon – system performance under switching surges- Ferranti Effect, Temporary overvoltage – load rejection – line faults – Ferro resonance, VFTO.
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Unit 3:TRAVELLING WAVES ON TRANSMISSION LINE
Circuits and distributed constants, wave equation, reflection and refraction – behavior of travelling Waves at the line terminations – Lattice Diagrams – attenuation and distortion – multiconductor System and multivelocity waves.

Unit 4: INSULATION CO-ORDINATION
Insulation co-ordination –volt –time characteristics, Insulation strength and their selection- Evaluation Of insulation strength standard BILs-Characteristics of protective devices, applications, location of Arresters – insulation co-ordination in AIS and GIS.

Unit 5: COMPUTATION OF POWER SYSTEM TRANSIENTS
Computation of transients using electromagnetic transient program-Modeling of power system Components- Simple case studies - Application of simplified method: single line station, two line station, gas insulated substations, comparison with IEEE and IEC guides.

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Course Outcome: *Optional*

CO1: Ability to understand various sources of transients
CO2: Ability to compute possible overvoltage's in power systems
CO3: Ability to predict overvoltage's in power system using travelling wave theory
CO4: Ability to compute overvoltage's using EMTP with multiple sources
CO5: Ability to coordinate the insulation level of the power system.

References:

[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.

Text Books:

[1]. Andrew R. Hileman, "Insulation Coordination for Power Systems", CRC press, Taylor & Francis Group, New York, 1999.
[2]. Klaus Ragaller, "Surges in High Voltage Networks", Plenum Press, New York, 1980.
[3]. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", (Second Edition) New age International (P) Ltd., New Delhi, 2006.
[4]. Naidu M S and Kamaraju V, "High Voltage Engineering", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.
[5]. IEEE Guide for safety in AC substation grounding IEEE Standard 80-2000.
[6]. Working Group 33/13-09 (1988), 'Very fast transient phenomena associated with Gas Insulated System', CIGRE, 33-13, pp. 1-20.
[7]. R. Ramanujam, "Computational Electromagnetic Transients: Modeling, Solution Methods and Simulation", I.K. International Publishing House Pvt. Ltd, New Delhi -110 016, 2014
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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF193E5	Industrial Load Modeling and Control	3	3	50

Course Objective

- 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

Unit 1:
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.

Unit 2:
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.

Unit 3:
Reactive power management in industries - controls-power quality impacts application of filters Energy saving in industries

Unit 4:
Cooling and heating loads , load profiling ,Modeling- Cool storage, Types-Control strategies , Optimal operation, Problem formulation- Case studies, Captive power units, Operating and control strategies, Power Pooling- Operation models ,Energy banking , Industrial Cogeneration.

Unit 5:
Selection of Schemes Optimal Operating Strategies, Peak load saving Constraints Problem formulation- Case study, Integrated Load management for Industries.

Course Outcome: *Optional*

CO:1. Knowledge about present energy scenario, types of industrial loads
CO:2. different types of industrial processes and optimize the process using various tools
CO:3. Reactive power management in industry
CO:4. different energy saving opportunities in industries

References:

[1]. H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Interscience Publication, USA,1989.

[2]. I.J.Nagarath and D.P.Kothari, .Modern Power System Engineering., Tata McGraw Hill publishers, NewDelhi, 1995.

[3]. IEEE Bronze Book- "Recommended Practice for Energy Conservation and cost effective planning in Industrial facilities", IEEE Inc,USA.

[4]. J.Nagarath and D.P.Kothari, Modern Power System Engineering, Tata McGraw Hill, 4th Edition, 2016.

Text Books:

[1]. C.O. Bjork " Industrial Load Management - Theory, Practice and Simulations", Elsevier, the Netherlands,1989

[2]. R. Paranjothi, Modern Power Systems, New age Publishers, 5th Edition, 2017

[3]. C.W. Gellings and S.N. Talukdar,. Load management concepts. IEEE Press, New York, 1986, pp.3-28

[4]. Y. Manichaikul and F.C. Schweppe ," Physically based Industrial load", IEEE Trans. on PAS, April 1981.

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF192E5	Advanced Digital Signal Processing	3	3	50

Course Objective

- To teach the fundamentals of digital signal processing in time-frequency domain& its application
- To teach the fundamentals of audio signal processing & its application
- To discuss on Application development with commercial family of DS Processors
- To expose the fundamentals of digital signal processing in frequency domain & its application

Unit 1: INTRODUCTION TO DIGITAL SIGNAL PROCESSING

Introduction to Digital Signal Processing System- Discrete Time Sequences- Time-Invariant & Time-variant Systems, Decimation and Interpolation- The Sampling Process - Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT)- Basics of Digital Filters- FIR Filters, IIR Filters -adaptive filter based on LMS.

Unit 2: WAVELET TRANSFORM

Introduction to continuous wavelet transform- discrete wavelet transform -orthogonal wavelet decomposition- Multiresolution Analysis-Wavelet function-DWT, bases, orthogonal Basis-Scaling function, Wavelet coefficients- Multirate signal processing and their relationship to filter banks- Digital filtering interpolation(i) Decomposition filters, (ii) reconstruction, the signal- Example MRA- Haar & Daubechies wavelet.

Unit 3: AUDIO SIGNAL PROCESSING

Introduction to Speech and Audio Processing - Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters- convolution - autoregressive model, autocorrelation estimation, General structure of speech coders; Requirements of speech codecs –quality, LPC model of speech production- LPC encoders and decoders-Power spectral density, periodogram ,Spectral measures of audio signal

Unit 4: ARCHITECTURES OF COMMERCIAL DIGITAL SIGNAL PROCESSORS

Introduction, catogorisation of DSP Processors-one case example Architecture Processor for Fixed Point (Blackfin),Floating Point & Speech Processor- Basics of Architecture – study of functional variations of Computational building blocks(with comparison onto their MAC, Bus Architecture ,I/O interface, application).

Unit 5: IMPLEMENTATION OF DSP BASED SYSTEMS

Introduction- Interfacing processor- Memory Interface-I/O Interface-Mapping of DSP algorithm onto hardware -Design of Filter-FFT Algorithm- Application with DSP based Interfacing- Power Meter; DSP as motor control.

Course Outcome: *Optional*

CO1: The concepts of Time and frequency analysis of Signal Transforms based on signal types.
CO2: The fundamentals of Time-Frequency Transforms are introduced
CO3: Analyze the quality and properties of speech based on DSP
CO4: Study features through comparison on commercial available DS Processors

References:

[1]. Avatar Sing, S. Srinivasan, “Digital Signal Processing- Implementation using DSP Microprocessors with Examples from TMS320C54xx”, Thomson India,2004.
[2]. Ashok Ambardar,”Digital Signal Processing: A Modern Introduction”,Thomson India edition, 2007.
[3]. Lars Wanhammer, “DSP Integrated Circuits”, Academic press, 1999, NewYork.
[4]. Raghuveer M.Rao and Ajit S. Bapardikar, Wavelet transforms- Introduction to theory and applications, Pearson Education, 2000.
[5]. K.P. Soman and K.L. Ramchandran,Insight into WAVELETS from theory to practice, Eastern Economy Edition, 2008.
[6]. Ifeachor E. C., Jervis B. W ,”Digital Signal Processing: A practical approach, Pearson- Education, PHI/ 2002.
[7]. B Venkataramani and M Bhaskar “Digital Signal Processors”, TMH, 2nd, 2010.
[8]. A.M.Kondoz “Digital Speech”, , Second Edition (Wiley Students_ Edition), 2004.

Text Books:

[1]. John G. Proaks, Dimitris G. Manolakis, “Digital Signal Processing”, Pearson Education 2002.
[2]. Vinay K.Ingle,John G.Proakis,”DSP-A Matlab Based Approach”,Cengage Learning,2010
[3]. Taan S.Elali,”Discrete Systems and Digital Signal Processing with Matlab”,CRC Press2009.
[4]. Sen M.Kuo and Woon-Seng S.Gan, Digital Signal Processors-Architectures, implementation and applications”, Pearson Education 2008.

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF192E5	Micro-Grid Operation and Control	3	3	50

Course Objective

- To study concept of islanding and impact on protection
- To study concept of hybrid microgrid and its controllers
- To study concept of DC microgrid and its controllers
- To study concept of AC microgrid and its controllers
- To illustrate the concept of micro sources and storage

Unit 1: MICRO SOURCES AND STORAGE
Microgrid Structure and Operating Modes – Solar PV – Wind Energy – Fuel Cell –Battery – Super capacitor.

Unit 2:AC MICROGRID
Hierarchical Control: Primary, Secondary and Tertiary Control– Primary Control: Droop Control, Virtual Synchronous Generator Control for VSC – Secondary Control – Simulation Studies.

Unit 3: DC MICROGRID
Hierarchical Control: Primary, Secondary and Tertiary Control – Primary Control: Droop Control, Virtual Inertia Control – Secondary Control: Centralized and Decentralized Control – Simulation Studies.

Unit 4: HYBRID MICROGRID
Hybrid AC/DC Microgrid Structure: AC Coupled, DC Coupled, AC-DC Coupled –Control Strategies: different modes of operation, during transition – Simulation Studies.

Unit 5: MICROGRID PROTECTION
Protection: Effect on Relay Protection of distribution network, Differential Relay Protection, Directional Impedance Relay Protection– Islanding: Active and Passive Techniques– Earthing: Requirements, Earthing mode of DG in TN/TT Earthing System, Earthing mode of DG in IT.

Course Outcome:

CO1: Ability to analyze micro-sources and storage systems.

CO2: Able to analyse the configurations and control aspects of AC microgrid.

CO3: Understand and analyse the configurations and control aspects of DC microgrid.

CO4: Acquired knowledge about configurations and control aspects of Hybrid microgrid.

CO5: Learned the protection aspects of microgrid

References:

[1]. Li Fusheng, Li Ruisheng and Zhou Fengquan, 'Microgrid Technology and Engineering Application', Elsevier, 2016.

[2]. M.S. Mahmoud, 'Microgrid - Advanced Control Methods and Renewable Energy System Integration', Elsevier, 2017.

[3]. 3. FarzamNejabatkhah and Yun Wei Li, 'Overview of Power Management Strategies of Hybrid AC/DC Microgrid', IEEE Transactions on Power Electronics, 2014.

Text Books:

[1]. H. Bevrani, Bruno Francois and ToshifumiIse, 'Microgrid Dynamics and Control', Wiley, 2017.

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF192E5	Energy Storage Technologies	3	3	50

Course Objective

- To analyze different battery storage technologies
- To analyze thermal storage system.
- To understand the various types of energy storage Technologies.
- To study the various applications of energy storage systems.
- To analyze the thermodynamics of Fuel Cell

Unit 1: INTRODUCTION

Necessity of energy storage – types of energy storage – comparison of energy storage technologies – Applications.

Unit 2: THERMAL STORAGE SYSTEM

Thermal storage – Types – Modeling of thermal storage units – Simple water and rock bed storage system – pressurized water storage system – Modelling of phase change storage system – Simple units, packed bed storage units - Modelling using porous medium approach, Use of TRNSYS

Unit 3: ELECTRICAL ENERGY STORAGE

Fundamental concept of batteries – measuring of battery performance, charging and is charging of a battery, storage density, energy density, and safety issues. Types of batteries – Lead Acid, ickel – Cadmium, Zinc Manganese dioxide - Mathematical Modelling for Lead Acid Batteries – Flow Batteries

Unit 4: FUEL CELL

Fuel Cell – History of Fuel cell, Principles of Electrochemical storage – Types – Hydrogen oxygen cells, Hydrogen air cell, Hydrocarbon air cell, alkaline fuel cell, detailed analysis – advantages and disadvantages –Fuel Cell Thermodynamics.

Unit 5: ALTERNATE ENERGY STORAGE TECHNOLOGIES

Flywheel , Super capacitors, Principles & Methods – Applications, Compressed air Energy storage, Concept of Hybrid Storage – Applications, Pumped Hydro Storage – Applications.

Course Outcome:

CO1: Gained knowledge of various storage technologies.
CO2: Able to design a thermal storage system.
CO3: Ability to model battery storage system.
CO4: Learned to analyze the thermodynamics of fuel cell
CO5: Gained Knowledge of various applications of storage technologies and perform the selection based on techno-economic view point.

References:

[1]. Lunardini.V.J, ‘Heat Transfer in Cold Climates’, John Wiley and Sons 1981.
[2]. Ru-shiliu, Leizhang and Xueliang sun, ‘Electrochemical technologies for energy storage and conversion’, Wiley publications, 2012.
[3]. Schmidt.F.W. and Willmott.A.J., ‘Thermal Storage and Regeneration’, Hemisphere Publishing Corporation, 1981.

Text Books:

[1]. Ibrahim Dincer and Mark A. Rosen, ‘Thermal Energy Storage Systems and Applications’, JohnWiley & Sons 2002.
[2]. James Larminie and Andrew Dicks, ‘Fuel cell systems Explained’, Wiley publications, 2003.

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF193OE	Research Methodology	3	3	50

Unit 1:
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 interpretation, Necessary instrumentations collection, analysis

Unit 2:
Effective literature studies approaches, analysis Plagiarism, Research ethics

Unit 3:
Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 4:
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT

Unit 5:
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. 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]. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007.
[2]. Mayall , "Industrial Design", McGraw Hill,1992.
[3]. Research Methodology (Methods and Technique),New Age International Publishers. Authors- CR Kothari, Gaurav Garg, 2019.
[4]. Research Methodology,CR Kothari 2nd edition 2021.

Text Books:

[1]. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science& Engineering students".
[2]. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction".
[3]. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step-by-Step Guide for beginners".

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF193OE	Industrial safety	3	3	50

Unit 1:
Industrial safety: 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 andmethods

Unit 2:
Fundamentals of maintenance engineering: 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

Unit 3:
Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit 4:
Fault tracing: 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.

Unit 5:
Periodic and preventive maintenance: 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

References:

[1]. Industrial Safety Management -1st July 2017,LM DESHMUKH

[2]. Advance in Industrial Safety – 2018 select proceedings of HSFEA,Springer,Authors:FaisalI.Khan,NihalAnwar,SiddiqusS.M.Tauseef,B.P.Yadaw Editors, 2018

Text Books:

[1]. Higgins & Morrow , "Maintenance Engineering Handbook", , Da Information Services.

[2]. H. P. Garg, "Maintenance Engineering", S. Chand and Company.

[3]. Audels, "Pump-hydraulic Compressors", Mcgrew Hill Publication.

[4]. Winterkorn, Hans , "Foundation Engineering Handbook", Chapman & Hall London.

[5]. Principles of Industrial Safety management,1st January 2020,Authors:Akil Kumar Das

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF193OE	Operations Research	3	3	50

Unit 1: RESOURCE SCHEDULING AND NETWORK ANALYSIS
Problem of sequencing – Sequencing n jobs through 2 machines and 3 machines, 2 jobs through mmachines. PERT and CPM –Critical path calculation – Probability and cost consideration.

Unit 2: REPLACEMENT AND GAME THEORY
Replacement Models – Replacement of items that deteriorate with time – Equipment that fails suddenly. Two-person zero sum games – Pure strategies and saddle point – Mixed strategies – 2 x n and m x 2 games – Method of dominance – Numerical and graphical solutions.

Unit 3: INVENTORY CONTROL
Inventory models – Deterministic models – Economic ordering quantity, Reorder level, optimum cost – Instantaneous and Non-instantaneous receipt of goods with or without shortages.

Unit 4: LINEAR PROGRAMMING
Introduction to Linear Programming – Formulation of the problem – Graphical method – Simplexmethod – Artificial variable techniques - Primal-dual problems – Dual Simplex method.

Unit 5: ADVANCED LINEAR PROGRAMMING PROBLEMS
Integer programming problem - Cutting plane algorithm – Transportation models - Vogel's Approximation method – MODI method – Unbalanced transportation problem – Degeneracy in transportation models – Assignment models – Traveling salesman problem-Dynamic Programmingproblem

References:

[1]. Billy B. Gillet, "Introduction to Operations Research "– TMH Publishing Co.
[2]. Gupta P.K., Manmohan, "Operations Research & Quantitative Analysis" – S.Chand & Co., NewDelhi.
[3]. Hamblin S., and Stevens Jr., "Operations Research", Mc Graw Hill Co.
[4]. Taha H.A., "Operations Research – An introduction", 8th edition, Taha H.A., "Operations Research An introduction", 7th Edition, PHI,2002.
[5]. Operations Research- An Introduction,Publisher:Pearson Education,Edition-10th,Publication date 31 August 2019,Author: Amdy A Taha.

Text Books:

[1]. Kanti Swarup, Gupta P.K., and Man Mohan, "Operations Research" Sultan Chand & Sons, 1994.
[2]. Gupta P.K., and Hira D.S., "Operations Research", S.Chand & Sons,2000.
[3]. Sundaresan.V, Ganapathy Subramanian.K.S. and Ganesan.K, "Resource Management Techniques", A.R. Publications,2002

[4]. Taha H.A., “Operations Research – An introduction”, 7th edition, PHI,2002.
[5]. Sharma S.D., “Operations Research”, Kedarnath Ramnath & Co.,Meerut,1994.
[6]. Operations Research Theory and Applications,Macmillian India Ltd -New Delhi ,Author JK Sharma,5th edition.

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF193OE	Cost Management of Engineering Projects	3	3	50

Unit 1:
Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision- making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit 2:
Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non- technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Unit 3:
Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis

Unit 4:
Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value- Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing

Unit 5:
Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

[1]. Ashish K. Bhattacharya, “Principles and Practices of Cost Accounting”, PHI Publisher, Third Edition, 2012.

[2]. N.D. Vohra, “Quantitative Techniques in Management”, Tata McGraw Hill Publisher, 2000.

Text Books:

[1]. Charles T, “Cost Accounting A Managerial Emphasis”, Pearson, Thirteenth Edition, 2008.
[2]. Barry McCarthy, “Advanced Management Accounting”. Harlow, Pearson Education Limited, 2010.
[3]. Robert S Kaplan, Anthony A. Alkinson, Management & Cost Accounting, 2003.

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF193OE	Composite Materials	3	3	50

Unit 1:
INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Unit 2:
REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Iso strain and Iso stress conditions.

Unit 3:
Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications

Unit 4:
Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression Moulding – Reaction injection Moulding. Properties and applications.

Unit 5:
Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hydrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

References:

[1]. K.K.Chawla, "Composite Materials", Springer Publications, 2012.
[2]. Ed-Lubin, "Hand Book of Composite Materials", Springer Publications, 2014.
[3]. Deborah D.L.Chung, "Composite Materials Science and Applications", Springer Publications, 2010.
[4]. Krishan K.Chawla, "Composite Materials Science and Engineering", Springer Publications, Third Edition, 2012.

Text Books:

[1]. R.W.Cahn, “Material Science and Technology”, Vol. 13, Wiley VCH, 1993.

[2]. WD Callister, R.Balasubramaniam, “Materials Science and Engineering an introduction”, John Wiley & Sons, Indian Edition, 2007.

[3]. T.WClyne, D. Hull, “An introduction to composite Materials, Cambridge University Press, Third Edition, 2019.

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SYLLABUS

Course Code	Course Name	Semester	Credit	Hours
MPSF193OE	Waste To Energy	3	3	50

Unit 1: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.
Unit 2: Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.
Unit 3: . Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.
Unit 4: Biomass Combustion: 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.
Unit 5: Biogas: 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]. Himadri P," Complete Technology Of Biomass Chemicals From Biomass Biofuels & Biodiesels", Engineers India Research Institute,January 2018.

[2]. M. Moo-Young ,J. Lamptey, B. Glick," Biomass Conversion Technology: Principles and Practice ",Kindle Edition,2013

[3]. B.H.Khan," Non-Conventional Energy Resources" McGraw Hill Education India Private Limited,3rd Edition July 2017.

Text Books:

[1]. Desai, Ashok V, “Non Conventional Energy”, Wiley Eastern Ltd, 1990.

[2]. Khandelwal, K. C, Mahdi, S. S, “Biogas Technology - A Practical Hand Book”, Vol. I & II, Tata Mc Graw Hill Publishing Co. Ltd, 1983.

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SYLLABUS

Course Code	Course Name	Semester	Credit
MPSF193Z30	Phase – I Dissertation	3	10

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SYLLABUS

Course Code	Course Name	Semester	Credit
MPSF193Z10	Phase-II Dissertation	4	16