CURRICULUM

&

ACADEMIC REGULATIONS

POST-GRADUATE PROGRAMME

M.Tech. in Power Systems

(2020-2022)

Department of Electrical and Electronics Engineering

The National Institute of Engineering

Mysuru-570 008
Department of Electrical & Electronics Engineering

VISION

The department will be an internationally recognized centre of excellence imparting quality education in electrical engineering for the benefit of academia, industry and society at large

MISSION

M1: Impart quality education in Electrical and Electronics Engineering through theory and its applications by dedicated and competent faculty

M2: Nurture creative thinking and competence leading to innovation and technological growth in the overall ambit of electrical engineering

M3: Strengthen industry-institute interaction to inculcate best engineering practices for sustainable development of the society

PROGRAM EDUCATIONAL OBJECTIVES

PEO1: Graduates will be competitive and have a successful career in electric power industry and other organizations.

PEO2: Graduates will excel as academicians and contribute to research and development.

PEO3: Graduates will demonstrate leadership qualities with professional standards for sustainable development of society.
PROGRAM OUTCOMES

Students graduating from M.Tech - Power systems of department of Electrical & Electronics Engineering shall have the ability to:

**PO1:** Independently carry out research/ investigation and development work to solve practical problems in the field of power systems engineering.

**PO2:** Write and present a substantial technical report/document.

**PO3:** Demonstrate a degree of mastery in the field of power systems engineering in a technologically changing scenario.

**PO4:** Demonstrate managerial and financial skills.

**PO5:** Demonstrate concern for the safety and environment for sustainable development of society.
# LIST OF COURSES OFFERED AS PER CATEGORY

<table>
<thead>
<tr>
<th>Core – Theory</th>
<th>Core – Lab</th>
<th>Project, Seminar, etc</th>
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<tbody>
<tr>
<td><strong>Core – Theory</strong></td>
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<tr>
<td>MPS1E202 Wind &amp; Solar Power Systems and Energy Storage (3-0-0)</td>
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<td>MPS1E203 Smart Grid-Technology and Applications (3-0-0)</td>
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<td>MPS1E103 Electrical Transients in Power Systems (3-0-0)</td>
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<td>MPS1E2XX Digital Control Systems (3-0-0)</td>
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**SUGGESTED PLAN OF STUDY**

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<th>II</th>
<th>III</th>
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**Table of total credits to be earned by a student**

**Degree Requirements:**

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<th>Category of courses</th>
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<td>Basic science</td>
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<td>(from other departments)</td>
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COURSE NUMBERING SCHEME

Core

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Lab

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Elective

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Industry Driven Elective

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Mooc Elective

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TABLE OF SCHEME AND EXAMINATION FROM 1ST TO 4TH SEMESTER

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<td>2</td>
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Elective - 1

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<td>Economic Operation of Power Systems*</td>
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**Elective – 3**

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* Pre-requisite: Power System Analysis and Stability (MPS1CXX)  
** Pre-requisite: Power System Protection

## DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
### SCHEME OF TEACHING AND EXAMINATION
#### III SEMESTER

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**Total Credits** 19

Note: MOOC Electives will be decided on the availability courses during the corresponding academic year

## DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
### SCHEME OF TEACHING AND EXAMINATION
#### IV SEMESTER

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**Total Credits** 15
M.Tech.: Power Systems
(2020-2022)

Syllabus – I Semester

Department of Electrical and Electronics Engineering
The National Institute of Engineering
Mysuru-570 008
Applied Engineering Mathematics (4-0-0)

Sub Code : AEM1C01  CIE : 50% Marks
Hrs/Week : 4+0+0  SEE : 50% Marks
SEE Hrs : 03  Max.Marks : 100 Marks

Course outcomes:

On successful completion of the course the students will be able to:
1. Compute the extremals of functionals and solve standard variational problems.
2. Solve linear homogeneous partial differential equations with constant and variable coefficients.
3. Use optimization techniques to solve Linear and Non-Linear Programming problems.
4. Apply geometry of Linear transformations and construct orthonormal basis of an inner product space.
5. Apply the method of least square to predict the best fitting curve for a given data and solve problems associated with discrete probability distribution.
6. Solve problems associated with discrete joint probability distribution, Markov chain using transition probability matrix and the concept of Queuing theory.

MODULE 1: Calculus of Variation: Variation of a function and a functional. Extremal of a functional, variation problems, Euler’s equation, Standard variational problems including geodesics, minimal surface of revolution, Brachistochrone problems, Isoperimetric problems. Functionals of second order derivatives

SLE: hanging chain problem  

 MODULE 2: Partial Differential Equations: Solution of linear homogeneous PDE with constant and variable coefficients.

SLE: Cauchy’s partial differential equation  

 MODULE 3: Optimization: Standard form of LPP, Simplex method, Big-M method, Duality, Non-Linear programming problems

SLE: Degeneracy in simplex method  


SLE: Least square problems

**8 Hours**

**SLE:** fitting of the curves \( y = ax^b \) and \( y = ab^x \)

MODULE 6: Probability II: Joint probability distribution (Discrete), Markov chains – probability vector, stochastic matrix, transition probability matrix. Concept of queuing – M/M/1 and M/G/1 queuing system.

**SLE:** continuous joint probability distribution

**8 Hours**

**Reference Books:**

1) **Higher Engineering Mathematics** – Dr. B.S. Grewal, 42\textsuperscript{nd} edition, Khanna publication.
2) **Advance Engineering Mathematics** – H. K. Dass, 17\textsuperscript{th} edition, Chand publication.
3) **Higher Engineering Mathematics** – Dr. B.V. Ramana, 5\textsuperscript{th} edition, Tata Mc Graw-Hill.
Course Outcomes

On successful completion of the course, the students will be able to:

1. Explain and apply basic concepts of digital protection.
2. Discuss hardware considerations and relaying algorithms.
3. Explain principles of digital protection to Generator, Motor, Transmission lines, Bus bar and Transformers.
4. Explain protection schemes, testing and maintenance of digital relays.

MODULE 1: Introduction to Numerical Relay: Numerical relay, Comparison between electromechanical relays and numerical relay, Computer relay architecture and subsystems, Advantages and disadvantages of Numerical relay and Adaptive relaying.

06 Hours

SLE: Study of protection philosophy and protection systems currently employed in India.


Digital Signal Processor: Digital signal processing system, Major features of programmable digital signal processor, Basic architecture features, DSP computational building blocks, Bus architecture.

08 Hours

SLE: Memory selection

MODULE 3: Hardware Considerations: IC Elements and circuits for interfaces: Zero crossing detector, Phase shifter, Current to voltage converter, Precision rectifier.


Filters: Digital Filters, Finite Impulse Response and Infinite Impulse Response Filters.

10 Hours

SLE: Digital to Analog Converters


09 Hours

SLE: Differential equation technique
MODULE 5: Protection schemes: Generator, Motor, Transmission line protection schemes.

Bus bar: Faults and Protection requirements. Transformer: CT Saturation, faults.

Power transformer algorithms: Current derived restraints, voltage based restraints, flux restraints, inrush current restraint. 09 Hours

SLE: Bus bar arrangements


Numerical Distance Protection: Impedance, Reactance, Mho and Offset Mho, Quadrilateral, and Distance relay reach, Testing of Digital relays. 10 Hours

SLE: Maintenance aspects of Digital relays

Text Books:

Reference Books:
Power System Analysis and Stability (4-2-0)

Sub Code: MPS1CXX
Hrs/week: 4+2+0
SEE Hrs: 3

CIE: 50% Marks
SEE: 50% Marks
Max marks: 100

Course Outcomes
On successful completion of the course, students will be able to:

1. Apply the different Load Flow Techniques to given Power Systems.
2. Analyze the symmetrical and unsymmetrical faults of a Power system.
3. Analyze transient stability and voltage stability of a Power system.
4. Explain the concept of state estimation and system security.


SLE: Bifactorization method.

09 Hours


SLE: Analysis of open circuit faults.

08 Hours


SLE: Methods of improving transient stability.

09 Hours

MODULE 4: Voltage Stability: Definition and classification, Mechanism of voltage collapse, Analysis of voltage stability, Modeling of voltage collapse, Voltage security, Transient voltage stability, Power transfer at voltage stability limit, Maximum power angle at voltage stability limit, Relation between reactive power variation and system stability.

SLE: Loading limit of transmission system voltage.

09 Hours

09 Hours

SLE: Relation with off nominal tap ratio.


08 Hours

SLE: Contingency Selection.

Text Books:


Reference books:

Power Electronic Converters and Applications (3-2-0)

Sub Code: MPS1C04
Hrs/week: 3+2+0
SEE Hrs : 3

CIE: 50% Marks
SEE: 50% Marks
Max marks: 100

Course Outcomes

On successful completion of the course, students will be able to:

1. Describe the circuit topologies of Line commutated and SMPS Converters.
2. Analyze different types of Chopper and Inverters circuits.
3. Describe the operations of AC/DC/AC conversion technologies.
4. Describe the operations of DC/AC/DC conversion technologies.

MODULE 1: Line Commutated Converter: Functional circuit block of Line commutated converter, Direction of power flow-inverter operation, Phase controlled converter single and two quadrant operations, Converter for HVDC power link, Midpoint configuration-transformer connection, The bridge configuration-basic building blocks, Voltage and current ripples on dc side, Commutation and overlap.

08 Hours

SLE: Inversion mode.

MODULE 2: Choppers: Introduction, Voltage step down chopper, Voltage step up chopper, Two quadrant chopper, Multiphase choppers, problems.

08 Hours

SLE: Coupled reactor in multiphase choppers.

MODULE 3: Inverters: Full bridge configuration, Shaping of output voltage waveform-sinusoidal pulse width modulation (SPWM), Three phase inverter, Inverter operation with reverse power flow, Multilevel Inverters - types, Topology and operation.

08 Hours

SLE: SPWM with reverse voltage excursions.


07 Hours

SLE: Resonant converter.

MODULE 5: AC/DC/AC Converters: Introduction, AC/DC/AC converters used in wind turbine systems, New AC/DC/AC converters, AC/DC/AC boost-type converters, Two-level AC/DC/AC ZSI, Three-level diode-clamped AC/DC/AC converter, Linking a wind turbine system to a utility network.
DC/AC/DC Converters: Review of traditional DC to DC converters, Chopper type DC/AC/DC converters, Switched capacitor DC/AC/DC converters- single stage, three stage and four stage

SLE: Tapped transformer converters

Text Books:

Reference Books:
Restructured Power Systems (3-0-0)

Sub Code : MPS1E101
Hrs/week : 3+0+0
SEE Hrs:3

Course Outcomes

On successful completion of the course, students will be able to:

1. Understand and explain the need for restructured power system and economics.
2. Discuss and analyze transmission congestion and loss allocation in PowerSystem.
3. Evaluate LMP and explain the concept of FTR for a given powersystem.
4. Explain the generator bidding in powermarket.

MODULE 1: Introduction to Restructuring of Power Industry and Fundamentals of Economics:
Introduction, Reasons for restructuring/deregulation of power industry, Understanding the restructuring process, Introduction to issues involved in deregulation, Reasons and objectives of deregulation of various power systems across the world. Consumer behavior, Supplier behavior, Market equilibrium, Short-run and Long-run costs, Various costs of production, Relationship between short-run and long-run average costs.

09 Hours

SLE: Perfectly competitive market.

MODULE 2: Transmission Congestion Management: Introduction, Classification of congestion management methods, Calculation of ATC, Non-market methods, Market based methods, Nodal pricing, Inter-zonal and Intra-zonal congestion management, Price area congestion management.

09 Hours

SLE: Capacity alleviation method.

MODULE 3: Pricing of transmission network usage and loss allocation: Introduction to transmission pricing, Principles of transmission pricing, Classification of transmission pricing methods, Rolled-in transmission pricing methods, Marginal transmission pricing paradigm, Composite pricing paradigm, Merits and de-merits of different paradigms, Debated issues in transmission pricing, Introduction to loss allocation, Classification of loss allocation methods.

09 Hours

SLE: Comparison between various methods.
MODULE 4: Locational Marginal Prices (LMP) and Financial Transmission Rights (FTR): Fundamentals of locational marginal pricing, Lossless DCOPF model for LMP calculation, Loss compensated DCOPF model for LMP calculation, ACOPF model for LMP calculation. Introduction to financial transmission rights, Risk hedging functionality of financial transmission rights, Simultaneous feasibility test and revenue adequacy, FTR issuance process, Treatment of revenue shortfall, Secondary trading of FTRs, Flow gate rights, FTR and market power.

06 Hours

SLE: FTR and merchant transmission investment.

MODULE 5: Market power and generators bidding: Attributes of a perfectly competitive market, The firm's supply decision under perfect competition, Imperfect competition market power, Financial markets associated with electricity markets, Introduction to optimal bidding by a generator company.

06 Hours

SLE: Optimal bidding methods

Text Book:

Reference Books:
Integration of Distributed Generation in Power Systems (3-0-0)

Sub Code: MPS1E102
Hrs/week: 3+0+0
SEE Hrs: 3

Course Outcomes:
On successful completion of the course, students will be able to:

1. Explain various non-conventional energy sources and methods of interfacing with grid.
2. Analyze the impact of distributed generation on general performance of power system.
3. Analyze the impact of distributed generation on over loading and losses, voltage magnitude variations and system protection.
4. Explain the influence of distributed generation on Power Quality and transmission system operation.

MODULE 1: Sources of Energy: Status and properties of wind power, Power distribution as a function of wind speed, Status and properties of solar power, Photo voltaic, Interfacing with grid.

08 Hours

SLE: Status and properties of combined heat and power.

MODULE 2: Impact of DG on Power System Performance, Overloading and Losses: Impact of distributed generation on power system performance, Hosting capacity approach, Power quality and design of distributed generation, increasing the hosting capacity.

Impact of distributed generation on over loading and losses, Overloading of Radial distribution network, Increasing the hosting capacity.

08 Hours

SLE: Hosting capacity approach for events.

MODULE 3: Impact of DG on Voltage Magnitude Variations: Impact of distributed generation, Voltage margin and hosting capacity, Voltage rise owing to distributed generation, Hosting capacity and measurements to determine hosting capacity, Estimating the hosting capacity without measurements, Increasing the hosting capacity.

08 Hours

SLE: Numerical approach to voltage variations.

MODULE 4: Impact of DG on Protection: Impact of distributed generation, Over current protection, Upstream and downstream faults, Hosting capacity, Fuse – recloser coordination, Bus bar protection, Generator protection, General requirements, Non controlled island operation, Increasing the hosting capacity.

08 Hours

SLE: Basic method of islanding detection.
MODULE 5: Impact of DG on Power Quality Disturbances and Transmission System Operation:
Impact of DG on power quality disturbances, Fast voltage fluctuations, Voltage unbalanced, Introduction to low frequency harmonics, High frequency distortion and voltage dips, Increasing the hosting capacity.
Impact of distributed generation and transmission system operation, Fundamentals of transmission system operation, Increasing the hosting capacity.

07 Hours

SLE: Balancing and reserve.

Text Book:
Electrical Transients in Power Systems (3-0-0)

Sub Code: MPS1E103
Hrs/week: 3+0+0
SEE Hrs: 3

CIE: 50% Marks
SEE: 50% Marks
Max marks: 100

Course Outcomes:

On successful completion of the course, students will be able to:

1. Discuss the generation of switching transients.
2. Describe the transients in DC circuits, conversion equipments and static VAR controls.
3. Discuss the concept of Insulation coordination.
4. Analyze the lightning phenomenon and transient over voltage protection methods.

MODULE 1: Abnormal Switching Transients: Normal and abnormal switching transients, Current suppression, Capacitance switching, Other restriking phenomena, Transformer magnetizing inrush current, Ferro resonance, Worked examples. 08 Hours

SLE: Three phase capacitor switching.

MODULE 2: Transients in Direct Current Circuits, Conversion Equipment and Static Var Controls: Introduction, Interruption of direct current in low voltage circuits, Transients associated with HVDC circuit breakers, Delayed and periodic functions, Commutation transients – the current-limiting static circuit breaker, Commutation transients in conversion equipment, Worked examples. 08 Hours

SLE: Transient behavior of a transformer coil.

MODULE 3: Lightning: The Scope of the lightning problem, The physical phenomenon of lightning, Interaction between lightning and the power system, Computation of a specific lightning event, Thunderstorm tracking and other recent developments, Worked examples. 08 Hours

SLE: Induced Lightning Surges.

MODULE 4: Insulation Coordination: Some basic ideas about insulation coordination, The strength of insulation, The hierarchy of insulation coordination, Test voltage waveforms and transient ratings, Statistical approaches to insulation coordination, Worked examples. 08 Hours

SLE: Deterministic statistical approaches to insulation coordination.
MODULE 5: Protection of Systems and Equipment Against Transient Over voltages: Introduction, Protection of transmission lines against lightning, Lightning shielding of substations, Surge suppressors and lightning arresters, Application of surge arresters, Surge suppressors for direct current circuits, Transient voltages and grounding practices, Protection of control circuits, Surge protection scheme for an industrial drive system, Worked examples.

SLE: Surge protection of rotating machines.

Text Books:
Digital Control Systems (3-0-0)

Sub Code: MPS2E4XX
Hrs/week: 3+0+0
SEE Hrs: 3
CIE: 50% Marks
SEE: 50% Marks
Max marks: 100

Course Outcomes
On successful completion of the course, students will be able to:
1. Understand, analyze and apply knowledge of control engineering and mathematics in industrial problems
2. Analyze digital control systems using transform techniques
3. Analyze digital control systems using state-space methods.
5. Analyze the concepts of nonlinear digital control systems.

MODULE 1: Introduction to digital control systems and Z-Transform Techniques:
Introduction, Discrete time system representation, data conversion and quantization, sample and Hold devices, mathematical modeling of the sampling process, data reconstruction and filtering of sampled signals, zero-order hold, the first-order hold, aliasing and folding, choice of the sampling period – Z-transform, Inverse Z-transform, pulse transfer and z-transfer function, pulse transfer function of the ZOH, solution of difference equation, response of discrete-data control system.

SLE: Choice of the sampling period
08 Hours

MODULE 2: Analysis using Z-Transform Techniques:
Comparison of time responses of continuous data and discrete data systems, steady state error analysis of digital control systems, correlation between time response and root locations in the s-plane and the z-plane, constant damping factor and constant damping ratio loci, dead beat response at the sampling instants, root loci for digital control systems, effect of adding poles and zeroes to the open-loop transfer function

SLE: Practical issues with deadbeat response design
08 Hours

MODULE 3: Discrete state space model:
State equations of discrete-data systems with sample and hold devices, state equations of digital systems with all digital elements, different state variable models, digital simulation and approximation, state transition equations, state diagrams of digital systems, Decomposition of discrete data transfer functions, Controllability and observability of discrete data systems, relation between observability, controllability and transfer functions, Controllability and observability versus sampling period.

SLE: Stability of discrete state space models
08 Hours
MODULE 4: Discrete state space model - Controller Design: Controller Design using Discrete-time state model, Pole placement design by state feedback, Full order and reduced order observer design, design of digital control systems with state feedback and dynamic output feedback, realization of state feedback by dynamic controllers. Introduction to Multivariable & Multi-input Multi-output (MIMO) Digital Control Systems

08 Hours

SLE: Set point tracking controller

MODULE 5: Nonlinear Digital control systems: Discretization of nonlinear systems, Extended linearization by input redefinition, input and state, Equilibrium of nonlinear discrete-time systems, Lyapunov stability theory, Lyapunov functions, Stability theorem, Rate of convergence, Lyapunov stability of linear systems, Lyapunov’s linearization method, Instability theorems, Discrete-time nonlinear controller design

07 Hours

SLE: - Extended linearization using matching conditions

Text Books


References
Wind & Solar Power Systems and Energy Storage (3-0-0)

Sub Code : MPS1E202
Hrs/week : 3+0+0
SEE Hrs : 3

CIE: 50% Marks
SEE: 50% Marks
Max marks : 100

Course Outcomes

On successful completion of the course, students will be able to:

1. Explain the basic design aspects of wind and solar powersystems.
2. Discuss the issues related to grid connection of wind and solar power systems.
3. Explain the various energy storage schemes related to renewable energysystems.

MODULE 1: Wind Power Systems: System components, Turbine rating, Power v/s Speed and TSR, Maximum energy capture, Maximum power operation, System-design trade-offs, System control requirements, BIS and IEC specifications and codes governing wind power systems.

07 Hours

SLE: Environmental aspects

MODULE 2: Electrical Generators and drives: Introduction to electrical generators, Doubly fed induction generator, Direct-driven generator, Generator drives, Speed control regions, Generator drives, Drive selection.

08 Hours

SLE: Cutout Speed Selection

MODULE 3: Photovoltaic Power Systems: Introduction to PV cell technologies, PV cell, Module and array, Equivalent electrical circuit, Open-circuit voltage and short-circuit current, Array design, Peak-power operation, Components, BIS and IEC specifications and Codes governing photovoltaic systems.

09 Hours

SLE: I-V and P-V curves

MODULE 4: Grid-Connected Systems: Interface requirements, Synchronizing with the grid, Operating limit, Energy storage and load scheduling, Utility resource planning tools, Wind farm–grid integration, BIS and IEC specifications and Codes governing grid-connected systems.

08 Hours

SLE: Grid stability issues
**MODULE 5: Energy Storage**: Types of battery, Equivalent electrical circuit, Performance characteristics, More on the lead-acid battery, Battery design, Battery charging, Charge regulators, Management, Flywheel, Superconducting magnet, Technologies compared, BIS specifications and codes governing lead acid and nickel cadmium batteries.

07 Hours

**SLE**: Compressed air as energy storage.

**Text Book:**


**E-resource link:**

1. www.bis.org.in
2. www.iec.ch
Smart Grid-Technology and Applications (3-0-0)

Sub Code: MPS1E203                               CIE: 50% Marks
Hrs/week: 3+0+ 0                                  SEE: 50% Marks
SEE Hrs: 3                                         Max. Marks: 100

Course Outcomes

On successful completion of the course, students will be able to:

1. Explain the concept of smart grid and its realisation.
2. Discuss various concepts of dynamic energy management systems.
3. Describe interoperability, standards and cyber security.
4. Describe the characteristics of smart transmission and distribution grids
5. Discuss the interaction of smart grid with electric vehicles.

MODULE 1: Introduction to smart grid: Background and history of smart Grid evolution, Definition and characteristics of smart grid, Benefits of smart grid, Smart Grid vision and its realisation, Motives behind developing the Smart Grid concept, Examples of Smart Grid projects/initiatives, The Smart Grid basic infrastructure.

08 Hours

SLE: Comparison between Smart Grid and conventional electrical networks

MODULE 2: Dynamic Energy Systems Concept: Smart energy efficient end use devices, Smart distributed energy resources, Advanced whole building control systems, Integrated communications architecture, Energy management, Role of technology in demand response, Current limitations to dynamic energy management, Distributed energy resources, Overview of a dynamic energy management, Key characteristics of smart devices, Key characteristics of advanced whole building control systems.

08 Hours

SLE: Key characteristics of dynamic energy management system

MODULE 3: Interoperability Standards and Cyber Security: Introduction to Interoperability, Analogy between the interoperability of a digitally based device and human interoperability, Type and characteristics of interoperability standards for Smart Grid Electrical power industry standards development organizations (SDOs) and key interoperability standards: IEEE, ANSI, NIST, NERC, W3C, Smart Grid communication system infrastructure, Cyber security of power systems: Smart Grid cyber-security challenges, Communication-based attacks, Emerging Smart Grid cyber-security technologies, Smart Grid cyber-security standards.

09 Hours

SLE: Mitigation approach to cyber security risks.

MODULE 4: Smart Transmission and Distribution Grids: Smart distribution networks versus conventional distribution networks, Basic building blocks of a smart distribution network, Introduction
to smart transmission grid, Challenges and requirements of future STG, Characteristics of smart transmission network, Characteristics of a smart substation. IEEE C 37.118 and series standards communications in smart grid.

08 Hours

SLE: IEC 61850 substation architecture

MODULE 5: Smart Grid Interaction with Electric Vehicles: Types of electric drive vehicle, Characteristics of energy storage devices/systems, Types, characteristics and benefits of EES systems, Types of EV charging systems, smart charging in smart grid, Load management of EVs using Smart-Grid technologies.

06 Hours

SLE: Components related to EV-Smart-Grid integration

Text Books:
Research Methodology (2-0-0)

Sub Code: MPS1CRM
Hrs/week:2+0+0
SEE Hrs:2

CIE: 50% Marks
SEE: 50% Marks
Max marks :50

Course outcomes
After studying this course, students will be able to:

1. Understand the basic framework of research process, research design and techniques
2. Understand the processes of quantitative data collection, analysis, interpretation and presentation
3. Understand the components of scholarly writing and ethical issues in research

MODULE-1
Overview of research: Introduction to research, Objectives and motivations for research, Significance of research, Research Methods v/s Methodology, Types of research, Quantitative Research Methods, Variables, Conjecture, Hypothesis. Research Process, Steps in research process, Criteria of good Research, Importance of literature review in defining a problem - Survey of literature - Primary and secondary sources -Reviews, - web as a source - searching the web - Identifying gap areas from literature review, Development of working hypothesis.
Research problem-definition, selection and formulation of a research problem selection, criteria of a good research problem. Introduction to research design, Characteristics of good research design.

8 Hours

SLE : Developing a research plan, Department/program specific research problem discussions

MODULE-2
Data collection, processing and analysis: Sources of data, collection of data, Primary and secondary Data, Collection of Data through various methods, Measurement and scaling, Sources of error in measurement. Modeling, Mathematical Models for research

9 Hours

SLE : Measures of central Tendency (Mean, medium, Mode), Measures of dispersion (range, mean deviation, standard deviation) Graphical representation of Data.

MODULE-3
Report writing and ethics in Research: Writing Research Report: Format and style. Review of related literature its implications at various stages of research. (Formulation of research problem, hypothesis, interpretation and discussion of results. Major findings, Conclusions and suggestions.) Layout of a Research Paper, Research proposal, Citation of references, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, effective technical presentation in seminars/workshops/symposiums

Dept. of EEE, NIE, Mysuru
Significance of ethical conduct in research, Ethical issues related to publishing, Plagiarism. Software for detection of Plagiarism.

9Hours

SLE: Intellectual property rights, importance and protection, copyrights, patents, Impact factor of Journals

Text books:

Reference books:
Power Systems Lab - I (0-0-2)

Sub Code: MPS1L01
Hrs/Week: 0+0+2
Max Marks: 50

CIE: 50% Marks
SET: 50% Marks

Course Outcomes
On successful completion of the course, the students will be able to:

1. Perform Steady state analysis of power systems.
2. Perform Transient analysis of power systems.
3. Execute relaying algorithms and Test power system protection schemes.

List of Experiments:
1. To perform power flow studies of 5 Bus system with HVDC transmission line.
2. To carry out short circuit studies on a given power system.
3. To determine voltage stability indicator and investigation of voltage stability of power system.
4. To carryout Contingency analysis on a power system.
5. To perform State Estimation and bad data detection for a given power system.
6. Simulation of Relaying Algorithms for numerical protection
7. To test and analyze Feeder protection schemes
8. To test and analyze Motor protection schemes
9. To test and analyze Generator protection schemes
M.Tech.: Power systems
(2020-2022)

Syllabus – II Semester

Department of Electrical and Electronics Engineering
The National Institute of Engineering
Mysuru-570 008
Economic Operation of Power Systems (4-2-0)
Pre-requisite: Power System Analysis and Stability (Sub Code: MPS1CXX)

Sub Code : MPS2C01
Hrs/week : 4+2+0
SEE Hrs: 3
SEE: 50% Marks
Max marks : 100

Course Outcomes

On successful completion of the course, students will be able to:

1. Solve economic dispatch and unit commitment in Thermal Power Plant.
2. Formulate and evaluate the economic dispatch Hydro - Thermal Power Plant.
3. Analyze single area and two area load frequency control of power system.
4. Apply optimization techniques to solve optimal power flow problem.
5. Explain the concept of interchange of power and energy.


08 Hours

SLE: Base Point and participation Factors

MODULE 2: Economic Dispatch – II and Optimal Unit Commitment (OUC) of Thermal Units: Derivation of transmission line loss expressions, Economic load dispatch with transmission network losses, Introduction to OUC, Constraints in OUC, Priority list method and dynamic programming for UC, Problems.

08 Hours

SLE: Optimal Unit Commitment (OUC) considering start up cost for thermal units

MODULE 3: Hydrothermal Coordination: Introduction, Hydroelectric plant models, Composite generation production cost function, Long-range hydro-scheduling, Short-range hydro-scheduling, Short-term hydro-scheduling; a gradient approach, Hydro-units in series (hydraulically coupled), Pumped-storage hydro plants, Dynamic-programming solution to the hydrothermal scheduling problems.

10 Hours

SLE: Hydrothermal scheduling using linear programming

MODULE 4: Load Frequency Control: Single area block diagram representation, Single area – steady state and dynamic analysis, Static load frequency curves, Integral control, Response of a two – area system for uncontrolled and controlled case with block diagram, Dynamic state variable model.

08 Hours

SLE: Area control error

Dept. of EEE, NIE, Mysuru
**MODULE 5: Optimal Power Flow:** Introduction, Solution of the optimal power flow – Gradient method, Newton’s method, Linear sensitivity analysis, Linear programming methods, Security-constrained optimal power flow.  

09 Hours

**SLE:** Bus incremental cost

**MODULE 6: Interchange of Power and Energy:** Introduction, Economy interchange between interconnected utilities, Inter utility economy energy evaluation, Interchange evaluation with unit commitment, Multiple-utility interchange transactions, Other types of interchange- capacity interchange, Diversity interchange, Energy banking, Emergency power interchange, Inadvertent power exchange, Power pools - the energy-broker system, Allocating pool savings, Transmission effects and issues-transfer limitations, Wheeling, Rates for transmission services in multiparty utility transactions, Someobservations.  

09 Hours

**SLE:** Transactions involving nonutility parties

**Text Books:**

2. S. Sivanagaraju, G. Sreenivasan, “Power System Operation and Control”, Pearson Publisher.
Power System Dynamics and Control (4-0-0)
Pre-requisite: Power System Analysis and Stability (Sub Code: MPS1CXX)

Sub Code : MPS2C05
Hrs/week : 4 +0+0
SEE Hrs: 3 Hrs

CIE : 50% Marks
SEE : 50% Marks
Max marks : 100

Course Outcomes
On successful completion of the course, students will be able to:

1. Explain the concepts of power system security and stability.
2. Construct the models of synchronous machine and other power system components for the study of system dynamics.
3. Investigate small signal stability of a synchronous generator connected to an infinite bus and explain the structure and design aspects of PSS

MODULE 1: Introduction to the power system stability problem:
Rotor angle stability, Voltage stability and voltage collapse, Mid-term and long-term stability, Classification of stability problems, States of operation and system security, Review of classical methods, Swing equation, Some mathematical preliminaries, Analysis of steady state stability.

09 Hours

SLE: Analysis of transient stability

MODULE 2: Modeling of Synchronous Machine:
Flux linkage equations, Voltage and torque equations, Park’s transformation, Transformation of flux, Stator voltage equations and rotor equations, Transformation of torque equations, Choice of constants, Analysis of steady state performance, Per unit quantities, Equivalent circuits of synchronous machine.

09 Hours

SLE: Determination of synchronous machine reactances

MODULE 3: Modeling of Excitation Systems and Prime Mover Controllers:
Excitation system requirements, Elements of excitation systems, Types of excitation systems, Excitation system modeling, Standard block diagrams, System representation by state equations, Inclusion of limits, Modeling of turbines and speed-governing systems.

09 Hours

SLE: Excitation system control and protective circuits

MODULE 4: Modeling of Transmission Lines and Loads:
Transmission line model, Transformation to D-Q components, Steady state equations, Transformation using α-β variables, Modeling of static and dynamic loads.

08 Hours

SLE: Modeling of SVC

Dept. of EEE, NIE, Mysuru
MODULE 5: Dynamics of a Synchronous Generator connected to Infinite bus: System model, Synchronous machine model, Application of model 1.1, Calculation of initial conditions, Consideration of other machine models, System simulation.

SLE: 08 Hours

MODULE 6: Analysis of Small Signal Stability and Power System Stabilizer: Small signal analysis with block diagram representation of SMIB systems with generators represented by classical and 1.0 models, Synchronizing and damping torque analysis, Basic concepts in applying PSS, Control signals, Structure and tuning of PSS.

SLE: Nonlinear oscillations- Hopf bifurcation 09 Hours

Text Book:

Reference Books:
Flexible AC Transmission Systems (4-2-0)

Sub Code : MPS2C06  
Hrs/week : 4+2+0  
SEE Hrs: 3

CIE: 50% Marks  
SEE: 50% Marks  
Max marks: 100

Course Outcomes

On successful completion of the course, students will be able to:

1. Analyze the behavior of uncompensated AC transmission system.
2. Analyze series and shunt compensated system with fixed compensators and FACTS controllers.
3. Explain the structure and functions of combined compensators.

MODULE 1: Uncompensated AC transmission system: Fundamental requirements in AC power transmission, Fundamental transmission line equation, Surge impedance & natural loading, Analysis of uncompensated AC lines - radial & symmetrical line on No-load & load, Transmission interconnections, Flow of power in AC system, Loading capability limitations,

SLE: Relative importance of controllable parameters.

09 Hours

MODULE 2: Types of compensation & fixed series compensation: Basic types of line compensation, Uniformly distributed fixed compensation, Objectives of series compensation, Compensation by a series capacitor connected at the midpoint of the line, Protective gear and reinsertion schemes.

SLE: Varistor protective scheme.

08 Hours

MODULE 3: Introduction to FACTS controllers and controlled series compensation: Basic types of FACTS controllers, Benefits from FACTS technology, Basic concepts of controlled series compensation, Operation of TCSC, Analysis of TCSC, GCSC, Applications of TCSC, Introduction to SSSC, Operation of SSSC & the control of power flow.

SLE: Applications of SSSC.

09 Hours

MODULE 4: Fixed shunt compensation and SVC: Objectives of shunt compensation, Compensation by a shunt capacitor connected at the midpoint of the line, SVC – objectives, Control characteristics, Analysis, Configuration, Applications.

SLE: SVC controller.

09 Hours
**MODULE 5: STATCOM**: Introduction to STATCOM, Basic operating principle, Control characteristics and simplified analysis of 3-phase 6 pulse STATCOM, Applications.

**SLE**: Comparison between STATCOM & SVC.

**MODULE 6: UPFC**: Introduction to UPFC, Operation of UPFC connected at sending end, midpoint & receiving end, Control of UPFC, Interline power flow controller.

**SLE**: Applications of UPFC.

**Text Books:**


**Reference book :**

Electrical Power Distribution Automation and Control(3-2-0)

Sub Code: MPS2C04
Hrs/week: 3+2+0
SEE Hrs: 3

CIE: 50% Marks
SEE: 50% Marks
Max marks: 100

Course Outcomes
On successful completion of the course, students will be able to:

1. Discuss the control and management in the Distribution Automation.
2. Model the Distribution system components.
3. Discuss the Feeder and Substation Automation & the communication technologies
4. Analyze the performance of distribution system


07 Hours

SLE: Different levels of automation preparedness.

MODULE 2: Central control and Management: Operations environment of distribution networks, Evolution and functions of Distribution management systems, Basics of real time control system (SCADA), Outage management, Decision support applications, Database structures and interfaces.

07 Hours

SLE: Data model standards.


08 Hours

SLE: Composite load model.

MODULE 4: Distribution Automation and Control Function: State and trends substation automation, Demand side management, Feeder automation - voltage/var control, Fault detection, Trouble calls, Restoration functions, Reconfiguration, Power quality assessments.

08 Hours

SLE: Demand response.

Communication system for control and automation: Introduction, Wire communication, Wireless communications, Distribution automation communications- protocols, Architecture, User interface, Requirements of dimensioning the communication channel.

09 Hours

SLE: Power theft

Text Books:

Reference Book:
EHV AC Transmission (3-0-0)

Sub Code : MPS2E301
Hrs/week : 3+0+0
SEE Hrs: 3
CIE: 50% Marks
SEE: 50% Marks
Max marks: 100

Course Outcomes
On successful completion of the course, students will be able to:

1. Understand the effect of corona and its assessment.
2. Gain knowledge on performance characteristics of EHV cables and principles of Lightning Protection.
3. Explain the method of voltage control and SSR phenomenon.
4. Gain knowledge of standard wave shapes and generator circuit for EHV testing.

MODULE 1 : Corona Effects: Power loss and Audible Noise (AN), Corona loss formulae, charge voltage diagram, Generation, characteristics, Limits and measurements of AN, Relation between 1-phase and 3-phase AN levels, Radio Interference (RI), Corona pulses generation, Properties, Limits, Frequency spectrum, Modes of propagation and excitation functions, Examples.

SLE: Measurement of RI.

MODULE 2: Lightning and lightning protection: Lightning strokes mechanism, Lightning strokes to lines, General principles of lightning protection problem, Tower footing resistance, Probability of occurrence of lightning stroke current, Lighting arrester and protective characteristics, Dynamic voltage rise arrester rating.

SLE: Insulation coordination based on lightning.

MODULE 3: Extra High voltage cable Transmission: Electrical characteristics of EHV cables, Properties of EHV cables, Breakdown and withstand electrical stress in solid insulation design basis, Test on cable characteristics and surge performance of cable system.

SLE: Gas insulated EHV Lines

MODULE 4: Voltage Control: Power circle diagram and its use, Voltage control using synchronous condensers, Cascade connection of shunt and series compensation, Sub- Synchronous Resonance (SSR) in series capacitor compensated lines, Static VAR compensating system.

SLE: SSR counter measures.

08 Hours

SLE: Generation of impulse current.

Text Books:


Power Quality and Custom Power Devices (3-0-0)

Sub Code: MPS2E302  
Hrs/week: 3+0+0  
SEE Hrs: 3  
CIE: 50% Marks  
SEE: 50% Marks  
Max marks: 100

Course Outcomes

On successful completion of the course, students will be able to:

1. Analyze the power quality problems and conventional mitigation techniques.
2. Describe the custom power devices.
3. Understand the principles of shunt and series compensation for power quality enhancement.
4. Describe different structures and control of UPQC.

MODULE 1: Analysis and Conventional Mitigation Methods:

Power quality terms and definitions, Analysis of power outages, Analysis of unbalance, Analysis of distortion, Analysis of voltage sag, Analysis of voltage flicker, Reduced duration and customer impact of outages, Classical load balancing problem and harmonic reduction.

SLE: Voltage sag reduction

09 Hours

MODULE 2: Custom Power Devices:

Utility-customer interface, Custom power devices, Network reconfiguring devices, Solid state current limiter, Solid state breaker, Issues in limiting and switching operations, Solid state transfer switch, Sag/swell detection algorithms.

SLE: Custom power park

08 Hours

MODULE 3: Realization and Control of DSTATCOM:

DSTATCOM structure, Control of DSTATCOM connected to a stiff source, DSTATCOM connected to weak supply point, DSTATCOM current control through phasors when both load and source are unbalanced, DSTATCOM in voltage control mode.

SLE: DSTATCOM current control when both load and source are unbalanced and distorted.

08 Hours

MODULE 4: Series Compensation of Power Distribution System:

Rectifier supported DVR, DC capacitor supported DVR, DVR structure, Voltage restoration, Series active filter.

SLE: State feedback control of DVR.

08 Hours
MODULE 5: Unified Power Quality Conditioner: UPQC configurations, Right-shunt UPQC characteristics, Left-shunt UPQC characteristics, Structure and control of right-shunt UPQC, Structure of left-shunt UPQC.

SLE: Control of left-shunt UPQC

Text Books:


Photovoltaic System Engineering (3-0-0)

Sub Code: MPS2E303  
Hrs/week: 3+0+0  
SEE Hrs : 3  
CIE: 50% Marks  
SEE: 50% Marks  
Max marks: 100

Course Outcomes

On successful completion of the course, students will be able to:

1. Analyze and design grid connected and standalone PV systems.
2. Design a battery system for grid connected PV systems.
3. Investigate the economics and environmental concerns associated with PV systems.
4. Describe the manufacturing technology of solar cells.

MODULE 1: Grid-Connected Utility-Interactive Photovoltaic System: Introduction, Applicable codes and standards, Design considerations for straight grid-connected PV systems, Design of a system based on desired annual system performance, Design of a system based upon available roof space, Design of a micro inverter-based system, Design of a nominal 20KW system that feeds a three-phase distribution panel.

08 Hours

SLE: Design of PV system.

MODULE 2: Battery-Backup Grid-Connected Photovoltaic Systems: Introduction, Battery-backup design basics, A single inverter 120V battery-backup system based on standby loads, A 120/240V battery-backup system based on available roof space, An 18-KW battery-backup system using inverters in parallel, AC-coupled battery-backup system.

08 Hours

SLE: Battery connection.


08 Hours

SLE: A cathodic protection system.

MODULE 4: Economics and Environmental Consideration: Introduction, Life-cycle costing, Borrowing money, Externalities, Environmental impact of PV systems.

08 Hours

SLE: Payback analysis.

07 Hours

SLE: Energy invested in the production of photovoltaic modules.

Text Books:


Cybersecurity in Power system (3-0-0)

Sub Code: MPS2E3XX
Hrs/Week: 03
SEE Hrs: 03

CIE: 50% Marks
SEE: 50% Marks
Max.: 100 Marks

Course outcomes:

On successful completion of the course the students will be able to:

1. Discuss the importance of cybersecurity in power systems.
2. Apply the cybersecurity standards for electricity sector.
3. Analyze the cost of cyber security management and controls.


09 Hours

SLE: Future Directions


06 Hours

SLE: Standards Limitations


09 Hours

SLE: Cybersecurity Assessment, Monitoring and Improvement.


08 Hours

SLE: MAISim


07 Hours

SLE: Situation Awareness Network.

Text book:
Electric and Hybrid Vehicles (3-0-0)

Sub Code: MPS2E404
Hrs/Week: 03
SEE Hrs: 03

Course outcomes:

On successful completion of the course the students will be able to:

1. To understand the basics of Electric and hybrid vehicles.
2. To analyze different Electric and Hybrid electric Drive train topologies.
3. To analyze different Drive system, and energy storage systems.
4. To size the electric and hybrid electric drive trains
5. To identify different energy management strategies.

MODULE 1: Introduction to Electric Vehicles: Basic Components of Electric and Hybrid Electric vehicles, History of Electric Vehicles, EV Advantages: Efficiency Comparison, Pollution Comparison, Capital and Operating Cost Comparison and U.S. Dependence on Foreign Oil
Vehicle Dynamics: Mathematical Model of vehicle to describe vehicle performance, Torque vs Speed characteristics of Electric vehicle and ICE vehicle, Performance of Electric Vehicles, Importance of gear in vehicles.

SLE: EV Market

09 Hours

MODULE 2: Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies.
Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies.

SLE: Plug-in Hybrid Electric Vehicles

06 Hours

MODULE 3: Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives.

SLE: Hybridization of different energy storage devices.

09 Hours


SLE: Applications of Communication Protocol

08 Hours
MODULE 5: Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies.

SLE: Challenges of energy management strategies.

Text books:


Reference book:

Course outcomes:
On successful completion of the course the students will be able to:

1. Discuss the concepts, organizational implementation and challenges of Internet of Things.
2. Explain the fundamental components for realizing IoT platforms targeting the smart-grid domain.
3. Explain various applications of IoT in Smart grid and Smart cities.


Organizational Implementation and Management Challenges in the Internet of things: Introduction, IoT in Organizations, Managing IoT Systems.

06 Hours

SLE: Building the Blocks of IoT.


08 Hours

SLE: Current Art in Edge Computing and Smart Grid.

MODULE 3: Communication Protocols for the IoT-Based Smart Grid: Introduction, IoT Application types, IoT based Smart-Grid review, Current IoT Based Smart Grid Technology Enablers.


08 Hours

SLE: Future and Enabling Technologies for IoT based Smart Grid.

**Intelligence in IoT-enabled Smart Cities:** Energy Consumption monitoring in IoT based smart cities, Smart homes in the crowd of IoT based cities, Smart meters for the smart city’s grid, Intelligent parking solutions in IoT based smart cities.

**09 Hours**

**SLE:** Smart Office

**MODULE 5: The Internet of Things in Electric Distribution Networks:** Introduction, Current Control and Communication Provision in DNOs, AuRA-NMS-Based Electric IoT Architecture, Communication Standards, Protocols, and Requirements of Electric IoT.

** Satellite-Based Internet of Things Infrastructure for Management of Large-Scale Electric Distribution Networks:** Introduction, Distributed Control Approach for Smart Distribution Grid, LEO Network Characteristics and Modeling, Communication Performance Assessment.

**08 Hours**

**SLE:** Communication Infrastructure Requirements

**Text books:**


**Reference books**


2. IEEE journal publications.
PLC & SCADA (3-0-0)

Sub Code :MPS2E403
Hrs/week :3+0+0
SEE Hrs:3

Course Outcomes
On successful completion of the course, students will be able to:

1. Describe architecture and hardware of PLC.
2. Explain the interface for a variety of input and output devices for PLC.
3. Use programming constructs for ladder diagram, Instruction list, Sequential function charts (SFC) and Structured text.
4. Application of SCADA to Power System operation and management.

MODULE 1: Introduction to PLC: Programming logic controller hardware and internal architecture, PLC systems basic configuration and development, Desktop and PC configurated system, I/O devices, Mechanical switches, Proximity switches, Photoelectric sensors and switches, Temperature sensors, Position sensors, Pressure sensors and smart sensors.

08 Hours

SLE: Interface of encoder device to PLC.

MODULE 2: Output devices: Relay, Directional control valves, Control of single and double acting cylinder control, Conveyors control, I/O processing-signal conditioning, Remote connections, Networks, Processing inputs, Programming features.

08 Hours

SLE: Serial and parallel communication standards.

MODULE 3: Programming methods: Ladder programming, Ladder diagrams, Logic functions, latching multiple outputs, Entering programs, Function blocks, Programming with examples, Instruction List(IL), Sequential Function Charts(SFC), Structured text example with programs.

08 Hours

SLE: Implementation of different programming languages to practical systems.

MODULE 4: Extended Programming methods: Ladder program development examples with jump and call subroutines, Timers, Programming timers, Off-delay timers, Pulse timers, counters, Forms of counter, Up and down counting, Timer with counters, Programming with examples.

08 Hours

SLE: Sequencers.

MODULE 5: SCADA in Power Systems: SCADA basic functions, SCADA application functions, Advantages of SCADA in power systems, Power system field, Flow of data from the field to the SCADA control center.

07 Hours

Dept. of EEE, NIE, Mysuru
SLE: Smart devices for substation automation.

**Text Books:**

**Reference Books:**
Design and Analysis of Industrial Power System Protection (2-0-0)

Pre-requisite: Course on power system protection (Sub Code: MPS1CXX)

<table>
<thead>
<tr>
<th>Sub Code : MPS2I01</th>
<th>CIE: 50% Marks</th>
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<tbody>
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<td>Hrs/week : 2+0+0</td>
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</tr>
<tr>
<td>SEE Hrs: 2</td>
<td>Max marks: 50</td>
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**Course Outcomes**

On successful completion of the course, students will be able to:

1. Familiar with Types of relays, protection schemes, computer applications, fault calculation used in an industrial power system
2. Apply the protection schemes to design and solve the industrial power system protection problem.
3. Familiar with special protection needs, disturbance file analysis, post-mortem analysis following a disturbance.

**MODULE 1:** Typical industrial system SLD, Power flow and fault analysis of the industrial system to establish the base case, Stability study to compute the critical clearing time, Impact of large motor starting, Impact of loss of generation and loss of grid.

09 Hours

**SLE:** Electromagnetic transient analysis for the industrial system

**MODULE 2:** Understanding the protection diagram of the industrial system, Relay setting calculation for feeder protection, motor protection, generator protection, transformer protection, line protection, bus bar protection, Application of frequency based relays.

09 Hours

**SLE:** Grid islanding relay settings.

**MODULE 3:** Protection system simulation, COMTRADE file format, Tripping analysis, Adaptive relaying.

08 Hours

**SLE:** Special protection schemes

**Reference:**

1. Lecture and tutorial notes by the Industry offering the course and Journal publications.
Power Systems Lab - II (0-0-2)

Sub Code : MPS2L01
Hrs/Week : 0+0+2
Max Marks: 50

CIE: 50% Marks
SET: 50% Marks

Course Outcomes:

On successful completion of the course, the students will be able to:

1. Perform studies on Economic dispatch of thermal and hydro units
2. Simulate load frequency control.
3. Perform studies on optimal power flow
4. Model and evaluate performance of SMIB systems with PSS.
5. Simulate voltage control methods in distribution system.

List of Experiments:

1. To perform Economic dispatch and Unit commitment of thermal units.
2. To perform Economic dispatch of hydro – thermal units.
3. To simulate single area and two area systems for load frequency control.
4. To perform optimal power flow for a given power system.
5. To study the effect of StaticVar Compensator connected at the load bus using hardware simulator.
6. To model a SMIB system with synchronous generator represented by classical model and obtain the system response for a step increase in Tm by 5%.
7. To model a SMIB system (with synchronous generator represented by classical model) with a STATCOM damping controller and to evaluate its response for a step increase in Tm by 5%.
8. To model a SMIB system with synchronous generator (represented by 1.0 model) and obtain response for the following conditions:
   (a) Step increase in Vref or Tm by 5%
   (b) 3-phase short circuit at generator terminals.
9. Design a PSS for the system described in experiment no 5 and evaluate its performance for the following conditions:
   (a) Step increase in Vref or Tm by 5%
   (b) 3-phase short circuit at generator terminals.
10. To simulate voltage/var control methods in distribution system.
M.Tech.: Power systems

(2020-2022)

Syllabus – III Semester

Department of Electrical and Electronics Engineering
The National Institute of Engineering
Mysuru-570 008
MOOC Elective (Department Specific/Management) (3-0-0)

Sub Code : MPS3MXX
Hrs/week : 3+0+0
SEE Hrs: 3

CIE: 50% Marks
SEE: 50% Marks
Max marks: 100

MOOC open Elective(from other departments)(2-0-0)

Sub Code : MPS3MXX
Hrs/week : 2+0+0
SEE Hrs: 2

CIE: 50% Marks
SEE: 50% Marks
Max marks: 50

Seminar/ Paper Presentation (1 Credit)

Sub Code : MPS3C02

Max marks: 50

Course Outcomes:
On successful completion of the course, students will be able to:
1: Identify the topic of relevance within the discipline.
2: Understand the study material in depth.
3: Inculcate ethical practices.
4: Present and document the study.
5: Acquire knowledge by introspection.

Internship (5 Credits)

Sub Code : MPS3C03

Max marks: 50

Course Outcomes:
On successful completion of the course, students will be able to:
1: Gain field experience in the relevant discipline.
2: Connect the theory with practice.
3: Present and document the training experience.
4: Acquire knowledge by introspection.
Project Phase – 1(8 Credits)

Sub Code: MPS3CXX

Course Outcomes:
On successful completion of the course, students will be able to:
1: Identify the topic of relevance within the discipline
2: Carry out literature survey
3: Formulate the problem, Identify the objectives and develop solution methodology
4: Inculcate ethical practices.
5: Present and document the preliminary project work.
6: Acquire knowledge by introspection.
M.Tech.: Power systems

(2020-2022)

Syllabus – IV Semester

Department of Electrical and Electronics Engineering

The National Institute of Engineering

Mysuru-570 008
Project Phase - 2(15 Credits)

Sub Code: MPS4C01
Max marks: 250

Course Outcomes:
On successful completion of the course, students will be able to:
1: Implement solution methodology.
2: Judiciously execute the project schedule.
3: Harness the modern tools.
4: Analyze, interpret the results and establish the scope for future work.
5: Identify and execute economically feasible projects of social relevance.
6: Present and document the project work.
7: Acquire knowledge by introspection.