Haldia Institute of Technology
West Bengal
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology)

Curriculum Structure for M. Tech. courses in
Power Systems
(Applicable from the academic session 2022-2023)
Haldia Institute of Technology, West Bengal  
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology)

Department of Electrical Engineering

VISION

To be a front runner in Electrical Engineering education, research and profession and will facilitate the growth of Electrical Engineering graduates with dynamic capabilities of accepting new challenges

MISSION

M1: The primary mission of the Department of Electrical Engineering is to produce quality human resource with capacity to serve the fraternity in a wide variety of roles including science, engineering, teaching, research, entrepreneurship and management.

M2: Putting emphasis on areas such as communication skills, professional and ethical responsibility, lifelong learning and contemporary issues to complement the technical aspects of the engineering course.

M3: To ensure combination of engineering and complementary course works in the curriculum so that Electrical Engineering graduates are well-rounded, able to work effectively in team settings and able to adapt to different work environments.
Haldia Institute of Technology, West Bengal  
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology)

Department of Electrical Engineering

PROGRAMME EDUCATIONAL OBJECTIVES:

PEO 1: To provide technical knowledge, skill and competence to identify, comprehend and solve problem in industry, research and academics related to Electrical Engineering and related disciplines.

PEO 2: To prepare the students to successfully work in various public and private sectors Organizations, at regional, state, national and international levels, with professional competence and ethical administrative acumen.

PEO 3: To frame the students to improve their technical and intellectual capabilities through lifelong learning process, which may include professional career and/or postgraduate education, for successful adaptation to technological and cultural changes and to foster adept functioning in society.

PEO 4: They will be able to work as an individual, as a team leader or as a member of a team in multicultural global environment.

PEO 5: Fulfill the needs of society in solving technical problems using engineering principles, tools and practices, in an ethical and responsible manner.

PROGRAM SPECIFIC OUTCOMES:

PSO1: Be able to analyze and understand mathematical, scientific and engineering fundamentals to identify complex engineering problems and design system components or processes considering health, safety, cultural, societal and environmental aspects.

PSO2: Conduct research based investigation including design of experiments interpretation of data Synthesis of information usages of modern engineering tool to solve complex engineering activities with an understanding of the limitations related to societal health safety and legal issues.

PSO3: Apply ethical principles related to societal and environmental context in a multidisciplinary Setting as an individual or in a team.

PSO4: Able to comprehend effective reports and design documentation considering management and financial principles that will benefit the society at large for life long period in the broadest context of technological changes.
Program Outcomes (PO):

PO 1: Engineering Knowledge: Ability to apply mathematical, scientific, and engineering principles to the identification, formulation, and solution of practical electrical engineering problems

PO 2: Problem Analysis: Ability to do experiments & to sense, process, analyze and interpret data using modern engineering tools and techniques leading to decision making in real time for electrical engineering systems and processes

PO 3: Design/development of solutions: Ability to design engineering processes and products to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability

PO 4: Conduct investigation of Complex Problem: Ability to conduct complex electrical designs and interpret different experimental data using research-based knowledge and research methods

PO 5: Modern Tool Usage: Ability to apply modern tools like MATLAB, PSCAD, LABVIEW and also different other IT tools for modeling, prediction of complex electrical engineering activities with an understanding of limitation.

PO 6: The engineer and Society: Ability to analyze important social problems and identify ways to contribute to solutions, including professional, economic, and ethical considerations in generation, transmission, and distribution of electrical energy

PO 7: Environment and sustainability: Ability to analyze important environmental issues and identify ways for sustainable development, in generation, transmission, and distribution of electrical energy

PO 8: Ethics: To understand and commit to professional ethics and responsibilities and norms of engineering practice.

PO 9: Individual and Team Work: Ability to function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

PO 10: Communication: Ability to communicate effectively in both writing and speaking and to prepare formal technical plans leading to solutions and detailed reports for electrical systems

PO 11: Project management and finance: Ability to understand management and business practices in engineering works and multidisciplinary areas.

PO 12: Life-long learning: Ability to recognize the need for identifying contemporary issues due to changing technical scenario and engage in lifelong learning
Course Outcomes of Power Systems:

CO1: Ability to apply the enhanced knowledge in advanced technologies for modeling analyzing and solving contemporary issues in power sector with a global perspective.

CO2: Ability to critically analyze and carry out detailed investigation on multifaceted complex Problems in area of Power Systems and envisage advanced research in thrust areas.

CO3: Ability to identify, analyze and solve real-life engineering problems in the area of Power Systems and provide strategic solutions satisfying the safety, cultural, societal and environmental aspects/ needs.

CO4: Ability for continued pursuance of research and to design, develop and propose theoretical and practical methodologies towards research and development support for the Power System infrastructure.

CO5: Ability to develop and utilize modern tools for modeling, analyzing and solving various Engineering problems related to Power Systems.

CO6: Willingness and ability to work in a team of engineers/ researchers with mutual understandings to take unsophisticated challenges, in the field of Power Systems, lead and motivate the group to inculcate multidisciplinary and collaborative approach.

CO7: Willingness and ability to take up administrative challenges including the management of various projects of interdisciplinary nature and carry out the same in an efficient manner giving due consideration to societal, environmental, economical and financial factors.

CO8: Ability to express ideas clearly and communicate orally as well as in writing with others in an effective manner, adhering to various national and international standards and practices for the documentation and presentation of the contents.
# Curriculum Structure for M. Tech. courses in Power Systems

(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology)

(Applicable from the academic session 2022-2023)

## SEMESTER - I

### Theory:

<table>
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<th>Subject Code</th>
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<td>1</td>
<td>MTPS PC 101</td>
<td>Computer Aided Power System Analysis</td>
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<td>2</td>
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<td>Power System Dynamics and Control</td>
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### Professional Elective - I

- **MTPS PE 101A** Advanced Control System
- **MTPS PE 101B** EHVAE and HVDC Transmission
- **MTPS PE 101C** Renewable Energy Sources and Energy Converter
- **MTPS PE 101D** Advanced Microprocessors & its applications

### Audit-I:

1. Constitution of India
2. Pedagogy Studies
3. Stress Management by Yoga
4. Personality Development through Life Enlightenment Skills
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**SEMESTER – II**

**Theory:**

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<td>MTPS PE 201B</td>
<td>Power System Reliability</td>
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<td>MTPS PE 201C</td>
<td>Power System Planning</td>
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<td>MTPS PE 201D</td>
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<td>MTPS PE 202B</td>
<td>AI Application in Power System</td>
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<td>Power Quality</td>
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<td>MTPS PE 202D</td>
<td>Energy Management Systems</td>
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**Audit-II:**

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
Haldia Institute of Technology, West Bengal  
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**SEMESTER - III**

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<td>Restructured Power Systems</td>
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<td>Smart Grid</td>
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**Open Elective - I**

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<td>MTPS OE 301B</td>
<td>Composite Materials</td>
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**SEMESTER – IV**

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**Course Code:** MTPS PC 101  
**Category:** Professional Core Courses  
**Course Title:** Computer Aided Power System Analysis  
**Semester:** First  
**L-T-P : 3-0-0**  
**Credit:** 3  

**Pre-Requisites:** Basic of power system, Computer Knowledge, Numerical analysis  

**Course Outcomes:**  
CO1: To solve large scale simultaneous linear equations.  
CO2: To solve large scale power flow problems  
CO3: To solve optimal power flow problem using various solution methods  
CO4: To do fault calculations for various fault conditions on three phase basis  

**Module 1: POWER SYSTEM COMPONENTS AND MODELING**  

**Module 2: ADMITTANCE, IMPEDANCE MODEL AND NETWORK CALCULATIONS**  
Admittance Model: Branch and Node Admittance, mutually coupled branches in Y-Bus, An Equivalent admittance network, The network impedance matrix and Y-Bus Node Elimination  
Impedance Model: Bus admittance and impedance matrix, Thevenin' Theorem and Z-Bus, Direct determination of Z-Bus, Calculation of Z-Bus from Y-Bus, Mutually Coupled branches in Z-Bus, Node Elimination  

**Module 3: LOAD FLOW STUDIES**  

**Module 4: SYMMETRICAL FAULTS USING Z-BUS**  
Transients in RL Circuits, Internal voltages of loaded machines under fault condition, Fault calculation using Z-Bus, Fault calculation using Z-bus Equivalent circuit, Selection of circuit breakers  

**Suggested Reading:**  
3. L.P. Singh, Advanced Power System Analysis and Dynamics, Wiley Eastern,  

**Related e-Journals and books for advanced work.**

(i) IEEE Transactions on Power System
(ii) IET Research Journal on Generation, Trans and Distribution
(iii) NPTEL Course on Electrical Engg
### Course Code: MTPS PC 102

### Category: Professional Core Courses

**Course Title**: Power System Dynamics and Control

**Semester**: First

**L-T-P**: 3-0-0

**Credit**: 3

**Pre-Requisites**: Knowledge of structure and control, FACTS control

**Course Outcomes:**

**CO1**: To impart knowledge about the structure and control aspect of the power system operation

**CO2**: To understand steady state and transient stability, PMU, AGC control, excitation and reactive power control, system security

**CO3**: To implement the procedure of state estimation

**CO4**: Able to do operations at a Load dispatch center or planning such operations.

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### Module 1: Introduction to Power System Dynamics and Stability


### Module 2: Introduction to Power System Control

Large scale power systems - their interconnection and operation, load dispatch center and control center, introduction to centralized and decentralized controls, Wide Area Measurement System (WAMS), Phasor Measurement Unit (PMU).

### Module 3: Dynamics of Synchronous Machines

Mathematical description of synchronous machine, Park’s transformation, equivalent circuit for direct and quadrature axis for synchronous generator, equation of motion and steady state analysis, elements of excitation system, types of excitation systems (IEEE), modeling of excitation system components, Phillips-Heffron model, PSS, block diagram development.

### Module 4: Small Signal Stability

Small signal model of single machine infinite bus system (SMIB), multimachine modeling, Eigenvalue and participation factor analysis, application of PMU in small signal stability analysis.

### Module 5: State Estimation

State estimation, linear and nonlinear models, detection and identification of measurement errors, application of PMU in dynamic state estimation.

### Module 6: Automatic Generation Control

Automatic voltage regulators for generation excitation control, static and dynamic performance of AVR loop, Automatic Load Frequency Control, primary ALFC, secondary ALFC, extension of ALFC control loop to multi area system, tie line power flow model.
**Suggested Reading:**


**Related e-Journals and books for advanced work:**

(i) IEEE Transactions on Power System
(ii) IEEE Transactions on Power Delivery
(iii) IET Research Journal on Generation, Transmission and Distribution
(iv) NPTEL Courses on Electrical Engg.
Haldia Institute of Technology, West Bengal  
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1st Semester Curriculum Structure for M. Tech. courses in Power Systems  
(Applicable from the academic session 2022-2023)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>MTPS PC 103</th>
<th>Category</th>
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<tbody>
<tr>
<td>Course Title</td>
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<td>Semester</td>
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<td>L-T-P</td>
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<tr>
<td>Pre-Requisites</td>
<td>Basic Engineering Mathematics</td>
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</table>

Course Outcomes:

- **CO1:** To emphasize the fundamentals of Complex Variables
- **CO2:** To analyze basic problems of Numerical Analysis
- **CO3:** To analyze the Optimization Technique
- **CO4:** To solve the problems Probability and Statistics

**Module 1: Numerical Analysis:** Introduction, Interpolation formulae, Roots of equations, solutions linear and non-linear equations, Solution Techniques for ODE and PDE

**Module 2: Transformation:** Vector spaces, Linear transformations, Matrix representation of linear transformation. Eigen values and Eigen vectors of linear operator

**Set Theory:** Concepts of set theory, Union, Intersection, Complement, Venn diagram, Logical Interpretation of Set Operations, Properties of union of sets, Commutative Law, Associative Law, Identity Law

**Module 3: Optimization Technique:** Calculus of several variables, Implicit function theorem, Nature of singular points, necessary and sufficient conditions for optimization, Elements of calculus of variation, constrained Optimization, Lagrange multipliers, gradient method, dynamic programming.

**Module 4: Probability and Statistics:** Basic elements of probability: Sample space, Events, mutually exclusive events, Bayes’ Theorem, Probability of independent and dependent events, Conditional probability, Probability of complement, Probability of a union, Binomial distribution, Poisson distribution, Normal distribution, Correlation, Correlation coefficient.
Suggested Reading:

11. Statistical Methods By N.G. Das McGraw Hill Education India
12. Higher Algebra S K mapa, Levant Books
Course Code: MTPS PR 105  
Category: Professional Core Courses  
Course Title: Research Methodology and IPR  
Semester: First  
L-T-P : 2-0-0  
Credit: 2  
Pre-Requisites: Research activity, Research ethics, computer knowledge etc  

Course Outcomes:  
CO1: Understand research problem formulation  
CO2: Analyze research related information  
CO3: Follow research ethics  
CO4: Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity  

Module 1: Introduction: Objective of Research; Definition and Motivation; Types of Research; Research Approaches, Steps in Research Process; Criteria of Good Research; Ethics in Research. Research Formulation and Literature Review: Problem Definition and Formulation; Literature Review; Characteristics of Good Research Question; Literature Review Process.  

Module 2: Primary and Secondary Data; Primary and Secondary Data Sources; Data Collection Methods; Data Processing; Classification of Data, analysis Plagiarism, Research ethics  

Module 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  


Suggested Reading:  
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”  


# Course Details

**Course Code:** MTPS PC 191  
**Category:** Professional Core Courses  
**Course Title:** Computer Aided Design of Power System Laboratory  
**Semester:** First  
**L-T-P:** 0-0-4  
**Credit:** 2

### Pre-Requisites
- Graph theory-Formulation, Network matrices, Load Flow, Knowledge of Numerical analysis

### Course Outcomes:

**CO1:** To emphasize the fundamentals of Power System analysis while employing a Computer for computational purposes.

**CO2:** To handle three basic problems of short circuit studies, flow studies and the transient stabilities

**CO3:** To develop his own program for such purposes

**CO4:** To feel more confident while using various software available in the field.

### List of Experiments:

1. Y-Bus Building Algorithm
2. Z-Bus Building Algorithm
3. Load Flow by Gauss-Seidel Method
4. Load Flow by Newton Raphson Method
5. Load Flow by Decoupled Newton Method
6. Load Flow by Fast decoupled Method
7. Load Flow analysis by MATLAB Simulink Model
<table>
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<tr>
<th>Course Code: MTPS PC 192</th>
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<tr>
<td>Course Title: Power System Dynamics Laboratory</td>
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<td>Pre-Requisites: Knowledge of structure and control, FACTS control</td>
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### Course Outcomes:

- **CO1**: To impart knowledge about the structure and control aspect of the power system operation
- **CO2**: To understand SCADA, optimal economic operations, AGC control, excitation and reactive power control, system security
- **CO3**: To implement the elements of FACTS control
- **CO4**: Able to do operations at a Load dispatch centre or planning such operations.

### List of Experiments:

1. Familiarization with Simulation software and understanding of Reactive Power and Power Factor Correction in AC Circuits
2. Develop a program for small signal stability and transient stability for SMIB
3. Develop a program for small signal stability and transient stability for multimachine system
4. Design and simulate a model for load frequency dynamics of single area and two area power system.
5. Develop a program for transient stability analysis of SMIB with statcom.
6. Develop a program for optimal PMU placement in IEEE bus system.
### Haldia Institute of Technology, West Bengal
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1st Semester Curriculum Structure for M. Tech. courses in Power Systems
(Applicable from the academic session 2022-2023)

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<td>Pre-Requisites: Basic of power system, basic of control system</td>
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#### Course Outcomes:

**CO1:** To design different types of controllers and compensators to achieve the required dynamic response from the system

**CO2:** To acquire knowledge of state space and state feedback in modern control systems, pole placement, design of state observers and output feedback controllers.

**CO3:** To handle different control system problems in nonlinear as well as discrete domain

**CO4:** To understand optimal control problems and the basic concepts of adaptive, robust and sliding mode control

#### Module 1: Design of Controller and Compensator

- Improvement of System Performance through Compensation; Design of lag; Lead and Lag load Compensators; PI, PD & PID control; PID Controller Design and tuning; Disturbance rejection; System Uncertainty and performance Robustness.

#### Module 2: Analysis in States Space


#### Module 3: Analysis of Nonlinear Systems

- Common physical non linearites, singular points, phase plane analysis, limit cycle, describing function method and stability analysis, jump resonance, linearization of nonlinear system. Lyapunov stability, methods for generating lyapunov function, statement of lure problem, circle criterion, popov criterion.

#### Module 3: Discrete Time Control System

- Discrete time signals and systems, z-transformation, modeling of sample hold circuit, pulse transfer function, solution of difference equation by z-transform method, stability analysis in z-plane.

#### Module 4: Optimal Control

- Introduction, Optimal control problems, Mathematical procedures for optimal control design: Calculus of variations, Pontryagin’s optimum policy, Bang-Bang Control, Hamilton-Jacobi Principle.

#### Module 5: Robust, Adaptive and Sliding Mode Control

- Basic concepts of adaptive control and robust control systems. Introduction and the concept of Sliding Mode Control, Sliding surface, Equivalent Control.
Suggested Reading:

1. K.Ogata, “Modern Control Engineering”, Prentice Hall of India, 1999

Related e-Journals & books: for advanced work:

(i) IEEE Transactions on Control SystemTechnology
(ii) IET Research Journal on ControlTheory& Applications
(iii) NPTEL Courses on Electrical Engineering
**Course Code:** MTPS PE 101B  
**Category:** Professional Elective Courses

**Course Title:** EHVAC and HVDC Transmission  
**Semester:** First

**L-T-P : 3-0-0**  
**Credit:** 3

**Pre-Requisites:** Basic of power system, Generation system, protection system

**Course Outcomes:**

- **CO1:** To provide an in-depth understanding of the different aspects of Extra High Voltage A.C. and D.C. Transmission system design
- **CO2:** To provide an in-depth understanding of the different aspects of Extra High Voltage A.C. and D.C. Transmission system analysis
- **CO3:** Able to design commercial transmission systems
- **CO4:** Able to design commercial HVDC transmission systems

**Module 1: Introduction**
Need of EHV transmission, comparison of EHV AC & HVDC transmission, mechanical considerations of transmission line.

**Module 2: EHV AC Transmission**
Parameters of EHV lines, Voltage gradient in bundle conductors lines, conductor sizing, overvoltages due to switching, Corona & its effects, power loss, long distance transmission with series and shunt compensations, flexible ac transmission, Theory of Travelling Waves and Standing Waves

**Module 3: Lightning and Lightning Protection**
Lightning Strokes to Lines, Lightning-Stroke Mechanism, General Principles of the Lightning-Protection Problem, Tower-Footing Resistance, Insulator Flashover and Withstand Voltage

**Module 4: HVDC Transmission**
Types of dc links, terminal equipments & their operations, comparison of different DC link & AC line, converter operation & its control, harmonics and filters, multi-terminal dc (MTDC) system, protection of terminal equipments. HVDC transmission based on voltage source-converters.

**Module 5: Faults and Protection Schemes in HVDC Systems**
Introduction, Nature and types of Faults, Faults on DC side of the system, Protection against over current and over voltage
Suggested Reading:


Related e-Journals & books: for advanced work:

(i) IEEE Transmissions on Power Delivery
(ii) IEEE Transmission on Power System
(iii) IET Research Journal on Generation Transmission and Distribution
(iv) NPTEL Course on Electrical Engg.
# Course Information

**Course Code:** MTPS PE 101C  
**Category:** Professional Elective Courses  
**Course Title:** Renewable Energy Sources and Energy Converters  
**Semester:** First  
**L-T-P :** 3-0-0  
**Credit:** 3  

**Pre-Requisites:** Basic of power system, Power electronics

**Course Outcomes:**

<table>
<thead>
<tr>
<th>CO1</th>
<th>To design for the development of self study and seminar delivery skills in Non-conventional Energy Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>To learn wind energy, Solar Energy and Fuel Cell Technologies</td>
</tr>
<tr>
<td>CO3</td>
<td>To understand the concepts of generation of renewable energy</td>
</tr>
<tr>
<td>CO4</td>
<td>To handle different control topologies of renewable energy</td>
</tr>
</tbody>
</table>

## Module 1: Introduction

Various non-conventional energy resources-importance, classification, relative merits and demerits.

## Module 2: Solar Energy

Solar photovoltaics: Introduction, solar radiation & its relation with photovoltaic effect. Solar cell material; silicon mono & poly crystalline, raw material other than silicon. Different types of solar cell construction and design, flat plate arrays:-optimal system sizing & protection. Photovoltaic concentration, photovoltaic systems-standalone, PV-hybrid, grid-interactive. Stationary and tracking panels, maximum power point tracking, energy storage, converter & inverter systems & their control. Application-water pumping & power plants, cost & economics, recent developments.

## Module 3: Solar thermal


## Module 4: Wind Energy

Wind power and its sources, site selection criterion, wind characteristics, momentum theory, Classification of wind machines. Wind mills-different design & their control, wind generators-different types, wind farms & grid. Wind generation in India. Issues of wind integrations-intermittent supply, economics, governmental regulations & subsidies. Wind penetration & its effects, economic issues, recent developments, international scenario.

## Module 5: Fuel Cell

Basic construction & principle of operation of fuel cell, Gibbs-Helmholtz equations, thermodynamic free energy and conditions of equilibrium, classification of fuel cell, different types of fuel cell:-direct type-low or medium temperature alkaline type, low temperature ion exchange membrane, direct high...
temperature fuel cells, Redox fuel cells, operation characteristic. Fuel cell power plants & its integration with wind and solar photovoltaic systems, smart grids.

Suggested Reading:

1. F.C. Treble, “Generating electricity from sun”, pergamon press, U K

Related e-Journals & books: for advanced work:

(i) IEEE Transactions on Power Delivery
(ii) IEEE Transactions on Power System
(iii) IEEE Transactions on Energy Conversion
(iv) IET Research Journal on Renewable Power Generation.
(v) NPTEL Courses on Electrical Engg.
Haldia Institute of Technology, West Bengal
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology)

1st Semester Curriculum Structure for M. Tech. courses in Power Systems
(Applicable from the academic session 2022-2023)

<table>
<thead>
<tr>
<th>Course Code: MTPS PE 101D</th>
<th>Category: Professional Elective Courses</th>
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<tbody>
<tr>
<td>Course Title: Advanced Microprocessors and Applications</td>
<td>Semester: First</td>
</tr>
<tr>
<td>L-T-P : 3-0-0</td>
<td>Credit: 3</td>
</tr>
<tr>
<td>Pre-Requisites: Basic of power system, microprocessor</td>
<td></td>
</tr>
</tbody>
</table>

Course Outcomes:

CO1: To impart advanced knowledge of microprocessor system.
CO2: To learn different type of interfacing system.
CO3: To understand the concepts of custom Power and improving stability using microprocessor.
CO4: Ability to design power and distribution system using various microprocessor programming.

Module 1: Introduction
Review of basic microprocessor, architecture and instruction set of typical 8 bit microprocessor.

Advanced Microprocessor: Overview of 16 bit and 32-bit microprocessors, arithmetic and I/O coprocessors, architecture, register details, operation addressing models and instruction set of a 16 bit 8086 microprocessor, assembly language programming, introduction to multiprocessing, multiuser, multitasking operating system concepts, Pentium I, II, III, IV processors, Motorola 68000 processor.

Module 2: Input-Output Interfacing
Parallel an series I/O, programmed I/O, Interrupt driven I/O, single and multi-interrupt levels, use of software polling and interrupt controlling for multiplying interrupt levels, programmable interrupt controller, DMA controller programmable timer/counter, programmable communication and principal interface, synchronous and asynchronous data transfers, standard serial interfaces like RS.232.

Memory Interfacing: Types of Memory: RAM and ROM, interfacing with timing consideration DRAM interfacing

Module 3: Programmable Support Chips
Functional schematic, operating modes, programming and interfacing of 8255, 8251, 8259 and 8253 with microprocessor.

Analog Input & Output: Microprocessor compatible ADC and DAC chips, interfacing of ADC and DAC with microprocessor, use of sample and hold circuit and multiplexer with ADC.

Module 4: Micro-controller and Micro-Computer
Concepts of micro controller and microcomputer micro controller (8051/8759) based design. Application of micro computer in online real time control.

Microprocessor Development System (MDS): Single user, time shared and networked MOS, hardware facilities and software support in MDS, development of hardware and application software and hardware software integration in MDS.
Module 5: Microprocessor Application
Design methodology, examples of microprocessor applications.

Suggested Reading:

3. Liu & Gibson, “Micro-Computer System the 8086/8088 family architecture,” Prentics Hall of India.

Related e-Journals & books: for advanced work:

(i) IEEE Transactions on Industrial applications
(ii) IEEE Transactions on Power Electronics
(iii) IEEE Transactions on Power Delivery
(iv) MATLAB Tools on Microprocessor
(v) NPTEL Courses on Electrical Engineering
<table>
<thead>
<tr>
<th>Course Code: MTPS MC 101</th>
<th>Category: Audit-I</th>
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</thead>
<tbody>
<tr>
<td>Course Title: Constitution of India</td>
<td>Semester: First</td>
</tr>
<tr>
<td>L-T-P : 2-0-0</td>
<td>Credit: 0</td>
</tr>
<tr>
<td>Pre-Requisites: Philosophy of Indian Constitution, Liberty and freedom, Role of constitution</td>
<td></td>
</tr>
</tbody>
</table>

**Course Outcomes:**

**CO1:** Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective

**CO2:** To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.

**CO3:** To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

**CO4:** To address Philosophy of the Indian Constitution

**Module 1: History of Making of the Indian Constitution:** History Drafting Committee, (Composition & Working)

**Module 2: Philosophy of the Indian Constitution:** Preamble Salient Features


**Module 4: Organs of Governance:** Parliament Composition, Qualifications and Disqualifications, Powers and Functions, Executive President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

**Module 5: Local Administration:** District’s Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation. **Pachayati raj:** Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. **Block level:** Organizational Hierarchy (Different departments), **Village level:** Role of Elected and Appointed officials, Importance of grass root democracy

**Module 6: Election Commission:** Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. **State Election Commission:** Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.
Suggested Reading:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
## Course Structure

<table>
<thead>
<tr>
<th>Course Code: MTPS MC 101</th>
<th>Category: Audit-I</th>
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</thead>
<tbody>
<tr>
<td><strong>Course Title:</strong> Pedagogical Studies</td>
<td><strong>Semester:</strong> First</td>
</tr>
<tr>
<td><strong>L-T-P:</strong> 2-0-0</td>
<td><strong>Credit:</strong> 0</td>
</tr>
<tr>
<td><strong>Pre-Requisites:</strong> Good Practices, guidance, behavior</td>
<td></td>
</tr>
</tbody>
</table>

**Course Outcomes:**

CO1: To understand pedagogical practices are being used by teachers in formal and informal classrooms in developing countries

CO2: To understand effectiveness of these pedagogical practices.

CO3: To learn curriculum and guidance materials best support effective pedagogy.

CO4: To improve Professional development

**Module 1: Introduction and Methodology:** Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology and Searching.

**Module 2: Thematic overview:** Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.

**Module 3: Methodology for the in depth stage:** quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change, Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches, Teachers’ attitudes and beliefs and Pedagogic strategies.

**Module 4: Professional development:** alignment with classroom practices and follow-up support Peer support, Support from the head teacher and the community. Curriculum and assessment

**Barriers to learning:** limited resources and large class sizes

**Module 5:** Research gaps and future directions Research design Contexts Pedagogy-Teacher education, Curriculum and assessment, Dissemination and research impact.

## Suggested Reading:


research project (MUSTER) country report 1. London: DFID.
### Course Details

<table>
<thead>
<tr>
<th>Course Code</th>
<th>MTPS MC 101</th>
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</thead>
<tbody>
<tr>
<td>Category</td>
<td>Audit-I</td>
</tr>
<tr>
<td><strong>Course Title</strong></td>
<td>Stress Management by Yoga</td>
</tr>
<tr>
<td><strong>Semester</strong></td>
<td>First</td>
</tr>
<tr>
<td><strong>L-T-P</strong></td>
<td>2-0-0</td>
</tr>
<tr>
<td><strong>Credit</strong></td>
<td>0</td>
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</table>

**Pre-Requisites:** NIL

**Course Outcomes:**

<table>
<thead>
<tr>
<th>CO1:</th>
<th>To achieve overall health of body</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2:</td>
<td>To overcome stress</td>
</tr>
<tr>
<td>CO3:</td>
<td>To improve health efficiency</td>
</tr>
<tr>
<td>CO4:</td>
<td>To improve overall health of mind</td>
</tr>
</tbody>
</table>

**Module 1:** Definitions of Eight parts of yog. (Ashtanga)

**Module 2:** Yam and Niyam. Do’s and Don’t’s in life.
- i) Ahinsa, satya, astheya, bramhacharya and aparigraha
- ii) Shaucha, santosh, tapa, swadhyay, ishwarpnanidhan

**Module 3:** Asan and Pranayam
- i) Various yog poses and their benefits for mind & body
- ii) Regularization of breathing techniques and its effects-Types of pranayam

**Suggested Reading:**

1. ‘Yogic Asanas for Group Tarining-Part-I’ : Janardan Swami Yogabhya Mandal, Nagpur
2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
<table>
<thead>
<tr>
<th>Course Code: MTPS MC 101</th>
<th>Category: Audit-I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: Personality Development through Life and Enlightenment Skills</td>
<td>Semester: First</td>
</tr>
<tr>
<td>L-T-P : 2-0-0</td>
<td>Credit: 0</td>
</tr>
<tr>
<td>Pre-Requisites: NIL</td>
<td></td>
</tr>
</tbody>
</table>

**Course Outcomes:**

- **CO1:** To learn to achieve the highest goal happily
- **CO2:** To become a person with stable mind, pleasing personality and determination
- **CO3:** To awaken wisdom in students
- **CO4:** To improve personal stability

**Module 1:** Neetisatakam-Holistic development of personality

Verses- 19,20,21,22 (wisdom)
Verses- 29,31,32 (pride & heroism)
Verses- 26,28,63,65 (virtue)
Verses- 52,53,59 (dont’s)
Verses- 71,73,75,78 (do’s)

**Module 2:** Approach to day to day work and duties.

Shrimad BhagwadGeeta :
Chapter 2-Verses 41, 47,48.
Chapter 3-Verses 13, 21, 27, 35,
Chapter 6-Verses 5,13,17, 23, 35,
Chapter 18-Verses 45, 46, 48.

**Module 3:** Statements of basic knowledge.

Shrimad BhagwadGeeta :
Chapter 2-Verses 56, 62, 68
Chapter 12-Verses 13, 14, 15, 16,17, 18
Personality of Role model.
Shrimad BhagwadGeeta :
Chapter2-Verses 17,
Chapter 3-Verses 36,37,42,
Chapter 4-Verses 18, 38,39
Chapter18 – Verses 37,38,63
Suggested Reading:

1. “Srimad Bhagavad Gita” by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari’s Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.
Haldia Institute of Technology, West Bengal
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2nd Semester Curriculum Structure for M. Tech. courses in Power Systems
(Applicable from the academic session 2022-2023)

<table>
<thead>
<tr>
<th>Course Code: MTPS PC 202</th>
<th>Category: Professional Core Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: Protection of Power System</td>
<td>Semester: Second</td>
</tr>
<tr>
<td>L-T-P : 3-0-0</td>
<td>Credit: 3</td>
</tr>
<tr>
<td>Pre-Requisites: Basic of power system, Generation system, protection system</td>
<td></td>
</tr>
</tbody>
</table>

Course Outcomes:

CO1: To impart advanced knowledge in static & microprocessor based protective
CO2: To improve the protection schemes of long transmission lines
CO3: To develop mathematical approach towards protection
CO4: To handle modern Power System relaying systems.

Module 1: Introduction-Essential qualities of protection, zones of protection, classification of relays, basic protective schemes. Static Protection Overcurrent relaying schemes, differential relaying schemes, distance relaying schemes,

Module 2: Comparators Transfer impedance, mixing circuits, amplitude and phase comparators and their duality, static realization of amplitude and phase comparators, multi-input comparators.

Module 3: Digital Protection: Basic elements of digital protection, Signal conditioning: transducers, surge protection, analog filtering, analog multiplexers, Conversion subsystem: the sampling theorem, signal aliasing error, sample and hold circuits, multiplexers, analog to digital conversion, Digital filtering concepts, The digital relay as a unit consisting of hardware and software

Module 4: Power swing, carrier protection of long lines, protection of multi terminal lines, new type of relaying criteria, quadrilateral relay, elliptical relay, restricted distance relays.

Algorithm: Mathematical background to protection algorithms, Finite difference techniques, Sinusoidal wave based algorithms, Sample and first derivative (Mann and Morrison) algorithm. Traveling Wave based Techniques.

Module 5: Digital Relays: Evolution of digital relays from electromechanical relays, Performance and operational characteristics of digital protection.

Suggested Reading:


Related e-Journals & books: for advanced work:

(i) IEEE Transactions on Power System
(ii) IEEE Transactions on Power Delivery
(iii) IET Research Journal on Generation, Trans and Distribution
(iv) NPTEL Course on Electrical Engg.
Haldia Institute of Technology, West Bengal  
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology)  

2nd Semester Curriculum Structure for M. Tech. courses in Power Systems  
(Applicable from the academic session 2022-2023)

<table>
<thead>
<tr>
<th>Course Code: MTPS PC 201</th>
<th>Category: Professional Core Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: Advanced Power System Stability</td>
<td>Semester: Second</td>
</tr>
<tr>
<td>L-T-P : 3-0-0</td>
<td>Credit: 3</td>
</tr>
<tr>
<td>Pre-Requisites: Basic of power system, Generation system, protection system</td>
<td></td>
</tr>
</tbody>
</table>

**Course Outcomes:**

CO1: To impart detailed knowledge about the stability of power systems - this happens to be the largest control structure in the world.

CO2: To improve methodologies of dynamic & transient stability studies of large systems.

CO3: To investigate Stability problems of the combined operation of EHV AC and HVDC system.

CO4: To design and handle a large power system studies.

**Module 1:** Modeling - Detailed synchronous machine modeling, modeling of turbine-generator and associated systems, modeling of induction motor and static loads, sub-synchronous resonance (SSR) and system modeling for SSR studies.

**Module 2:** Dynamic Stability - Review of stability of single machine connected to infinite bus system, multimachine system stability, role of prime mover, governor and excitation system, design concept of machine and power system stabilizers based on modern control techniques, self-excited oscillations and their remedies.

**Module 3:** Transient Stability - Single machine and multimachine transient stability considering voltage regulators, governors and supplementary controls, methods of improving transient stability, stability of long lines.

**Module 4:** Voltage Stability - P-V and Q-V curves, static analysis, sensitivity and continuation method.

**Module 5:** Stability of AC-DC system.

**Suggested Reading:**


Related e-Journals & books: for advanced work:

(i) IEEE Transactions on Power Systems
(ii) IET Research Journal on Generation, Trans & Distributed
(iii) MATLAB TOOL BOX on Control and Power System
(iv) Digsilent – Version 14 software
(v) NPTEL Courses on Electrical Engg.
### Course Outcomes:

**CO1:** To emphasize the fundamentals of Power System analysis while employing a Computer for computational purposes.

**CO2:** To handle three basic problems of short circuit studies, flow studies and the transient stabilities

**CO3:** To develop his own program for such purposes

**CO4:** To feel more confident while using various software available in the field.

### List of Experiments:

1. P-Q Control of Synchronous machine
2. Simulation of faults for multi machine system on DC network analyzer
3. Reactive power control of artificial transmission line
4. Sequence reactance and fault studies on synchronous machine, Reactive control by tap changing transformers
5. Testing of Static relays
6. 3 - zone distance Protection scheme
7. Digital Mapping of distribution Networks, Measurement of High AC voltages using sphere gap, Determination of breakdown strength of oil
8. Generation of different impulse waveforms.
**Haldia Institute of Technology, West Bengal**
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**2nd Semester Curriculum Structure for M. Tech. courses in Power Systems**
(Applicable from the academic session 2022-2023)

<table>
<thead>
<tr>
<th>Course Code: MTPS PE 201A</th>
<th>Category: Professional Elective Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course Title:</strong> Optimization Techniques in Power System</td>
<td>Semester: Second</td>
</tr>
<tr>
<td><strong>L-T-P : 3-0-0</strong></td>
<td>Credit: 3</td>
</tr>
<tr>
<td><strong>Pre-Requisites:</strong> Basic of power system, Generation system</td>
<td></td>
</tr>
</tbody>
</table>

**Course Outcomes:**

**CO1:** To formulate and solve LP Problem

**CO2:** To Solve Nonlinear Programming Problems.

**CO3:** To apply search methods to solve constrained and unconstrained optimization problems.

**CO4:** To solve optimization problems using evolutionary techniques like Genetic Algorithms and Particle Swarm Optimization.


**Suggested Reading:**

6. Xin-She Yang, “Recent Advances in Swarm Intelligence and Evolutionary Computation”, Springer International Publishing, Switzerland.

Related e-Journals & books: for advanced work:

(i) IEEE Transaction on Power System
(iii) NPTEL Course on Electrical Engg.
## Course Code: MTPS PE 201B  
**Category:** Professional Elective Courses  
**Course Title:** Power System Reliability  
**Semester:** Second  
**L-T-P:** 3-0-0  
**Credit:** 3  
**Pre-Requisites:** Basic of power system, Generation system, protection system

### Course Outcomes:

**CO1:** To evaluate the reliability of a large power system.  
**CO2:** To emphasize the basic principles and advanced methodologies of power system.  
**CO3:** To deal with techniques of large scale power system reliability  
**CO4:** To solve the problem is to be broken down into the reliability of Generation system, transmission system and composite reliability.

### Module 1: Basic Probability Theory
- Probability concepts, Basic Reliability Evaluation  
- General reliability functions, probability distributions in reliability evaluation, network modeling and evaluation of complex systems, cut-set method, tie-set method, discrete Markov chains, continuous Markov process, frequency and duration technique concepts, application to multistate problems, approximate system reliability evaluation.

### Module 2: Generation System Reliability
- Generation system models, capacity outage table, recursive algorithm, loss of load indices, inclusion of scheduled outage, load forecast uncertainty, loss of energy indices, expected energy generation, energy limited systems, Gram-Charlier series and its application to generation system reliability evaluation, generating capacity-frequency and duration method.

### Module 3: Interconnected System Probability
- Array method in two inter-connected system, effect of tie capacity, tie reliability and number of tie lines, equivalent assistance unit method for reliability evaluation of inter-connected system, elementary concepts for reliability evaluation of multi-connected systems.

### Module 4: Composite Generation and Transmission System Reliability
- Radial configurations, conditional probability approach, network configurations, conditional probability approach, network configuration, state selection, system and load point indices.

### Module 5: Distribution System Reliability
- Basic technique and application to radial systems, customer-oriented indices, load and energy indices, effect of lateral distributor protection, effect of disconnects effect of protection failures, effect of load transfer, meshed and parallel networks, approximate methods, failure modes and effects analysis, inclusion of scheduled maintenance, temporary and transient failures, inclusion of weather effects.
Suggested Reading:


Related e-Journals & books: for advanced work:

(i) IEEE Transaction on Reliability
(ii) IEEE Transaction on Power System
(iii) IEEE Transaction on Power Delivery
(v) NPTEL Course on Electrical Engg.
Haldia Institute of Technology, West Bengal  
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology)  
2nd Semester Curriculum Structure for M. Tech. courses in Power Systems  
(Applicable from the academic session 2022-2023)

<table>
<thead>
<tr>
<th>Course Code: MTPS PE 201C</th>
<th>Category: Professional Elective Courses</th>
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<tbody>
<tr>
<td>Course Title: Power System Planning</td>
<td>Semester: Second</td>
</tr>
<tr>
<td>L-T-P : 3-0-0</td>
<td>Credit: 3</td>
</tr>
</tbody>
</table>

Pre-Requisites: Basic of power system, Generation system, protection system

Course Outcomes:

CO1: To evaluate the Long and short term planning.
CO2: To emphasize the objectives of load forecasting.
CO3: To deal with techniques of expansion planning
CO4: To design the distribution system planning


Module 2: 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.

Module 3: Expansion planning 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.

Module 4: Distribution system planning overview Introduction, sub transmission lines and distribution substations-Design primary and secondary systems-distribution system protection and coordination of protective devices

Suggested Reading:

Related e-Journals & books: for advanced work:

(i) IEEE Transaction on Power System
(ii) IEEE Transaction on Power Delivery
(iii) IET Research Journal on Generation Trans. And Distribution.
(iv) NPTEL Course on Electrical Engg.
Haldia Institute of Technology, West Bengal
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology)

1st Semester Curriculum Structure for M. Tech. courses in Power Systems
(Applicable from the academic session 2022-2023)

<table>
<thead>
<tr>
<th>Course Code: MTPS PE 201D</th>
<th>Category: Professional Elective Courses</th>
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</thead>
<tbody>
<tr>
<td>Course Title: Flexible AC Transmission Systems</td>
<td>Semester: Second</td>
</tr>
<tr>
<td>L-T-P : 3-0-0</td>
<td>Credit: 3</td>
</tr>
<tr>
<td>Pre-Requisites: Basic of power system, Generation system, protection system</td>
<td></td>
</tr>
</tbody>
</table>

**Course Outcomes:**

**CO1:** To impart advanced knowledge about the FACTS – systems involving their applications in long Bulk power Transmission line

**CO2:** To impart advanced knowledge about the FACTS – systems involving their applications in long Bulk power Distribution line

**CO3:** To understand the concepts of custom Power and improving stability & voltage profile in power system

**CO4:** Ability to design power and distribution system using various FACT devices

**Module 1: Basic Issues Involved in Bulk Power Transmission**
Angle stability, voltage stability, power flow control and sub-synchronous resonance (SSR).

**Module 2: Basic Issues Involved in Power distribution Systems**
Harmonics, load unbalance, poor power factor and voltage interruptions.

**Module 3: Introduction of Basic FACTS devices**
SVC, STATCOM, TCSC, SSSC and UPFC. Introduction to concepts of Custom Power (CP) devices

**Module 4: Introduction to CP devices**
DSTATCOM, DVR, UPQC. Modeling of SVC, STATCOM, TCSC, SSSC and UPFC.

**Module 5: Case Study**
DSTATCOM in Current Control Mode: Reference current generation techniques. DSTATCOM in voltage control Mode: Reference voltage generation, DVR reference voltage generation.

**Suggested Reading:**

Related e-Journals & books: for advanced work:

(i) IEEE Transactions on Industrial applications
(ii) IEEE Transactions on Power Electronics
(iii) IEEE Transactions on Power Delivery
(iv) MATLAB Tools on Control and power system
(v) NPTEL Courses on Electrical Engineering
(vi) IET Research Journal on Power Electronics
### Course Code: MTPS PE 202A  |  Category: Professional Elective Courses
Course Title: Electric Power Distribution System  |  Semester: Second
L-T-P : 3-0-0  |  Credit: 3
Pre-Requisites: Basic of power system, Generation system, protection system

<table>
<thead>
<tr>
<th>Course Outcomes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1: To learn about power distribution system.</td>
</tr>
<tr>
<td>CO2: To emphasize the objectives of power distribution system.</td>
</tr>
<tr>
<td>CO3: To learn SCADA System.</td>
</tr>
<tr>
<td>CO4: To understand distribution automation system.</td>
</tr>
</tbody>
</table>

#### Module 1:

#### Module 2:

#### Module 3:

#### Module 4:
Calculation of Optimum Number of Switches, Capacitors, Optimum Switching Device Placement in Radial, Distribution Systems, Sectionalizing Switches – Types, Benefits, Bellman’s Optimality Principle, Remote Terminal Units, Energy efficiency in electrical distribution & Monitoring

#### Module 5:
Maintenance of Automated Distribution Systems, Difficulties in Implementing Distribution Automation in Actual Practice, Urban/Rural Distribution, Energy Management, AI techniques applied to Distribution Automation

### Suggested Reading:

Related e-Journals & books: for advanced work:

(i) IEEE Transaction on Power System
(ii) IEEE Transaction on Power Distribution
(iii) IET Research Journal on Generation Trans. And Distribution.
(iv) NPTEL Course on Electrical Engg.
Haldia Institute of Technology, West Bengal
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology)
2nd Semester Curriculum Structure for M. Tech. courses in Power Systems
(Applicable from the academic session 2022-2023)

<table>
<thead>
<tr>
<th>Course Code: MTPS PE 202B</th>
<th>Category: Professional Elective Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: AI Application in Power System</td>
<td>Semester: Second</td>
</tr>
<tr>
<td>L-T-P: 3-0-0</td>
<td>Credit: 3</td>
</tr>
<tr>
<td>Pre-Requisites: Basic of Neural Network and Artificial Intelligence</td>
<td></td>
</tr>
</tbody>
</table>

**Course Outcomes:**

CO1: To learn about Neural Network and Expert system.
CO2: To emphasize the objectives of NN in the power system.
CO3: To learn the application of Neural networks and Expert System in power system.
CO4: To understand advanced automation systems.

**Module 1: Introduction to AI:** Definition, Applications, Components of AI program production system. Problem Characteristics. Overview of searching techniques. Knowledge representation: Knowledge representation issues; and overview. Representing knowledge using rules; procedural versus declarative knowledge. Logic programming, forward versus backward reasoning, matching. Control knowledge


**Module 4: Artificial Neural Networks:** Biological Neuron, Neural Net, use of neural nets, applications, Perception, idea of single layer and multilayer neural nets, back propagation, Hopfield nets, supervised and unsupervised learning.


**Suggested Reading:**

1. Artificial Intelligence Techniques in Power Systems (Energy Engineering), by Kevin Warwick (Editor), Arthur Ekwue (Editor), Rag Aggarwal (Editor), 1997
2. Artificial Intelligence Techniques in Power Systems Edited by Kevin Warwick, Arthur Ekwue, Rag Aggarwal
3. AI Application Areas in Power Systems, IrajDabbaghchi, American Electric Power Richard D.Christie,
Gary W. Rosenwald, and Chen-Ching Liu, University of Washington

4. N.P Pandey,” Artificial Intelligence and intelligent system” by Oxford.


**Related e-Journals & books: for advanced work:**

(i) IEEE Transactions on Artificial Intelligence
(ii) Intelligent Systems Engineering - IET Digital Library
(iii) NPTEL online course on An Introduction to Artificial Intelligence
Haldia Institute of Technology, West Bengal
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology)
2nd Semester Curriculum Structure for M. Tech. courses in Power Systems
(Applicable from the academic session 2022-2023)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>MTPS PE 202C</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Power Quality</td>
<td>Professional Elective Courses</td>
</tr>
<tr>
<td>L-T-P</td>
<td>3-0-0</td>
<td>Semester</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Second</td>
</tr>
<tr>
<td>Credit</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Pre-Requisites</td>
<td>Basic of power system, power quality, harmonics</td>
<td></td>
</tr>
</tbody>
</table>

**Course Outcomes:**

- **CO1:** To learn about power quality issues in power system.
- **CO2:** To emphasize the objectives of power quality monitoring.
- **CO3:** To solve the power quality problems in power system
- **CO4:** To understand modern power electronics devices.

**Module 1: Power Quality Problems and Monitoring:** Introduction, surges, voltage sag and swell, over voltage, under voltage, outage voltage and phase angle imbalances, electrical noise, harmonic, frequency deviation monitoring.

**Module 2: Solution to power quality problems:** Design, measures to minimize the frequency and duration of outages in distribution systems, voltages regulators, harmonic filters, power conditioners, uninterruptible power supplies, emergency and standby power systems, application of power conditioners.

**Module 3: Minimization of disturbances at Customer site:** Power quality standards, standard test waveforms, power distribution system design, measure to minimize voltage disturbances.

**Module 4: Applications:** Applications of modern power Electronics devices to improve the power quality.

**Suggested Reading:**

2. C. Sankaran, Power Quality CRC Press, USA
Related e-Journals & books: for advanced work:

(i) IEEE Transaction on Power System
(iii) NPTEL Course on Electrical Engg.
### Course Code: MTPS PE 202D | Category: Professional Elective Courses
---|---
### Course Title: Energy Management System | Semester: Second
### L-T-P : 3-0-0 | Credit: 3

**Pre-Requisites:** Basic of power system, Generation system, brief idea of energy management

**Course Outcomes:**

- **CO1:** To emphasize the important problem of integrated energy management
- **CO2:** To improve efficiencies and economics of equipment used including retrofitting
- **CO3:** To understand the concepts of energy audit
- **CO4:** To think in terms of overall energy system efficiencies and economics

**Module 1: Energy Resources**
Perspective on energy resources, Utilization and demand projections, Energy resource definition & classification, Causes of Energy scarcity and social disparity, Energy as a parameter of Techno-Socio-Economic development, Factors solving the energy crunch, Energy system model – Description & qualitative analysis, Acceptability Index and its significance.

**Module 2: Concept of Energy Management**

**Module 3: General Principles of Energy Management**

**Module 4: Energy Efficiency Analysis**

**Module 5: Energy Economics**
Comparison of alternatives options; Simple economic calculations, Life cycle casting, Life cycle savings, payback period and return of investments. Break Even Analysis & its limitations, Benefit / Cost analysis, Time value of money , Calculation of present worth & present worth factor, Simple
calculation of Payback period, solar energy economics.

**Module 6: Analysis and audit phase** - Database and information collection, Energy audit definition, Need for energy audit Preliminary Audit. Detailed Audit, Basic component of energy audit: understanding energy costs

**Suggested Reading:**


**Related e-Journals & books: for advanced work:**

(i) IEEE Transactions on Power Delivery
(ii) IEEE Transactions on Power System
(iii) IEEE Transactions on Energy Conversion
(iv) IET Research Journal on Renewable Power Generation
(v) IET Research Journal on Generation, Trans and Distribution
(vi) NPTEL Course on Electrical Engg.
**Haldia Institute of Technology, West Bengal**  
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology)  

**2nd Semester Curriculum Structure for M. Tech. courses in Power Systems**  
(Applicable from the academic session 2022-2023)

<table>
<thead>
<tr>
<th>Course Code: MTPS MC 201</th>
<th>Category: Audit-II</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course Title:</strong> English for Research Paper Writing</td>
<td><strong>Semester:</strong> Second</td>
</tr>
<tr>
<td><strong>L-T-P : 2-0-0</strong></td>
<td><strong>Credit:</strong> 0</td>
</tr>
<tr>
<td><strong>Pre-Requisites:</strong> Basics of English Grammar</td>
<td></td>
</tr>
</tbody>
</table>

### Course Outcomes:

- **CO1:** To improve your writing skills of Research paper
- **CO2:** To learn about what to write in each section of Research paper
- **CO3:** To Understand the skills needed when writing a title and ensure the good quality of paper at very first-time submission
- **CO4:** To improve the level of readability

#### Module 1: Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness


#### Module 3: Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

#### Module 4: Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature

#### Module 5: Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

#### Module 6: Useful phrases, how to ensure paper is as good as it could possibly be the first-time submission

### Suggested Reading:

Haldia Institute of Technology, West Bengal  
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology)  
2\textsuperscript{nd} Semester Curriculum Structure for M. Tech. courses in Power Systems  
(Applicable from the academic session 2022-2023)

<table>
<thead>
<tr>
<th>Course Code: MTPS MC 201</th>
<th>Category: Audit-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: Disaster Management</td>
<td>Semester: Second</td>
</tr>
<tr>
<td>L-T-P : 2-0-0</td>
<td>Credit: 0</td>
</tr>
<tr>
<td>Pre-Requisites: NIL</td>
<td></td>
</tr>
</tbody>
</table>

**Course Outcomes:**

- **CO1:** Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response  
- **CO2:** Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives  
- **CO3:** Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations  
- **CO4:** Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they working

**Module 1: Introduction Disaster:** Definition, factors and significance; difference between hazard and disaster; natural and manmade disasters: difference, nature, types and magnitude.

**Module 2: Repercussions of Disasters and Hazards:** Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem, Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

**Module 3: Disaster Prone Areas in India**  
Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

**Module 4: Disaster Preparedness And Management Preparation**  
Monitoring of Phenomena Triggering A Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness

**Module 5: Risk Assessment Disaster Risk**  

**Module 6: Disaster Mitigation Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India**
Suggested Reading:


2. Sahni, Pardeep Et.Al. (Eds.),” Disaster Mitigation Experiences And Reflections”, Prentice Hall OfIndia, New Delhi.

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2nd Semester Curriculum Structure for M. Tech. courses in Power Systems
(Applicable from the academic session 2022-2023)

<table>
<thead>
<tr>
<th>Course Code: MTPS MC 201</th>
<th>Category: Audit-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: Sanskrit for Technical Knowledge</td>
<td>Semester: Second</td>
</tr>
<tr>
<td>L-T-P : 2-0-0</td>
<td>Credit: 0</td>
</tr>
<tr>
<td>Pre-Requisites: NIL</td>
<td></td>
</tr>
</tbody>
</table>

Course Outcomes:

CO1: To get a working knowledge in illustrious Sanskrit, the scientific language in the world
CO2: Learning of Sanskrit to improve brain functioning
CO3: Learning of Sanskrit to develop the logic in mathematics, science and other subjects enhancing the memory power
CO4: The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Module 1: Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

Module 2: Order Introduction of roots technical information about Sanskrit Literature

Module 3: Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested Reading:

1. “Abhyaspustakam” – Dr V. Vishwas, Sanskrit-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication

Related e-Journals & books: for advanced work:

(i) IEEE Transaction on Power System
(iii) NPTEL Course on Electrical Engg.
Haldia Institute of Technology, West Bengal  
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology)  
2nd Semester Curriculum Structure for M. Tech. courses in Power Systems  
(Applicable from the academic session 2022-2023)

<table>
<thead>
<tr>
<th>Course Code: MTPS MC 201</th>
<th>Category: Audit- II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: Value Education</td>
<td>Semester: Second</td>
</tr>
<tr>
<td>L-T-P : 2-0-0</td>
<td>Credit: 3</td>
</tr>
<tr>
<td>Pre-Requisites: NIL</td>
<td></td>
</tr>
</tbody>
</table>

Course Outcomes:

CO1: To Understand value of education and self-development  
CO2: To Imbibe good values in students  
CO3: To know about the importance of character  
CO4: To develop overall personality

Module 1: Values and self-development – Social values and individual attitudes. Work ethics, Indian vision of humanism, Moral and non-moral valuation, Standards and principles, Value judgements.


Suggested Reading:

<table>
<thead>
<tr>
<th>Course Code: MTPS PE 301A</th>
<th>Category: Professional Elective Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: Restructured Power Systems</td>
<td>Semester: Third</td>
</tr>
<tr>
<td>L-T-P : 3-0-0</td>
<td>Credit: 3</td>
</tr>
<tr>
<td>Pre-Requisites: Basic of power system, integrated system, distributed system</td>
<td></td>
</tr>
</tbody>
</table>

**Course Outcomes:**

CO1: To learn about the restructured power system.

CO2: To emphasize the objectives of integrated system in power system.

CO3: To learn the application of distributed generation in restructured markets.

CO4: To understand advanced applications in restructured markets.

**Module 1:** Fundamentals of restructured system, Market architecture Load elasticity, Social welfare maximization.

**Module 2:** OPF: Role in vertically integrated systems and in restructured markets congestion management.

**Module 3:** Optimal bidding, Risk assessment, Hedging Transmission pricing, Tracing of power.

**Module 4:** Ancillary services, Standard market design Distributed generation in restructured markets.

**Module 5:** Developments in India IT applications in restructured markets.

**Module 6:** Working of restructured power systems PJM, Recent trends in Restructuring.

**Suggested Reading:**

Related e-Journals & books: for advanced work:

(i) IEEE Transaction on Power System
(iii) NPTEL Course on Electrical Engg.
### Course Code: MTPS PE 301B  
**Category:** Professional Elective Courses

**Course Title:** Smart Grid  
**Semester:** Third  
**L-T-P:** 3-0-0  
**Credit:** 3

**Pre-Requisites:** Basic of power system, grid connection, distributed energy

### Course Outcomes:

- **CO1:** To learn about smart grid system.
- **CO2:** To emphasize the objectives of smart grid technologies.
- **CO3:** To learn the application of micro grids and distributed energy resources.
- **CO4:** To understand power quality management in smart grid.

### Module 1: Introduction to Smart Grid:

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

### Module 2: Smart Grid Technologies:

- Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers. Unit III Smart Grid Technologies:
  - Smart Substations, Substation Automation, Feeder Automation. Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).

### Module 3: Microgrids and Distributed Energy Resources:

- Concept of microgrid, need & applications of microgrid, formation of microgrid, Issues of interconnection, protection & control of microgrid. Plastic & Organic solar cells, thin film solar cells, Variable speed wind generators, fuelcells, microturbines, Captive power plants, Integration of renewable energy sources.

### Module 4: Power Quality Management in Smart Grid:


### Suggested Reading:

7. Stuart Borlase, “Smart Grids (Power Engineering)”, CRC Press Reference Books:

Related e-Journals & books: for advanced work:

(i) IEEE Transaction on Power System
(iii) NPTEL Course on Electrical Engg.
Course Code: MTPS PE 301C

Category: Professional Elective Courses

Course Title: Distributed Generation

Semester: Third

L-T-P: 3-0-0

Credit: 3

Pre-Requisites: Basic of power system, Generation system, grid interconnection

Course Outcomes:

CO1: To emphasize the basic principles of distribution system
CO2: To emphasize the hardware and the software requirements and the data communication.
CO3: To deal with balanced and unbalanced load flow in distribution system.
CO4: To design and better prepared to work in the area of smart grid.


Module 2: Hybrid Energy Systems: Principles and applications; Comparison of schemes; System design concepts; Techno-economic performance; Energy storage schemes and estimation. Interconnection: Distributed power generation schemes using renewable energy sources.

Module 3: Decentralized Generation Systems: Decentralized generation technologies; Costs and choice of technology, Demand and benefits forecasting and program development, Principles of cost-benefit calculations, Economic and financial analysis of stand-alone electrification projects, Decentralized versus central station generation, Traditional power systems, Load curves and load curve analysis.

Module 4: Grid Interconnection Options: The power grid; DG-grid interconnection issues; Case studies of DG-grid interconnections, Case studies of JNNSM grid connected solar power plants of roof top systems and Megawatt systems, Case studies of wind-grid connected power plants.

Suggested Reading:

Related e-Journals & books: for advanced work:

(i) IEEE Transactions on Power System
(ii) IEEE Transactions on Power Delivery
(iii) IET Research Journal on Generation, Trans and Distribution
(iv) NPTEL Course on Electrical Engg. IEEE Transactions on Power Systems
**Haldia Institute of Technology, West Bengal**  
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology)  
*3rd Semester Curriculum Structure for M. Tech. courses in Power Systems*  
(Applicable from the academic session 2022-2023)

<table>
<thead>
<tr>
<th>Course Code: MTPS OE 301A</th>
<th>Category: Open Elective Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course Title</strong>: Industrial Safety</td>
<td><strong>Semester</strong>: Third</td>
</tr>
<tr>
<td><strong>L-T-P : 3-0-0</strong></td>
<td><strong>Credit</strong>: 3</td>
</tr>
<tr>
<td><strong>Pre-Requisites</strong>: Basic of industrial safety, maintenance, Fault tracing</td>
<td></td>
</tr>
</tbody>
</table>

**Course Outcomes:**

- **CO1**: To learn about industrial safety.
- **CO2**: To emphasize the objectives of industrial safety.
- **CO3**: To learn the application of fundamentals of maintenance engineering.
- **CO4**: To understand fault tracing and preventive maintenance.

**Module 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 and methods.

**Module 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.


**Module 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.

Suggested Reading:

Course Code: MTPS OE 301B  |  Category: Open Elective Courses
---|---
Course Title: Composite Materials  |  Semester: Third
L-T-P : 3-0-0  |  Credit: 3
Pre-Requisites: Basic of material science, composites, strength of material

Course Outcomes:

CO1: To learn about classification and characteristics of composite materials.
CO2: To emphasize the objectives of reinforcements.
CO3: To learn the application of metal and polymer matrix composite materials.
CO4: To understand strength and characteristics of the material.

Module 1: Introduction:

Module 2: Reinforcements:

Module 3: Manufacturing of Metal Matrix Composites:

Module 4: Manufacturing of Polymer Matrix Composites:

Module 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.

Suggested Reading:


# 3rd Semester Curriculum Structure for M. Tech. courses in Power Systems

(Haldia Institute of Technology, West Bengal)

(Applicable from the academic session 2022-2023)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
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<tbody>
<tr>
<td>MTPS OE 301C</td>
<td>Open Elective Courses</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Course Title</th>
<th>Semester</th>
</tr>
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<tbody>
<tr>
<td>Waste to Energy</td>
<td>Third</td>
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<table>
<thead>
<tr>
<th>L-T-P:</th>
<th>Credit: 3</th>
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<tbody>
<tr>
<td>3-0-0</td>
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<table>
<thead>
<tr>
<th>Pre-Requisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic of energy system, biomass, biogas</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Course Outcomes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1: To learn about the produce of energy from waste.</td>
</tr>
<tr>
<td>CO2: To emphasize the objectives of biomass pyrolysis.</td>
</tr>
<tr>
<td>CO3: To learn the combustion of biomass and biogas.</td>
</tr>
<tr>
<td>CO4: To understand the application of biomass and biogas energy.</td>
</tr>
</tbody>
</table>

**Module 1: Introduction to Energy from Waste:** Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

**Module 2: Biomass Pyrolysis:** Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.


**Module 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.

**Module 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.

**Suggested Reading:**


*****
The following BOS members were present in the meeting and have approved the M.Tech in power system syllabus after incorporating the suggested modifications:

<table>
<thead>
<tr>
<th>Name</th>
<th>Designation</th>
<th>University/Institute</th>
<th>Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Dilip Dey</td>
<td>Professor</td>
<td>Haldia Institute of Technology</td>
<td>[Signature]</td>
<td>07-07-2022</td>
</tr>
<tr>
<td>Dr. Arabinda Das</td>
<td>Professor</td>
<td>Jadavpur University</td>
<td>[Signature]</td>
<td>07-07-2022</td>
</tr>
<tr>
<td>Dr. Gautam Sarkar</td>
<td>Professor</td>
<td>Jadavpur University</td>
<td>[Signature]</td>
<td>07-07-2022</td>
</tr>
<tr>
<td>Dr. Chiranjib Koley</td>
<td>Professor</td>
<td>NIT Durgapur</td>
<td>[Signature]</td>
<td>07-07-2022</td>
</tr>
<tr>
<td>Mr. Subhashish Sarkar</td>
<td>Assistant Professor</td>
<td>Jalpaiguri Government Engineering College</td>
<td>[Signature]</td>
<td>07-07-2022</td>
</tr>
<tr>
<td>Mr. Jaikyoti Dhar</td>
<td>General Manager (Electrical)</td>
<td>Haldia Petrochemicals Ltd.</td>
<td>[Signature]</td>
<td>07-07-2022</td>
</tr>
<tr>
<td>Dr. Palash Pal</td>
<td>Professor</td>
<td>Haldia Institute of Technology</td>
<td>[Signature]</td>
<td>07-07-2022</td>
</tr>
<tr>
<td>Dr. Santigopal Sir</td>
<td>Associate Professor</td>
<td>Haldia Institute of Technology</td>
<td>[Signature]</td>
<td>07-07-2022</td>
</tr>
<tr>
<td>Dr. Parthasarathi Das</td>
<td>Associate Professor</td>
<td>Haldia Institute of Technology</td>
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