Curriculum Structure for B. Tech. courses in Electrical Engineering

(Applicable from the academic session 2020-2021)
Haldia Institute of Technology, West Bengal
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology.)

Departmental 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.)

Departmental 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
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Curriculum Structure for B.Tech courses in Electrical Engineering  
(Applicable from the academic session 2020-2021)  
SEMESTER - I

**Theory**

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Total Theory  
Group-A: 12.0  
Group-B: 14.0

**Practical/ Sessional**

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Total Practical / Sessional  
Group-A: 5.5  
Group-B: 6.5

Total Semester  
Group-A: 17.5  
Group-B: 20.5

For Honours Course in B. Tech. (As per New guideline of AICTE/MAKAUT), total 20 credits are required over four years in the following way:  
For first year 8 credits  
For second year 4 credits  
For third year 4 credits  
For fourth year 4 credits

A student in 1st year has to covers from at least three (03) skills:  
1. Computer Programming  
2. Soft skill  
3. Ethics
Haldia Institute of Technology, West Bengal  
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology.)
Curriculum Structure for B.Tech courses in Electrical Engineering  
(Applicable from the academic session 2020-2021)

**SEMESTER – II**

### Theory

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### Practical/ Sessional

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For Honours Course in B. Tech. (As per New guideline of AICTE/MAKAUT), total 20 credits are required over four years in the following way:

For first year 8 credits
For second year 4 credits
For third year 4 credits
For fourth year 4 credits

**A student in 1st year has to covers from at least three (03) skills:**
1. Computer Programming
2. Soft skill
3. Ethics
### Theory

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### Practical/Sessional

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For Honours Course in B. Tech. (As per New guideline of AICTE/MAKAUT), total 20 credits are required over four years in the following way:
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For fourth year 4 credits
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Curriculum Structure for B.Tech courses in Electrical Engineering  
(Applicable from the academic session 2020-2021)  
SEMESTER – IV

Theory

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For Honours Course in B. Tech. (As per New guideline of AICTE/MAKAUT), total 20 credits are required over four years in the following way:
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Haldia Institute of Technology, West Bengal
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Curriculum Structure for B.Tech courses in Electrical Engineering
(Applicable from the academic session 2020-2021)

SEMESTER – V

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Practical/ Sessional

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Professional Elective - I

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Open Elective - I

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For Honours Course in B. Tech. (As per New guideline of AICTE/MAKAUT), total 20 credits are required over four years in the following way:
For first year 8 credits
For second year 4 credits
For third year 4 credits
For fourth year 4 credits
**Curriculum Structure for B.Tech courses in Electrical Engineering**

*(Applicable from the academic session 2020-2021)*

**SEMESTER – VI**

### Theory

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**Total Theory**

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### Practical/ Sessional

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**Total Practical / Sessional**

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**Total Semester**

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</table>

**For Honours Course in B. Tech. (As per New guideline of AICTE/MAKAUT), total 20 credits are required over four years in the following way:**

- For first year 8 credits
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- For fourth year 4 credits
## Curriculum Structure for B.Tech courses in Electrical Engineering
### (Applicable from the academic session 2020-2021)

#### SEMESTER – VII

<table>
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<tr>
<th>Sl. No.</th>
<th>Code</th>
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**For Honours Course in B. Tech. (As per New guideline of AICTE/MAKAUT), total 20 credits is required over four years in the following way:**
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Haldia Institute of Technology, West Bengal
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology.)
Curriculum Structure for B.Tech courses in Electrical Engineering
(Applicable from the academic session 2020-2021)

SEMESTER — VIII

**Theory**

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**Practical/ Sessional**

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**Professional Elective - V**

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<tr>
<td>PE-EE801A</td>
<td>HVDC Transmission</td>
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<tr>
<td>PE-EE801B</td>
<td>Energy management &amp; audit</td>
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<tr>
<td>PE-EE801C</td>
<td>Illumination Technology</td>
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<tr>
<td>PE-EE801D</td>
<td>Sensors and Transducers</td>
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For Honours Course in B. Tech. (As per New guideline of AICTE/MAKAUT), total 20 credits are required over four years in the following way:
For first year 8 credits
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For third year 4 credits
For fourth year 4 credits
## Haldia Institute of Technology, West Bengal
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology)

### 2nd Year Curriculum Structure for B.Tech courses in Engineering & Technology
(Applicable from the academic session 2020-2021)

<table>
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<tr>
<th>Course Code: PC-EE 301</th>
<th>Category: Professional Core Courses</th>
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<tr>
<td><strong>Course Title:</strong> Electrical Network Analysis</td>
<td><strong>Semester:</strong> Third</td>
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<tr>
<td>L-T-P : 3-1-0</td>
<td><strong>Credit:</strong> 3+1</td>
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**Pre-Requisites:** Basic Electrical Engineering, Engineering Mathematics

### Course Outcomes:

**CO 1:** Define different elementary signals and identify network theorems to describe network problems by recalling the concept of Laplace Transform, Fourier Series and Graph Theory.

**CO 2:** Comprehend different methods of characterizing a Network to describe the network problems.

**CO 3:** Apply Network theorems and use mathematical tools to analyze the networks, characterized in different manner.

**CO 4:** Analyze the responses of the elementary signals applied to various electrical networks both in time and frequency domain.

**CO 5:** Develop generalized network models of different electrical components.

**CO 6:** Evaluate the network using different methods to justify the developed model.

### Module 1: Introduction (3 hours)

### Module 2: Magnetically Coupled Circuits (4 hours)
Magnetic coupling, Polarity of coils, Polarity of induced voltage, Concept of Self and Mutual inductance, Coefficient of coupling, Modeling of coupled circuits, Solution of problems.

### Module 3: Laplace Transform (8 hours)

### Module 4: Fourier method of waveform analysis (6 hours)
Fourier series and Fourier Transform (in continuous domain only). Application in circuit analysis, Solution of Problems.

### Module 5: Network Theorem (8 hours)
Formulation of network equations, Source transformation, Loop variable analysis and Node variable analysis (including Super mesh and Super node concept). Network theorem: Superposition, Thevenin’s, Norton’s & Maximum power transfer theorem. Millman’s theorem, Tellegen’s theorem, Reciprocity Theorem, Compensation theorem and their applications. Solution of Problems with independent and dependent DC and AC sources.

### Module 6: Two Port Networks (4 hours)
Open circuit Impedance & Short circuit Admittance parameter, Transmission parameters, Hybrid parameters and their inter relations. Driving point impedance & Admittance.

Solution of Problems

**Module 7: Active Filter Circuits (4 hours)**
Analysis and synthesis of Low pass, High pass, Bandpass, Band reject, All pass filters (first and second order only) using operational amplifier. Solution of Problems

**Module 8: Graph theory and Networks equations (4 hours)**
Graph, Tree and link branches, Network matrices and their relations, Choice of linearly independent network variables, Topological equations for loop current and for nodal voltage, Duality.

**Text Books:**

3. Networks and Systems, D. Roy Chowdhury, New Age International Publishers

**Reference Books:**

2. Introductory Circuit Analysis, Robert L. Boylestad, Pearson
3. Network Analysis, M.E. Valkenburg, Pearson Education
5. Electric Circuits and Networks, K. S. Suresh Kumar, Pearson
## Course Code: PC-EE 302
### Category: Engineering Science Courses

### Course Title: Analog Electronics Circuit
### Semester: Third

### L-T-P: 3-0-0
### Credit: 3+1

### Pre-Requisites:
Basic Electronics, Semiconductor physics

### Course Outcomes:

**CO 1**: Illustrate working principle of different electronic circuit and their application in real life.

**CO 2**: Define semiconductor device and different operating condition and their performance parameter.

**CO 3**: Choose proper semiconductor devices depending upon application considering economic and Technology up-gradation.

**CO 4**: Employ mathematical and graphical analysis considering different practical issues modeling of Semiconductor device; analyze the performance parameter of the system.

**CO 5**: Employ mathematical and graphical analysis considering different practical issues modeling of Semiconductor device; analyze the performance parameter of the system.

**CO 6**: Use modeling/simulation parameters with standard equivalent circuit models to predict correctly the expected performance of various general-purpose electronic circuits.

### Module 1: Diodes and Application (4 hours)
The PN junction, Biasing the semiconductor diode, Terminal characteristics of junction diodes, simple applications of diodes: rectifier circuits, clipping and clamping circuits. Introduction to Zener diode.

### Module 2: BJT (6 hours)
Device structure and physical operation, terminal characteristics, Bipolar Transistor amplifier circuits, Bipolar Transistor as switch, low and high frequency response different bipolar transistors.

### Module 3: Multi-staging and Power amplifiers (8 hours)
Capacitively coupled amplifiers, Transformer coupled amplifiers, Direct coupled amplifiers, class A power Amplifiers, class B power Amplifiers, class C and D power Amplifiers.

### Module 4: Field Effect Transistors (8 hours)
Structure of Field Effect Transistors, JFET characteristics and biasing, MOSFET characteristics and biasing, small and high frequency equivalent circuits and parameters, linear amplifiers.

### Module 5: OPAMP (8 hours)

### Module 6: Application of Op-amp and Oscillators (8 hours)
Text Books:
1. Analog Electronics, L.K Maheshwari, MM.S Anand, PHI Publication
2. Analog and Digital Electronics, Sanjay Agrawal, Sonveer Singh, Wiley Publication

Reference Books:
## Course Code: PC-EE 303  
**Category:** Professional Core Courses  
**Course Title:** Electric Field Theory  
**Semester:** Third  
**L-T-P:** 3-0-0  
**Credit:** 3  

### Pre-Requisites:  
Basic Electrical Engineering, Mathematics and Physics

### Course Outcomes:

**CO 1:** To understand the basic laws of electromagnetism. Apply different techniques of vector calculus to understand different concepts of electromagnetic field theory.

**CO 2:** To obtain the electric and magnetic fields for simple configurations under static conditions. Explain fundamental laws governing electromagnetic fields and evaluate the physical quantities of electromagnetic fields (Field intensity, Flux density etc.) in different media using the fundamental laws.

**CO 3:** Determine the electromagnetic force exerted on charged particles, current elements, working principle of various electric and electromagnetic energy conversion devices are based on this force.

**CO 4:** To analyze time varying electric and magnetic fields. To understand Maxwell’s equation in different forms and different media.

**CO 5:** Deduce and justify the concepts of electromagnetic waves, means of transporting energy or information, in the form of radio waves, TV signals, radar beams and light rays.

**CO 6:** Generalize the concepts of guided structures like transmission line, means of transporting energy or information, commonly used in power distribution and communication. To understand the propagation of EM waves.

### Module 1: Review of Vector Calculus (6 hours)

Introduction: Co-ordinate systems and transformation, Cartesian coordinates, Circular cylindrical coordinates, Spherical coordinates & their transformation. Differential length, area and volume in different co-ordinate system.

Introduction to Vector calculus: Gradient, Divergence and curl operation and applications. Divergence theorem and Stoke’s Theorem. Laplacian operator on scalar and vector, Classification of vector fields, Statement of Helmholtz’s theorem, Uniqueness theorem.

### Module 2: Static Electric Field (6 Hours)

Coulomb’s law, Electric field intensity: Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications.

Energy and potential: Absolute Electric potential, Potential difference, Relationship between E and V, Polarization and Dipole moment, Electrostatic Energy and Energy density.

### Module 3: Conductors, Dielectrics and Capacitance (4 Hours)

Current and current density, Continuity equation, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson’s equation, Laplace’s equation, Solution of Laplace and Poisson’s equation, Application of Laplace’s and Poisson’s equations.
Module 4: Static Magnetic Fields (6 Hours)

Module 5: Magnetic Forces, Materials and Inductance (6 Hours)
Force on a moving charge and current carrying conductor due to magnetic field, Torque developed in current carrying coil in a magnetic field, magnetic moments, forces on magnetic material, Magnetization in material, Magnetic boundary condition, Inductor and Inductances, Magnetic energy

Module 6: Time Varying Fields and Maxwell’s Equations (6 Hours)
Faraday’s law for Electromagnetic induction, Displacement current, Point form of Maxwell’s equation, Integral form of Maxwell’s equations, Transformer and Motional Electromotive forces. Time varying Potential and Time Harmonic Field.

Module 7: Electromagnetic Waves (6 Hours)
Electromagnetic wave equation in loss-less dielectric medium and conducting medium, Plane and polarized waves and their propagation, Pointing vector, Reflection and Refraction in plane wave and normal and oblique incidence. Standing-Wave Ratio, Skin effect, Skin depth.

Text Books:

Reference Books:
1. Electromagnetic fields by Griffiths.
Haldia Institute of Technology, West Bengal
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology)
2nd Year Curriculum Structure for B.Tech courses in Engineering & Technology
(Applicable from the academic session 2020-2021)

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<thead>
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<th>Category: Basic Science Courses</th>
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<tr>
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<td>Semester: Third</td>
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<tr>
<td>Pre-Requisites: Basic Biology</td>
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Course Outcomes:

CO 1: Understand and explain the biological concepts from an engineering perspective.

CO 2: Understand and explain the concepts of hierarchy of life forms at phenomenological level, biological sensing and its challenges.

CO 3: Understand and explain the concept of genetics as well as how genetic material passes from parent to offspring.

CO 4: Understand, assess and explain the different biomolecules as building blocks of life, macromolecular analysis, information transfer and metabolism as well as the basic concept of microbial system.

CO 5: Explain, assess and integrate biological principles for developing next generation technologies

CO 6: Understand and explain the development of artificial systems mimicking human action.

Module 1: Introduction (2 hours)
Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry. Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayer. These examples will highlight the fundamental importance of observations in any scientific inquiry.

Module 2: Classification (3 Hours)
To convey that classification per se is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure prokaryotes or eucaryotes. (c) energy and Carbon utilization - Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricotelic, ureotelic (e) Habitat- aquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E. coli, S. cerevisiae, D. melanogaster, C. elegans, A. thaliana, M. musculus.
### Module 3: Biomolecules (3 Hours)
To convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine. Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

### Module 4: Macromolecular Analysis (5 Hours)
To analyze biological processes at the reductionistic level. Proteins - structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

### Module 5: Metabolism (4 Hours)
**Purpose:**
The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergonic reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO₂ + H₂O (Glycolysis and Krebs cycle) and synthesis of glucose from CO₂ and H₂O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge.

### Module 6: Microbiology (3 Hours)
**Purpose:**

### Module 7: Immunology (5 Hours)
**Purpose:**
How does the immune system work? What are the molecular and cellular components and pathways that protect an organism from infectious agents or cancer? This comprehensive course answers these questions as it explores the cells and molecules of the immune system. Immunology - Self vs Non-self, pathogens, human immune system, antigen-antibody reactions.

### Module 8: Information Transfer (4 Hours)
**Purpose:**
The molecular basis of coding and decoding genetic information is universal. Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure - from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

### Module 9: Cancer Biology (5 Hours)
**Purpose:**
A basic understanding of cancer biology and treatment. The course is not designed for patients seeking treatment guidance – but it can help to understand how cancer develops and provides a framework for understanding cancer diagnosis and treatment. Identification of the major types of cancer worldwide. Description of how genes contribute to the risk and growth of cancer. List and description of the ten cellular hallmarks of cancer. Definition of metastasis, and identification of the major steps in the metastatic process. Description of the role of imaging in the screening, diagnosis, staging, and treatments of cancer. Explanation of how cancer is treated.

### Module 10: Techniques in Biophysics (3 Hours)
**Purpose:**
Biophysics is an interdisciplinary science that applies approaches and methods traditionally used in physics to study biological phenomena. The techniques including microscopy, spectroscopy, electrophysiology, single-molecule methods and molecular modeling.

### Module 11: Stem Cell (2 Hours)
**Purpose:**
Stem cells and derived products offer great promise for new medical treatments. Learn about stem cell types, current and possible uses, ethical issues.
Text/References:


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<th>Course Code: BS-M 301</th>
<th>Category: Basic Science Courses</th>
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<td>Semester: Third</td>
</tr>
<tr>
<td>L-T-P : 3-0-0</td>
<td>Credit: 3</td>
</tr>
<tr>
<td>Prerequisites: Basics of Mathematics</td>
<td></td>
</tr>
</tbody>
</table>

**Course Outcomes:**

**CO 1:** Recall the earlier mathematical thoughts, such as idea of sets, permutation, combination, number system, graphs, sequence, series and integral calculus.

**CO 2:** Exhibit the idea of preliminaries on probability, recognize the concept of Fourier series, statistics, numerical methods and integral transform.

**CO 3:** Apply the knowledge of probability, data statistics, numerical methods and Fourier transform to solve real life engineering problems.

**CO 4:** Justify and make gradation of above mentioned mathematical tools and determine the right approach to solve multidisciplinary engineering problems.

**CO 5:** To explore and enhance research potential explain how the ideas those are adopted can be implemented through projects and demonstrate various models, recent project proposals executing the knowledge adopted from the course.

**CO 6:** Explain about ethical awareness and impact in the field of environmental, social and safety of the finished products. Describe the pollution, legal aspects and impacts may arise in large scale production.

**Module-1: Fundamentals of Probability [8 Hours]**


**Module-2: Data statistics [6 Hours]**

Basic Statistics, Measures of Central tendency, Measures of dispersions, Moments, skewness and Kurtosis - Correlation and regression – Rank correlation. Curve fitting by the method of least squares-fitting of straight lines, second degree parabolas and more general curves.

**Module-3: Fourier Series [4 Hours]**

Module-4: Fourier Transform [6 Hours]

Module-5: Numerical Methods-I [7 Hours]
Error & Interpolation: Approximation in numerical computation and Interpolation: Truncation and rounding errors, Fixed and floating-point arithmetic. Calculus of finite differences, Newton forward/backward interpolation, Lagrange’s and Newton’s divided difference Interpolation.

Module-6: Numerical Methods-II [9 Hours]
Numerical integration: Trapezoidal rule, Simpson’s 1/3 rule, Expression for corresponding error terms.
Gauss elimination method, Matrix inversion, LU Factorization method, Gauss-Seidel iterative method.

References:

10. S. Ponnusamy, Foundations Of Complex Analysis, Narosa.
**Haldia Institute of Technology, West Bengal**  
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology)  
*2nd Year Curriculum Structure for B.Tech courses in Engineering & Technology*  
*(Applicable from the academic session 2020-2021)*

<table>
<thead>
<tr>
<th>Course Code: ES-ME 301</th>
<th>Category: Engineering Science Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: ENGINEERING MECHANICS</td>
<td>Semester: Third</td>
</tr>
<tr>
<td>L-T-P : 3-0-0</td>
<td>Credit: 3</td>
</tr>
<tr>
<td>Pre-Requisites: Mathematics, Physics</td>
<td></td>
</tr>
</tbody>
</table>

**Course Outcomes:**

CO 1: To understand the basic mathematical tools to deal with the physical bodies.

CO 2: To learn different mathematical techniques to analyze physical bodies.

CO 3: To learn analysis techniques of rigid bodies.

CO 4: To solve problem of general motion.

**Module 1: Introduction to vectors and tensors and co-ordinate (5 hours)**  
Introduction to vectors and tensors and coordinate systems; Vector and tensor algebra; Indicial notation; Symmetric and anti-symmetric tensors; Eigen values and Principal axes.

**Module 2: Three-dimensional Rotation (4 Hours)**  
Three-dimensional rotation: Euler’s theorem, Axis-angle formulation and Euler angles; Coordinate transformation of vectors and tensors.

**Module 3: Conductors, Dielectrics and Capacitance (6 Hours)**  
Kinematics of Rigid Body: Kinematics of rigid bodies; Dentition and motion of a rigid body; Rigid bodies as coordinate systems; Angular velocity of a rigid body, and its rate of change; Distinction between two and three dimensional rotational motion; Integration of angular velocity to find orientation; Motion relative to a rotating rigid body: Five term acceleration formula.

**Module 4: Kinetics of Rigid Bodies (5 Hours)**  
Kinetics of rigid bodies: Angular momentum about a point; Inertia tensor; Dentition and computation, Principal moments and axes of inertia, Parallel and perpendicular axes theorems; Mass moment of inertia of symmetrical bodies, cylinder, sphere, cone etc., Area moment of inertia and Polar moment of inertia, Forces and moments; Newton-Euler’s laws of rigid body motion.

**Module 5: Free Body Diagrams (1 Hours)**  
Examples on modelling of typical supports and joints and discussion on the kinematic and kinetic constraints that they impose.

**Module 6: General Motion (9 Hours)**  

**Module 7: Bending Moment (5 Hours)**  
Transverse loading on beams, shear force and bending moment in beams, analysis of cantilevers, simply supported beams and overhanging beams, relationships between loading, shear force and...
bending moment, shear force and bending moment diagrams.

<table>
<thead>
<tr>
<th>Module 8: Torsional Motion (2 Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Torsion of circular shafts, derivation of torsion equation, stress and deformation in circular and hollow shafts.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 8: Friction (3 Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept of Friction; Laws of Coulomb friction; Angle of Repose; Coefficient of friction.</td>
</tr>
</tbody>
</table>

Text books:

Course Code: MC-EE 301  
Category: Mandatory Courses  
Course Title: Indian Constitution  
Semester: Third  
L-T-P : 3-0-0  
Credit: 0  
Pre-Requisites: Nil  

**Course Outcomes:**  
CO 1: Describe different features of Indian constitution.  
CO 2: Describe power and functioning of Union, state and local self-government.  
CO 3: Describe basics of PIL and guideline for admission of PIL.  
CO 4: Describe structure, jurisdiction and function of Indian Judiciary.  
CO 5: Describe Functioning of local administration starting from block to Municipal Corporation  
CO 6: Identify authority to redress a problem in the profession and in the society.  

**Module 1: Indian Constitution (5 hours)**  
Source and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy  

**Module 2: Union government and its administration, State government and its administration (10 Hours)**  
Structure of the Indian Union: Federalism, Centre-State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha. Governor role and position, CM and Council of Ministers, State Secretariat: Organisation, Structure and Functions  

**Module 3: Court (10 Hours)**  
Supreme court: Organization of supreme court, procedure of the court, independence of the court, jurisdiction and power of supreme court.  
High court: Organization of high court, procedure of the court, independence of the court, jurisdiction and power of high court.  
Subordinate courts: constitutional provision, structure and jurisdiction. National legal services authority, Lok adalats, family courts, gramnyayalays. Public interest litigation (PIL): meaning of PIL, features of PIL, scope of PIL, principle of PIL, guidelines for admitting PIL.  

**Module 4: Local Administration (10 Hours)**  
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.

Text books:

Reference books
**Course Code**: PC-EE 391  
**Category**: Professional Core Courses

**Course Title**: Electrical Network Analysis Laboratory  
**Semester**: Third  
**L-T-P**: 0-0-2  
**Credit**: 1

**Pre-Requisites**: Basic Electrical Engineering (Theory and Laboratory)

**Course Outcomes**:

**CO 1**: Recall theoretical concepts of laplace Transform and fourier series to define the signals and responses in different software environment

**CO 2**: Discuss the principle of Network theorems and explain transient and frequency response of different electrical circuits.

**CO 3**: Prepare and demonstrate different electrical circuits and components used to perform the simulation in hardware and software.

**CO 4**: Perform hardware and software simulations and analyze the results.

**CO 5**: Summarize the experiments

**CO 6**: Justify the experimental results by theoretical knowledge.

**Choose 10 experiments from the following**:

1. Introduction to MATLAB: Basic matrix operation, file operations, plotting, MATLAB program Development in command window.

2. Generation of Periodic, Exponential, Sinusoidal, Damped Sinusoidal, Step, Impulse, Ramp signal using MATLAB in both discrete and analog form.

3. Determination of Laplace transform and Inverse Laplace transform using MATLAB.

4. Transient response of R-L and R-C network: simulation with software & hardware

5. Transient response of R-L-C series and parallel circuit: simulation with software & hardware

6. Amplitude and Phase spectrum analysis of different signals: Simulation with software

7. Verification of Network theorems using software & hardware

8. Determination of Impedance (Z) and Admittance (Y) parameter of two-port network: Simulation & hardware.


Haldia Institute of Technology, West Bengal  
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2nd Year Curriculum Structure for B.Tech courses in Engineering & Technology  
(Applicable from the academic session 2020-2021)

<table>
<thead>
<tr>
<th>Course Code: PC-EE 392</th>
<th>Category: Engineering Science Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course Title:</strong> Analog Electronics Circuit Lab</td>
<td><strong>Semester:</strong> Third</td>
</tr>
<tr>
<td><strong>L-T-P:</strong> 0-0-2</td>
<td><strong>Credit:</strong> 1</td>
</tr>
<tr>
<td><strong>Pre-Requisites:</strong> Basic Electronics, Semiconductor physics</td>
<td></td>
</tr>
</tbody>
</table>

**Course Outcomes:**

**CO 1:** Develop basic knowledge in semiconductor devices like diode, MOS-FETs, BJT and Operational Amplifier.

**CO 2:** Develop the ability to design analog electronic circuits using discrete components.

**CO 3:** Design, construct, and take measurement of various analog circuits to compare experimental results in the laboratory with theoretical analysis.

**CO 4:** Apply the knowledge of subject to develop analog circuits based on linear and non-linear applications of Op-amp.

**CO 5:** Understand the ideas of various analog signals and obtain them via different practical analog circuits.

**Choose 10 experiments from the following:**

1. Measure and plot the forward and reverse IV characteristics of a silicon diode and measure the dc and ac(dynamic)resistance of the diode.
2. Study and demonstrate the characteristics of a Zener diode and its use as a simple voltage regulator.
3. Determine the input and output and output characteristics of a bipolar junction transistor (BJT) in a common emitter configuration and measure its h-parameter at a given dcpoint.
4. To demonstrate the dc operating point for transistor fix bias circuit and voltage bias circuit and compare their bias stabilities against changes in the transistor beta.
5. Determine and sketch the characteristics of JFET and find its parameters.
6. Study of ripple and regulation characteristics of full wave diode rectifier with and without filter.
7. Study of class A power amplifier.
8. Study of class C power amplifier.
9. Construction of two stages R-C coupled amplifier and study its gain and bandwidth.
10. Development of diode clipping and clamping circuits and analyze their outputs with different analog inputs.
11. Design opamp based differentiator and integrator and observe its response with different analog inputs.
12. Develop RC phase shift oscillator for 1 kHz and measure the frequency of oscillation and plot its output waveform.
13. Study of ripple and regulation characteristics of half wave diode rectifier with and without filter.
Course Code: PC-CS 391 | Category: Engineering Science Courses
---|---
Course Title: Numerical Methods Laboratory | Semester: Third
L-T-P: 0-0-2 | Credit: 1

### Course Outcomes:

**CO 1:** Recalling the basic programming tools such as, variable declarations, array in one and two dimensions, for-loop, nested for-loop, if-else and repeated summation & multiplication.

**CO 2:** Describe how to write down a program. Explain the logic behind the different numerical tools.

**CO 3:** Use different programming language to write the program for interpolation, integration, algebraic equations, system of linear equations and boundary value differential equations for large number of data and complicated functions.

**CO 4:** Analyze different real time problems and categorize them during the process of solving, by numerical method using programming language.

**CO 5:** Justify and make gradation of above mentioned numerical tools and determine the appropriate program to find the optimal solution for multidisciplinary engineering problems.

**CO 6:** Design a working model and build a path by which a new approach can be generated to create a new problem appreciated by academics, research & emerging direction in industry.

### Laboratory Experiments:

1. Assignments on Newton forward /backward, Lagrange’s interpolation.
2. Assignments on numerical integration using Trapezoidal rule, Simpson’s 1/3 rule, Weddle’s rule.
3. Assignments on numerical solution of a system of linear equations using Gauss elimination and Gauss-Seidel iterations
4. Assignments on numerical solution of Algebraic Equation by Regular-falsi and Newton-Raphson methods.
5. Assignments on ordinary differential equation: Euler’s and Runge-Kutta methods.
6. Introduction to Software Packages: Matlab / Scilab / Labview / Mathematica.
## Course Code: PC-EE 401
### Category: Electrical Engineering
### Course Title: Electric Machine-I
### Semester: 4th
### L-T-P: 3-1-0
### Credit: 3+1

**Pre-Requisites:** Higher Secondary Level Physics and Mathematics

### Course Outcomes:

**CO 1:** Use concepts in trigonometry, complex algebra, phasor operations and principles of electromagnetism to find correct solutions to electrical machine performance questions.

**CO 2:** Select proper materials and methods for design and construction of electrical machines within the realm of manufacturing, economic, performance, efficiency and environmental constraints.

**CO 3:** Use modeling/simulation parameters with standard equivalent circuit models to predict correctly the expected performance of various general-purpose electrical machines and transformers.

**CO 4:** Compare accepted standards and guidelines to select appropriate electrical machines to meet specified performance requirements and choose the scope of applicability of various types of AC and DC machines in real-life multi-disciplinary usages.

**CO 5:** Demonstrate an understanding of the fundamental control practices associated with AC and DC rotating machines (starting, reversing, braking, speed control etc.) and transformers.

**CO 6:** Set up testing strategies to evaluate performance characteristics of electrical machines.

### Module 1: Magnetic Field, Magnetic Circuits, Electromagnetic Force and Torque (5 hours)


### Module 2: DC Machine (8 hours)

Basic construction of DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation – Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation, Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

### Module 3: DC Machine motoring and generation (7 hours)

Field excitations – separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines.
Module 4: Transformers (10 hours)

Module 5: Three Phase Induction Motor (6 hours)

Text Books:
2. Electrical Machines, P. Purkait and I. Bandyopadhyay, Oxford.

Reference Books:
2. Electrical Machines, R.K. Srivastava, Cengage Learning
### Course Code: PC-EE 402
#### Category: Electrical Engineering

<table>
<thead>
<tr>
<th>Course Title: Digital Electronics</th>
<th>Semester: 4th</th>
</tr>
</thead>
</table>

| L-T-P:3-1-0 | Credit: 3+1 |

**Pre-Requisites:** Basic concepts of number system, Basic concept of electronic circuits, Basic knowledge of circuit theory

### Course Outcomes:

**CO 1:** Convert different type of codes and number systems which are used in digital communication and computer systems.

**CO 2:** Employ the codes and number systems converting circuits and Compare different types of logic families which are the basic unit of different types of logic gates in the domain of economy, performance and efficiency.

**CO 3:** Analyze different types of digital electronic circuit using various mapping and logical tools and know the techniques to prepare the most simplified circuit using various mapping and mathematical methods.

**CO 4:** Design different types of with and without memory element digital electronic circuits for particular operation, within the realm of economic, performance, efficiency, user friendly and environmental constraint.

**CO 5:** Apply the fundamental knowledge of analog and digital electronics to get different types analog to digitalized signal and vice-versa converters in real world with different changing circumstances. Understand the process of Analog to Digital conversion and Digital to Analog conversion.

**CO 6:** Assess the nomenclature and technology in the area of memory devices and apply the memory devices in different types of digital circuits for real world application.

### Module 1 (10 hours)

**DATA AND NUMBER SYSTEM**
Binary, Octal and Hexadecimal representation and their conversion, BCD, ASCII, EBDIC, Gray codes and their conversion, Signed binary numbers representation with 1’s and 2’s complement methods, Binary arithmetic(addition, subtraction, multiplication, division), sign-magnitude binary representation. Error detecting and correcting codes,

**BOOLEAN ALGEBRA**
Various logic gates and their truth tables and circuits, Representation in SOP and POS forms, Minimization of logic expressions by algebraic method, K-map method. Q-M method of function realization

### Module 2: COMBINATIONAL CIRCUITS (6 hours)
Adder and sub-tractor circuit, Circuit of Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer, Parity Checker & Generator, Parity Encoder. Static and dynamic hazards for combinational logic.
## Module 3: SEQUENTIAL CIRCUITS (9 hours)
- **Flip-Flop:** Basic memory elements, S-R, J-K, D, and T Flip-flop.
- **Register:** Various types of Registers & their design.
- **Counter:** Counters & their design, Irregular counter, State table & State transition diagram, Sequential circuit design methodology.

## Module 4: A/D and D/A Converters (5 hours)
- **Digital to analog converters:** weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs.

## Module 5: (6 hours)
### MEMORY SYSTEMS - RAM, ROM, EPROM, EEROM, LOGIC FAMILIES
- Characteristics of digital ICs, TTL, Schottky TTL, ECL, MOS & CMOS, interfacing CMOS and TTL, Tri-state logic, their operation and specification. Programmable Logic Arrays (PLA), Programmable Array Logic (PAL), Combinational PLD-Based State Machines (CPLDS), Field Programmable Gate Array (FPGA).

## Text Books:
1. Fundamental of Digital Circuits, A. Anand Kumar, PHI.
3. Digital Logic Design, Morries Mano, PHI.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>Course Title</th>
<th>Semester</th>
<th>L-T-P</th>
<th>Credit</th>
<th>Pre-Requisites</th>
<th>Course Outcomes</th>
</tr>
</thead>
</table>
| PC-EE 403   | Electrical Engineering | Electrical and Electronics Measurement | 4th      | 3-0-0 | 3      | Basic Electrical Engineering, Electric Circuit Theory, Electromagnetism | CO 1: Develop the knowledge of theoretical and mathematical principles of electrical measuring instruments.  
CO 2: Examine various real life situations in domestic or industrial scenario where measurements of electrical quantities are essential.  
CO 3: Choose the proper type and specification of measuring procedure and measuring instruments for different industrial/commercial/domestic applications.  
CO 4: Assess fault conditions in electrical installations and identify necessary remedial measures.  
CO 5: Design new sensing and measuring schemes for various electrical and electronic applications.  
CO 6: Recognize basic supporting tools for applications in other electrical engineering core fields. |

**Module 1: Introduction of Measurement (3 Hours)**  
Method of measurement, Measurement system, Classification of instruments, Definition of accuracy, Precision, Resolution, Speed of response, Error in measurement, Classification of errors, loading effect due to shunt and series connected instruments.

**Module 2: Analog Meter (5 Hours)**  
General features, Construction, Principle of operation and torque equation of Moving coil, Moving iron, Electrodynamicometer, Induction instruments, Principle of operation of the Electrostatic, Thermoelectric, Rectifier type instruments, Extension of instrument ranges and multipliers.

**Module 3: Instrument Transformer (4 Hours)**  
Disadvantage of shunt and multipliers, Advantage of Instrument transformers, Principle of operation of Current & Potential transformer, errors.

**Module 4: Measurement of Power, Energy and Power Factor (5 Hours)**  
Power: Construction, Theory and principle of operation of electro dynamometer, electrostatic Wattmeter, Measurement of 1φ and 3 φ power by Wattmeter.  
Energy: Construction, Theory and principle of operation of 1φ and 3φ Induction watt-hour meter, Errors and compensation.  
Theory and operation of frequency, power-factor meters, calibration of Watt meters and Energy meters.
**Module 5: Oscilloscope (4 Hours)**
CRO, Block diagram, sweep circuits, Delay line, multiple trace, and oscilloscope probes. Measurement of voltage, current, frequency & phase by oscilloscope. Frequency limitation of CRO. Sampling and storage oscilloscope, Double beam CRO.

**Module 6: Measurement of Resistance (8 Hours)**
Measurement of medium, low and high resistances, Megger Potentiometer:
AC Bridge: Measurement of Inductance, Capacitance and frequency by AC bridges.

**Module 7: Electronic Instruments for measurement of basic parameters: (3 Hours)**

**Module 8: Sensors & Transducers (4 Hours)**
Introduction to sensors & Transducers, Strain gauge, LVDT, Temperature transducers, Flow measurement using magnetic flow measurement.

**Text Books:**


**Reference Books:**

2. Electronic Instrumentation & Measurements, David A. Bell, 3rd Edition, Oxford University press.
# 2nd Year Curriculum Structure for B. Tech courses in Engineering & Technology

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

**Course Code:** ES ME401 | **Category:** Engineering Science Courses

**Course Title:** Thermal Power Engineering | **Semester:** 4th

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

**Pre-Requisites:** High school Physics,

### Course Outcomes:

**CO 1:** Describe the function of different components of boilers, Engines and turbines.

**CO 2:** Explain the principle of operation of different types of boilers, turbines, IC engines and Gas turbines.

**CO 3:** Solve numerical problems of boilers, turbines, IC engines and Gas turbines.

**CO 4:** Evaluate possible causes of discrepancy in practical experimental observations in comparison to theory.

**CO 5:** Analyze the performance of boilers, engines and turbines.

**CO 6:** Explain methods to control boiler, engines and turbines parameters.

### Module 1: Boilers (12 Hours)


### Module 2: Turbines (12 Hours)


### Module 3: IC Engines (6 Hours)


### Module 4: Gas Turbines (6 Hours)

Gas turbine Analysis – Regeneration - Reheating, Isentropic efficiency Combustion efficiency

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**Text books:**


**Reference books:**

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

2nd Year Curriculum Structure for B. Tech courses in Engineering & Technology
(Applicable from the academic session 2020-2021)

<table>
<thead>
<tr>
<th>Course Code: HM-EE 401</th>
<th>Category: Electrical Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: VALUES &amp; ETHICS IN PROFESSION</td>
<td>Semester: 4th</td>
</tr>
<tr>
<td>L-T-P:3-0-0</td>
<td>Credit: 3</td>
</tr>
</tbody>
</table>

Pre-Requisites: Science, Technology and Engineering as knowledge and as Social and Professional Activities

Course Objectives:
- To create an awareness on Engineering Ethics and Human Values.
- To instill Moral and Social Values and Loyalty.
- To appreciate the rights of others.
- To create awareness on assessment of safety and risk.

Course Outcomes:

CO 1: Identify and analyze an ethical issue in the subject matter under investigation or in a relevant field

CO 2: Identify the multiple ethical interests at stake in a real-world situation or practice

CO 3: Articulate what makes a particular course of action ethically defensible

CO 4: Assess their own ethical values and the social context of problems

CO 5: Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data, and the treatment of human subjects

CO 6: Demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work integrate, synthesize, and apply knowledge of ethical dilemmas and resolutions in academic settings, including focused and interdisciplinary research

Module 1: Effects of Technological Growth (10 hours)
Rapid Technological growth and depletion of resources, Reports of the Club of Rome. Limits of growth: sustainable development
Energy Crisis: Renewable Energy Resources
Environmental degradation and pollution. Eco-friendly Technologies. Environmental Regulations, Environmental Ethics Appropriate Technology Movement of Schumacher; later developments
Technology and developing notions. Problems of Technology transfer, Technology assessment impact analysis.
Whistle blowing assembly line and automation. Human centered Technology.
<table>
<thead>
<tr>
<th>Module 2: Ethics of Profession (5 hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering profession: Ethical issues in Engineering practice, Conflicts between business demands and beyond, Case studies.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 3: Profession and Human Values (10 hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Values Crisis in contemporary society</td>
</tr>
<tr>
<td>Nature of values: Value Spectrum of a good life</td>
</tr>
<tr>
<td>Psychological values: Integrated personality; mental health</td>
</tr>
<tr>
<td>Societal values: The modern search for a good society, justice, democracy, secularism, rule of law, values in Indian Constitution.</td>
</tr>
<tr>
<td>Aesthetic values: Perception and enjoyment of beauty, simplicity, clarity</td>
</tr>
<tr>
<td>Moral and ethical values: Nature of moral judgments; canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility.</td>
</tr>
</tbody>
</table>

**Text/ Reference Books:**


Course Code: MC-EE 401

Category: Mandatory Courses

Course Title: Environmental Science

Semester: 4th

L-T-P : 3-0-0

Credit: 0

Pre-Requisites: Basic knowledge of science

Course Outcomes:

CO 1: Articulate the interconnected and interdisciplinary nature of environmental studies.

CO 2: Demonstrate an integrative approach to environmental issues with a focus on sustainability.


CO 4: Communicate complex environmental information to both technical and non-technical audiences.

CO 5: Understand and evaluate the global scale of environmental problems.

CO 6: Reflect critically on their roles, responsibilities, and identities as citizens, consumers and environmental actors in a complex, interconnected world.

Module 1: (8 Hours)

Basic ideas of environment, basic concepts, man, society & environment, their interrelationship.

Mathematics of population growth and associated problems, Importance of population study in environmental engineering, definition of resource, types of resource, renewable, nonrenewable, potentially renewable, effect of excessive use vis-à-vis population growth, Sustainable Development.


Module 2: (8 Hours)

Elements of ecology: System, open system, closed system, definition of ecology, species, population, community, definition of ecosystem- components types and function.

Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundar ban); Food chain [definition and one example of each food chain], Food web.

Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphate, Sulphur].

Biodiversity- types, importance, Endemic species, Biodiversity Hot- spot, Threats to biodiversity, Conservation of biodiversity.
### Module 3: (9 Hours)

Lapse rate: Ambient lapse rate Adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion). Atmospheric dispersion: Maximum mixing depth, ventilation coefficient, effective stack height, smokestack plumes and Gaussian plume model.  
Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant. Sources and effect of different air pollutants Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN, Smog, Photochemical smog and London smog. Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green-house gases, effect of ozone modification. Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP, cyclone separator, bag house, catalytic converter, scrubber (ventury), (Statement with brief reference).

### Module 4: (9 Hours)

Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, volatile organic compounds.  
River/Lake/ground water pollution: River: DO, 5-day BOD test, Seeded BOD test, BOD reaction rate constants, Effect of oxygen demanding wastes on river [deoxygenation, reaeration], COD, Oil, Greases, pH.  
Lake: Eutrophication [Definition, source and effect].  
Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only)  
Water pollution due to the toxic elements and their biochemical effects: Lead, Mercury, Cadmium, and Arsenic.

### Module 5: (6 Hours)

Environmental impact assessment, Environmental Audit, Environmental laws and protection act of India, Different international environmental treaty/ agreement/ protocol.

### Text/Reference Books:

2. Introduction to Environmental Engineering and Science, G.M. Masters, Prentice-Hall of India Pvt. Ltd.

3. Environmental Chemistry, A. De, New Age International

4. Text Book for Environmental Studies, ErachBharucha, UGC

5. Elements of Environmental Pollution Control, O.P. Gupta, Khanna Publishing House
   (AICTE Recommended Book).
**Course Code:** PC-EE 491  
**Category:** Professional Core Courses  
**Course Title:** Electric Machine-I Laboratory  
**Semester:** 4th  
**L-T-P:** 0-0-2  
**Credit:** 1  

**Pre-Requisites:** High school Physics (Theory and Laboratory), Circuit Theory, Basic Electrical Engg. (Lab and Theory)

**Course Outcomes:**

| CO 1 | Identify relevant information to supplement to the Electric Machine-I (EE401) course. |
| CO 2 | Set up testing strategies and select proper instruments to evaluate performance characteristics of electrical machines and Analyze their operation under different loading conditions. |
| CO 3 | Practice different types of wiring and devices connections keeping in mind technical, economical, safety issues. |
| CO 4 | Evaluate possible causes of discrepancy in practical experimental observations in comparison to theory. |
| CO 5 | Prepare professional quality textual and graphical presentations of laboratory data and computational results, incorporating accepted data analysis and synthesis methods, mathematical software, and word- processing tools. |
| CO 6 | Primarily via team- based laboratory activities, students will demonstrate the ability to interact effectively on a social and interpersonal level with fellow students, and will demonstrate the ability to divide up and share task responsibilities to complete assignments. |

**Choose 10 experiments from the following:**

1. Determination of the characteristics of a separately excited DC generator.
2. Determination of the characteristics of a DC motor
3. Study of methods of speed control of DC motor
4. Determination of the characteristics of a compound DC generator (short-shunt)
5. Determination of speed of DC series motor as a function of load torque.
6. Polarity test on a single phase transformer
8. Study of different connections of three phase transformer.
10. Determination of temperature rise and efficiency of the transformer. (Back to back test)
Course Code: PC-EE 492  Category: Professional Core Courses
Course Title: Digital Electronics Lab  Semester: 4th
L-T-P:0-0-2  Credit: 1

Pre-Requisites: Basic knowledge of Analog Electronics.

Course Objectives:
- To learn basic techniques for the purpose of digital circuits and central concepts employed in the conception of digitalsystems.
- To understand different forms of number representation and to be able to convert between different numbersystems.
- Representation of the truth table of various expressions and combinational circuits using logicgates.
- Construction of Adder, Subtractor circuit in digitaldomain.
- Construction of flips-flops, counters, shiftregisters.
- Knowledge of Digital design for electronicappliances.

Course Outcomes:
CO 1: Convert numerical data to various number systems.
CO 2: Can demonstrate t truth tables of different logicgates.
CO 3: Can design different digitalappliances
CO 4: Evaluate possible causes of discrepancy in practical experimental observations in comparison to theory.
CO 5: Prepare professional quality textual and graphical presentations of laboratory data and computational results, incorporating accepted data analysis and synthesis methods, mathematical software, and word-processing tools.
CO 6: Primarily via team-based laboratory activities, students will demonstrate the ability to interact effectively on a social and interpersonal level with fellow students, and will demonstrate the ability to divide up and share task responsibilities to complete assignments.

List of experiments:
1. Design of half adder, full circuit using logicgates.
2. Design of half subtractor, full subtractor circuit using logicgates.
4. Design of T and D Flip Flop circuit using logic gates.
5. Design of Register circuit using FlipFlop.
6. Design of serial to parallel converter and parallel to serial converter.
7. Design of asynchronous up/downcounters.
8. Design of synchronous up/downcounters.
**Course Code:** PC-EE 493  
**Category:** Professional Core Courses

**Course Title:** Electrical and Electronics Measurement Lab  
**Semester:** 4th

**L-T-P:** 0-0-2  
**Credit:** 1

**Pre-Requisites:** Basic Electrical Engineering, Electric Circuit Theory, Electromagnetism

**Course Outcomes:**

**CO 1:** Develop the fundamental knowledge and demonstrate various electrical measuring instruments which operated by different electrical, chemical, mechanical, optical and other physical properties.

**CO 2:** Relate the mathematical and theoretical knowledge with the practical electrical measuring system and realize the importance of further improvement of the measuring instrument for more improved performance, efficiency, cost effectiveness, safety and environmental aspects.

**CO 3:** Design the measuring circuit and perform the real life experiment to find out various electrical parameters which are important to design the electrical system considering safety, economic and environmental constrains.

**CO 4:** Able to standardize various measuring instrument with the help of standard absolute meters.

**CO 5:** Capable to analyze the effect on the electrical system with different types of changing electrical loads and supply.

**CO 6:** Develop themselves as a good team member and leader to perform the experiments with cooperation and communication with other team members. Also able to invent themselves the capability of decision making which leads a good performance and able to perform the documentation of experimental data.

**List of Experiments:**

1. Instrument workshop- Observe the construction of PMMC, Dynamometer, Electothermal and Rectifier type of instruments, Oscilloscope and Digital multimeter.

2. Calibrate moving iron and electrodynamometer type ammeter/voltmeter by potentiometer.

3. Calibrate dynamometer type wattmeter by potentiometer.


10. Measurement of capacitance by De Sauty Bridge.
Haldia Institute of Technology, West Bengal
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology)
2nd Year Curriculum Structure for B.Tech courses in Engineering & Technology
(Applicable from the academic session 2020-2021)

<table>
<thead>
<tr>
<th>Course Code: ES-ME 481</th>
<th>Category: Professional Core Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: Thermal Power Engineering Lab</td>
<td>Semester: 4th</td>
</tr>
<tr>
<td>L-T-P : 0-0-2</td>
<td>Credit: 1</td>
</tr>
<tr>
<td>Pre-Requisites: Thermal Power Engineering</td>
<td></td>
</tr>
</tbody>
</table>

**Course Outcomes:**

CO 1: Describe and analyze different types of sources and mathematical expressions related to thermodynamics and various terms and factors involved with thermal power operation.

CO 2: Analyze the working and layout of different power plants and the different systems comprising the plant and discuss about its economic and safety impacts.

CO 3: Combine concepts of learnt courses to define the working principle boiler, its layout, safety principles and compare it with plants of other types.

CO 4: Describe the working principle and basic components of the boiler and the economic and safety principles involved with it.

CO 5: Discuss the working principle and basic components of the petrol and diesel engine and the economic principles and safety precautions involved with it.

CO 6: Discuss and analyze the mathematical and working principles of different electrical equipments involved in the thermal power engineering.

**List of Experiments:**

1. Study of Cut Models – Boilers IC Engines
   - Lanchashire Boiler
   - Bahcock & Willcox Boiler
   - Cochran Boiler
   - Vertical Tubular Boiler
   - Locomotive Boiler
   - 4S Diesel Engine
   - 4S Petrol Engine
   - 2S Petrol Engine

2. Load Test on 4 Stroke Petrol Engine & Diesel Engine by Electrical Load Box.
3. Load Test on 4 Stroke Diesel Engine by Rope Brake Dynamometer.
6. To find the Calorific Value of Diesel Fuel & Coal by Bomb Calorimeter.
7. To find the Flash Point & Fire Point of Petrol & Diesel Fuel.
8. To find the Cloud Point & Pour Point of Petrol & Diesel Fuel.
9. To find Carbon Particle Percentage in Diesel Engine Exhaust Smoke by Smoke meter
and trace the BHP Vs. % Carbon Curve.

11. To find out the Boiler performance – Boiler efficiency & Steam evaporation rate.
12. To visit a Thermal Power Station & study of the followings:
   - Boiler
   - Steam pipe
   - Furnace
   - Economizer
   - Preheater
   - Steam turbines
   - Alternator
   - Water treatment plant
   - E. S. P.
Course Code: PC-EE 501  
Course Title: ELECTRICAL MACHINES – II  
Category: Professional Core Courses  
Semester: Fifth  
L-T-P: 3-0-0  
Credit: 3  

Pre-Requisites: Physics and Mathematics and Basic Electrical and Electronics Engineering

Course Objectives:

- To make students conversant about the underlying energy conversion theory between electrical and mechanical systems by introducing electromechanical energy conversion principles.
- To expose the students to the concepts of various types of electrical machines and applications of electrical machines.
- To acquaint the student with the concept of generation of electricity in power plant.

Course Objectives:

- CO1: Use concepts in trigonometry, complex algebra, phasor operations and principles of electromagnetism to find correct solutions to electrical machine performance questions. Select proper materials and methods for design and construction of electrical machines within the realm of manufacturing, economic, performance, efficiency and environmental constraints.
- CO2: Use modeling/simulation parameters with standard equivalent circuit models to predict correctly the expected performance of various general purpose electrical machines.
- CO3: Compare accepted standards and guidelines to select appropriate electrical machines to meet specified performance requirements.
- CO4: Demonstrate an understanding of the fundamental control practices associated with rotating machines (starting, reversing, braking, speed control etc.).
- CO5: Set up testing strategies to evaluate performance characteristics of electrical machines. Design of autonomous systems using special electrical machines. Justify contemporary issues within and outside the electrical engineering profession.
- CO6: Access the techniques, skills, and modern engineering tools necessary for electrical engineering practice. Choose the scope of applicability of various types of electrical machines in real life Multi-disciplinary usages.

Module 1: Single phase Induction motor (10 hours)

Construction, Double revolving field theory, Cross field theory, Starting methods, Speed —Torque characteristics, Phasor diagram, Condition of maximum torque, Determination of equivalent circuit parameters, Applications.

Single Phase AC series motor, Compensated & uncompensated motors.
Module 2: Synchronous machines (20 Hours)

Module 3: Special Electromechanical devices (10 hours)

Numerical problems to be solved in the tutorial classes.

Text Books:
3. Electrical Machines — Nagrath & Kothary,TMH
4. Electrical Machines, Theory & Applications, M.N. Bandyopadhyay, PHI

Reference Books:
3. Electric Machinery & Transformes, Irving L. Kosow, PHI
5. Electrical Machines, R.K. Srivastava, Cengage Learning
<table>
<thead>
<tr>
<th>Course Code: PC-EE 502</th>
<th>Category: Professional Core Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: Power Systems-I</td>
<td>Semester: 5th</td>
</tr>
<tr>
<td>L-T-P: 3-0-0</td>
<td>Credit: 3</td>
</tr>
<tr>
<td>Pre-Requisites: Power Electronics, Electrical Machine and Control System</td>
<td></td>
</tr>
</tbody>
</table>

**Course Outcomes:**

CO 1: Recall the different concepts of previously learned courses which can be applied to power systems.

CO 2: Identify the concepts applicable to different areas of power system and perform the required modifications to extend them to power system applications.

CO 3: Apply the modified concepts to calculate the different parameters of transmission line, power system protection, voltage surges and fault analysis.

CO 4: Analyze the effect of different parameter modifications on the state of the power generation, transmission and distribution system.

CO 5: Assemble and evaluate the information collected from applying the pre-learned concepts to determine procedures which can be applied to areas of power systems.

CO 6: Compare the different types of power system fault calculation and protection etc. to improve power system stability and reliability.

**Module 1- Basic Concepts (4 hours)**


**Module 2- Power System Components (14 hours)**


**Module 3- Over-voltages and Insulation Requirements (5 hours)**

Module 4- Fault Analysis and Protection Systems (13 hours)

Text/ References:
2. Power System Engineering, Nagrath & Kothyry, TMH
5. Elements of power system analysis, C.L. Wodhwa, New Age International.
### Curriculum Structure for B.Tech courses in Electrical Engineering

(Applicable from the academic session 2020-2021)

<table>
<thead>
<tr>
<th>Course Code: PC-EE 503</th>
<th>Category: Professional Core Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course Title:</strong> CONTROL SYSTEM</td>
<td><strong>Semester:</strong> 5th</td>
</tr>
<tr>
<td><strong>L-T-P:</strong> 3L+1T</td>
<td><strong>Credit:</strong> 4</td>
</tr>
</tbody>
</table>

**Pre-Requisites:** High school Physics, Mathematics and Circuit Theory

**Course Outcomes:**

**CO 1:** Categorize different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form using transfer function concept. Interpret different physical and mechanical systems in terms of electrical system to construct equivalent electrical models for analysis.

**CO 2:** Employ time domain analysis to predict and diagnose transient and steady state performance parameters of the system for standard input functions.

**CO 3:** Formulate different types of analysis in frequency domain to explain the nature of stability of the system.

**CO 4:** Identify the needs of different types of controllers and compensator to ascertain the required dynamic response from the system.

**CO 5:** Employ state variable approach to analyze SISO & MIMO systems.

**CO 6:** Understand the characteristics of various types of nonlinearities present in physical systems and carry out the stability analysis of non-linear control systems.

**Module 1: (6 hours)**


### Module 2: (10 hours)

### Module 3: (8 hours)

### Module 4: (8 hours)

### Module 5: (6 hours)

### Module 6: (5 hours)

### Text Books:

### Reference Books:
2. Advance Electrical Technology, H.Cotton, Reem Publication


6. Modern Control system, R.C. Dorf & R.H. Bishop, Pearson Education
Course Code: OE-EE-501A  Category: Open Elective Courses
Course Title: Data Structure and Algorithm  Semester: Fifth
L-T-P : 3-0-0  Credit: 3

Pre-Requisites: Programming for problem solving, Mathematics

Course Objectives:
1. To understand the basics of abstract data types.
2. To understand the principles of linear and nonlinear data structures.
3. To build an application using sorting and searching

Course Outcomes:
CO 1: Able to Differentiate how the choices of data structure & algorithm methods enhance the performance of the program.
CO 2: Able to Solve problems based upon different data structure & also write programs.
CO 3: Able to Write programs based on different data structure Understand the concept of sampling of a signal; obtain the output of a system using z – transform.
CO 4: Able to Identify appropriate data structure & algorithmic methods in solving problem.
CO 5: Able to Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing
CO 6: Able to Compare the benefits of dynamic and static data structures implementations.

Module 1: Introduction (10 Hours)
Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Technique sand their complexity analysis.

Module 2: Stacks and Queues (10 Hours)
ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.
Module 3: (10 Hours)
Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion in to, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis. Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations oneach of the trees and their algorithms with complexity analysis.
Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis

Module 4: (10 Hours)
Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

Text books:
1. Data Structures and Program Design In C, 2/E by Robert L. Kruse, Bruce P. Leung. PHI

Reference books
1. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, MIT press
2. Expert Data Structures with C++, R.B Patel, Khanna Publishing House
Haldia Institute of Technology, West Bengal
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology)
Curriculum Structure for B.Tech courses in Electrical Engineering
(Applicable from the academic session 2020-2021)

<table>
<thead>
<tr>
<th>Course Code: PE-EE-501A</th>
<th>Category: Professional Elective Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: Digital Signal Processing</td>
<td>Semester: Fifth</td>
</tr>
<tr>
<td>L-T-P : 3-0-0</td>
<td>Credit: 3</td>
</tr>
<tr>
<td>Pre-Requisites: Linear algebra, Complex number</td>
<td></td>
</tr>
</tbody>
</table>

Course Outcomes:

CO 1: Understand the concept of signals and analyze the spectral content in periodic and aperiodic signals.

CO 2: Understand the impulse response of a system, convolution of two signals and its application to dynamic systems.

CO 3: Understand the concept of sampling of a signal; obtain the output of a system using z – transform.

CO 4: Represent signals mathematically in continuous and discrete-time, and in the frequency domain.

CO 5: Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms

CO 6: Apply the knowledge of analog filters to digital filters, design a digital filter and physically realize any digital filter

Module 1 (6 hours)

Concept of discrete-time signal, basic idea of sampling and reconstruction of signal, Representation of continuous time signals by its samples- Types of sampling, aliasing, sequences, -periodic, energy, power, unit-sample, unit step, unit ramp & complex exponentials, arithmetic operations on sequences.

Module 2 (6 hours)

Definition, representation, impulse response, derivation for the output sequence, concept of convolution, graphical, analytical and overlap-add methods to compute convolution supported with examples and exercise, properties of convolution, interconnection of LTI systems with physical interpretations, stability and causality conditions, recursive and non-recursive systems.

Module 3 (8 hours)

Definition, mapping between s-plane & z-plane, unit circle, convergence and ROC, properties of Z-transform, Z-transform on sequences with examples & exercises, characteristic families of signals along with ROC, convolution, correlation and multiplication using Z- transform, initial value theorem, Perseval’s relation, inverse Z transform by contour integration, power series & partial-fraction expansions with examples and exercises.
Module 4 (8 hours)

Module 5 (6 hours)

Module 6 (8 hours)

Text Books:
1. Digital Signal Processing, P. Ramesh Babu
2. Digital Signal Processing-A computer based approach, S. Mitra, TMH
5. Digital Signal Processing-implementation using DSP microprocessors with examples from

Reference Books:
1. Digital Signal Processing, Chen, OUP
2. Digital Signal Processing, Johnson, PHI
10. Xilinx FPGA user manual and application notes.
### Course Code: PE-EE-501B  
### Category: Professional Elective Courses  
### Course Title: Computational Electromagnetic  
### Semester: Fifth  
### L-T-P : 3-0-0  
### Credit: 3  

**Pre-Requisites:** Electromagnet, Programming for problem solving, Mathematics

### Course Objectives:  
- To understand the concepts of computational electromagnetics, to enable analysis of numerical stability and dispersion

### Course Outcomes:  

**CO 1:** understand the fundamentals and overview of Partial Differential Equation and Time-Domain Methods  
**CO 2:** understand one-dimensional scalar wave equation  
**CO 3:** understand the concept of Maxwell’s’ Equations and Yee Algorithm  
**CO 4:** understand the Numerical Stability Schemes  
**CO 5:** understand the Numerical Dispersion

### Module 1: Overview (8 Hours)  

### Module 2: One-Dimensional Scalar Wave Equation (8 Hours)  

### Module 3: Introduction to Maxwell’s’ Equations and the Yee Algorithm (8 Hours)  
Maxwell's Equations in Three Dimensions, Reduction to Two Dimensions: TM Mode, TE Mode, Reduction to One Dimension: TM Mode, TE Mode, Equivalence to the Wave Equation in One Dimension, Yee Algorithm.

### Module 4: Numerical Stability (8 Hours)  
Basic-Stability Analysis Procedure, TM Mode, Time Eigen value Problem, Space Eigen value Problem, Enforcement of Stability, Extension to the Full Three-Dimensional Yee Algorithm,
### Module 5: Numerical Dispersion (8 Hours)

Basic Procedure, Substitution of Traveling-Wave Trial Solution, Extension to the Full Three-Dimensional Yee Algorithm, Comparison with the Ideal Dispersion Case, Reduction to the Ideal Dispersion Case for Special Grid Conditions, Dispersion-Optimized Basic Yee Algorithm, Dispersion-Optimized Yee Algorithm with Fourth-Order Accurate Spatial Central Differences: Formulation, Example, Pros and Cons

### Text/Reference books:

### Course Code: PC-EE 591

**Category:** Professional Core Courses  
**Course Title:** ELECTRICAL MACHINES -II LABORATORY  
**Semester:** Fifth  
**L-T-P:** 0-0-2  
**Credit:** 1  
**Pre-Requisites:** Physics and Basic Electrical and Electronics Engineering (Theory and Laboratory)

### Course Objectives:
- To expose the students to the operation of Synchronous machines and induction motors and give them experimental skills.
- To give students practical laboratory experience with the basic of Synchronization in grid.
- To introduce students to industrial control of electric machines as well with safe electrical connection and measurement practices.

### Course Outcomes:

| CO 1 | Identify relevant information to supplement to the Electric Machine-II (EE591) course. |
| CO 2 | Set up testing strategies and select proper instruments to evaluate performance characteristics of electrical machines. Develop testing and experimental procedures on different types of electrical machines and Analyze their operation under different loading conditions. |
| CO 3 | Estimate constraints, uncertainties and risks of the system (social, environmental, business, safety issues etc.). Combine an understanding of the established principles, theories, concepts and terminology relevant to electrical machines with practical laboratory experimentation. |
| CO 4 | Prepare professional quality textual and graphical presentations of laboratory data and computational results, incorporating accepted data analysis and synthesis methods, mathematical software, and word-processing tools. |
| CO 5 | Primarily via team-based laboratory activities, students will demonstrate the ability to interact effectively on a social and interpersonal level with fellow students, and will demonstrate the ability to divide up and share task responsibilities to complete assignments. |
| CO 6 | Originate a professional experience on working in a power plant or any practical field and to be ready for life-long involvement in the farther improvement of relevant technology. |

### List of Experiments:

1. Different method of starting of 3 phase squirrel cage Induction motor & their comparison [D.O.L, Auto transformer & Star-Delta].
2. Speed control of 3 phase squirrel cage induction motor by different methods & their comparison [voltage control & frequency control]
3. Speed control of three phase slip ring Induction motor by rotor resistance control.
7. Load test on single phase Induction motor to obtain the performance characteristics.
8. To determine the direct axis reactance [Xd] & quadrature axis reactance [Xq] of three phase synchronous machine by slip test.
9. Load test on wound rotor Induction motor to obtain the performance characteristics.
10. To make connection diagram of full pitch & fractional slot winding of 18 slot squirrel cage Induction motor for 6 pole & 4 pole operation.
Curriculum Structure for B.Tech courses in Electrical Engineering
(Applicable from the academic session 2020-2021)

**Course Code**: PC-EE 592
**Category**: Professional Core Courses
**Course Title**: POWER SYSTEM-I LABORATORY

**L-T-P**: 3P
**Credit**: 2

**Semester**: 5th

**Pre-Requisites**: P-SPICE, Basic Electrical Engg.

**Course Outcomes**:

**CO 1**: Identify relevant information to supplement to the Electric Power system I (EE502) course and set up testing strategies and select proper instruments to evaluate performance characteristics of transmission lines, insulators and distribution systems.

**CO 2**: Apply power to hardware models of transmission lines and dc distribution systems to evaluate their performance characteristics and compare them with the results obtained from computer simulations using PSPICE.

**CO 3**: Develop testing and experimental procedures on different types of insulating materials and analyze their operation under different levels of electrical stress.

**CO 4**: Practice different types of wiring and devices connections keeping in mind technical, economical, safety issues also evaluate possible causes of discrepancy in practical experimental observations in comparison to theory.

**CO 5**: Prepare professional quality textual and graphical presentations of laboratory data and computational results, incorporating accepted data analysis and synthesis methods, mathematical software, and word-processing tools.

**CO 6**: Primarily via team-based laboratory activities, students will demonstrate the ability to interact effectively on a social and interpersonal level with fellow students, and will demonstrate the ability to divide up and share task responsibilities to complete assignments.

**List of Experiments**:

1. Determination of generalized constants A, B, C, D for long transmission lines.
2. Simulation of DC distribution by network analyzer.
4. Dielectric strength test of insulating oil.
5. Determination of breakdown strength of solid insulating material.
6. Different parameter calculation by power circle diagram.
7. Study of different types of insulators.
8. Active and reactive power control of alternator.
9. Study and analysis of an electrical transmission line circuit with the help of PSPICE.
10. Study of the characteristics of Overcurrent Relay.
11. Study of the characteristics of Undervoltage and Earth fault relay.
12. Dielectric constant, tan delta, resistivity test of transformer oil.
### Course Code: PC-EE 593  
**Category:** Professional Core Courses  
**Course Title:** CONTROL SYSTEM LABORATORY  
**Semester:** 5th  
**L-T-P:** 0-0-2  
**Credit:** 1  
**Pre-Requisites:** MATLAB, PSPICE

### Course Outcomes:

**CO 1:** Discuss the need of software tools (MATLAB, PSPICE) to illustrate modeling and simulation of any system.

**CO 2:** Classify and evaluate the performance parameters of a system and then with simulation prepare an advance tool to modify the values of the parameter of the system in order to meet the desired need.

**CO 3:** Prepare professionals in laboratory to compute or to predict the characteristics of a system by visualizing experimental data and its graphical representation.

**CO 4:** Evaluate possible causes of discrepancy in practical experimental observations in comparison to theory by introducing the concepts of different stability theorems.

**CO 5:** Primarily via team-based laboratory activities, students will demonstrate the ability to interact effectively on a social and interpersonal level with fellow students, and will develop the ability to divide up and share task responsibilities to complete assignments.

**CO 6:** Develop professional quality textual and graphical presentations of laboratory data and computational results, incorporating accepted data analysis and synthesis methods, mathematical software, and word-processing tools.

### List of Experiments:

1. Familiarization with MATLAB control system tool box, MATLAB- SIMULINK tool box &PSPICE.
2. Determination of Step response for first order & Second order system with unity feedback on CRO & calculation of control system specification like Time constant, % peak overshoot, settling time etc. from the response.
3. Determination of Step response for first order & Second order system with unity feedback using MATLAB & calculation of different control system specifications.
4. Simulation of Step response & Impulse response for type-0, type-1 & Type-2 system with unity
feedback using MATLAB & PSPICE.

5. Determination of Root locus, Bode plot, Nyquist plot using MATLAB control system tool box for 2nd order system & determination of different control system specifications from the plot.


7. Determination of approximate transfer functions experimentally from Bode plot.

8. Evaluation of steady state error, setting time, percentage peak overshoot, gain margin, phase margin with addition of Lead.


10. Study of the effects of nonlinearity in a feedback controlled system using time response. Determination of step response with a limiter nonlinearity introduced into the forward path of 2nd order unity feedback control systems. The open loop plant will have one pole at the origin and other pole will be in LHP or RHP. To verify (by simulation) that (i) with open loop stable pole, the response is slowed down for larger amplitude input (ii) for unstable plant, the closed loop system may become oscillatory with large input amplitude.
Curriculum Structure for B.Tech courses in Electrical Engineering
(Applicable from the academic session 2020-2021)

<table>
<thead>
<tr>
<th>Course Code: OE EE 591A</th>
<th>Category: Open Elective Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: Data Structure and Algorithm Lab</td>
<td>Semester: 5th</td>
</tr>
<tr>
<td>L-T-P :0-0-2</td>
<td>Credit: 1</td>
</tr>
</tbody>
</table>

Pre-Requisites: Algorithm, Stack, Queue, Recursion, Tree, Graph

Course Outcomes:

CO 1: Ability to analyze algorithms and algorithm correctness
CO 2: Ability to summarize searching and sorting techniques
CO 3: Ability to describe stack, queue and linked list operation
CO 4: Ability to have knowledge of tree and graphs concepts

List of Experiments:

1. Implementation of array operation
3. Evaluation of expression operation on multiple stack & queues.
4. Implementation of linked lists, inserting, deleting, inverting a linked list, implementation of stacks & queue using linked list.
5. Polynomial addition, Polynomial multiplication
6. Sparse Matrices, Multiplication, addition
7. Recursive and Non-recursive traversal of Trees
8. Threaded binary tree traversal. AVL tree implementation.

Experiments mentioned above are not exhaustive. More experiments may be conducted.
<table>
<thead>
<tr>
<th>Course Code: PC-EE601</th>
<th>Category: Professional Core Course</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course Title:</strong> Power Systems-II</td>
<td><strong>Semester:</strong> 6&lt;sup&gt;th&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>L-T-P:</strong> 3-0-0</td>
<td><strong>Credit:</strong> 3</td>
</tr>
</tbody>
</table>

**Pre-Requisites:** Power Systems-I, Electrical Machine and Control System, Mathematics, Numerical Methods.

**Course Outcomes:**

**CO 1:** Recall the different concepts of previously learned courses which can be applied to power systems.

**CO 2:** Identify the concepts applicable to different areas of power system and perform the required modifications to extend them to power system applications.

**CO 3:** Apply the modified concepts to calculate the different parameters of power flow, power system control, stability and economics.

**CO 4:** Analyze the effect of different parameter modifications on the state of the power system.

**CO 5:** Assemble and evaluate the information collected from applying the pre-learned concepts to determine procedures which can be applied to areas of power systems.

**CO 6:** Compare the different methods of power flow calculation, control of power system etc. to improve power system economics and stability.

**Module 1: Power Flow Analysis (7 hours)**


**Module 2: Stability Constraints in synchronous grids (8 hours)**

### Module 3: Control of Frequency and Voltage (7 hours)

- Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing.

### Module 4: Monitoring and Control (6 hours)


### Module 5: Power System Economics and Management (7 hours)


### Text/References:

Course Code: PC-EE 602  
Category: Professional Core Courses

Course Title: Power Electronics  
Semester: Six

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

Pre-Requisites: Basic Electrical Engineering and Analog Electronics

Course Outcomes:

CO 1: Relate basic semiconductor physics to properties of power devices, and Analyze characteristics of power electronics devices.

CO 2: Describe basic operation and compare performance of various power semiconductor devices, passive components and switching circuits.

CO 3: Design and Analyze power converter circuits and learn to select suitable power electronic devices by assessing the requirements of application fields.

CO 4: Formulate and analyze a power electronic design at the system level and assess the performance.

CO 5: Identify the critical areas in application levels and derive typical alternative solutions.

CO 6: Recognize the role power electronics in the improvement of energy usage efficiency.

Module 1: Introduction: (5 hours)  
Concept of power electronics, application of power electronics, advantages and disadvantages of power electronics converters, power electronics systems, power diodes, power transistors, power MOSFETS, IGBT.

Module 2: PNPN devices (9 hours)  
Thyristors, brief description of members of Thyristor family with symbol, V-I characteristics and applications. Two transistor model of SCR, SCR turn on methods, switching characteristics, gate characteristics, ratings, SCR protection, series and parallel operation, gate triggering circuits, different commutation techniques of SCR.

Module 3: Phase controlled converters (8 hours)  

Module 4: DC-DC converters (7 hours)  
Principle of operation, concept of Buck, Boost and Buck-Boost Chopper, control strategies, types of choppers circuits based on quadrant of operation, performance parameters, and switching mode regulators.
**Module 5: Inverters (8 hours)**
Definition, classification of inverters based on nature of input source, wave shape of output voltage, Principle of operation of single phase and three phase bridge Voltage Source Inverter with R and R-L loads, Current Source Inverter, performance parameters of inverters, methods of voltage control and harmonic reduction of inverters by pulse width modulation.

**Module 6: AC controllers (3 hours)**
Principle of on-off and phase control, single phase controllers with R and R-L loads.
Principle of operation of cycloconverters, single phase to single phase step up and step down cycloconverters.

**Text Books:**


**Reference Books:**

1. Power Electronics, Mohan, Undeland & Riobbins, Wiley India.
### Course Code: PC-EE 603

<table>
<thead>
<tr>
<th>Course Title: Microprocessor and Micro-Controller</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semester: Sixth</td>
</tr>
<tr>
<td>L-T-P: 3-0-0</td>
</tr>
<tr>
<td>Credit: 3</td>
</tr>
</tbody>
</table>

**Pre-Requisites:** Physics and Mathematics and Basic Electrical and Electronics Engineering

**Course Objective:**
- To introduce students with the architecture and operation of typical microprocessors and microcontrollers.
- To familiarize the students with the programming and interfacing of microprocessors and microcontrollers.
- To provide strong foundation for designing real world applications using microprocessors and microcontrollers.

**Course Outcome:**

**CO 1:** Assess and solve basic binary math operations using the microprocessor and explain the microprocessor’s and Microcontroller’s internal architecture and its operation within the area of manufacturing and performance.

**CO 2:** Apply knowledge and demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor and microcontroller.

**CO 3:** Compare accepted standards and guidelines to select appropriate Microprocessor (8085 & 8086) and Microcontroller to meet specified performance requirements.

**CO 4:** Analyze assembly language programs; select appropriate assemble into machine a cross assembler utility of a microprocessor and microcontroller.

**CO 5:** Design electrical circuitry to the Microprocessor I/O ports in order to interface the processor to external devices.

**CO 6:** Evaluate assembly language programs and download the machine code that will provide solutions real-world control problems.

**MODULE 1: INTRODUCTION TO MICROPROCESSOR (10 hours)**
- Architecture of a typical 8 bit Microprocessor, block diagram representation, Bus configuration, application of microprocessor as CPU module, memory, ROM & RAM families, basic concepts of I/O peripheral devices, memory mapping, concept of word length, Use of microprocessor as programmable device, basic concept of algorithm and flow chart, Introduction to assembly language & machine language programming,
- Instruction set of typical microprocessors (e.g. 8085), Subroutine & stack, interrupt, Timing diagram, External Communication Interface, application in LED, LCD display, dc motor, stepper motor.

**MODULE 2: 8086 MICROPROCESSORS (6 hours)**
- Introduction to 8086 Microprocessor, Architecture, addressing modes, Instruction set, Assembly language programming, 8086 System bus structure, 8086 signals.
### Module 3: The 8051 Architecture (8 Hours)
Architecture of a typical Microcontroller (eg. 8051), concept of embedded microcontroller, memory unit, block diagram representation, CPU, BUS configuration, register banks and stack, SFRs, flags, D PTR register, Program Counter, Timing diagrams

### Module 4: Instruction Set and Programming (8 Hours)
Basic instructions of 8051 microcontroller, assembly language and C language programming, timing diagrams, programming using loop, jump and call instruction, different addressing modes, branch instructions, subroutine instructions, arithmetic operations, logical operations, description of assembler, compiler, editor, debugger.

### Module 5: Memory and I/O Interfacing (4 Hours)
Programmable peripheral interface, Architecture of 8255A, interfacing of ADC, keyboard, seven Segment display. Programmable interval timer (eg. 8254).

**Numerical problems are to be solved in the tutorial classes.**

**Text:**

**References:**
**Course Code:** HM-EE603  
**Category:** Professional Core Courses  
**Course Title:** Principle of management  
**Semester:** Sixth  
**L-T-P:** 3-0-0  
**Credit:** 3  
**Pre-Requisites:** Basic level of management

### Course Objectives:
- To help the students gain understanding of the functions and responsibilities of managers
- To provide them tools and techniques to be used in the performance of the managerial job
- To enable them to analyze and understand the environment of the organization
- To help the students to develop cognizance of the importance of management principles

### Course Outcomes:

<table>
<thead>
<tr>
<th>CO 1</th>
<th>Understand the concepts related to Business</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO 2</td>
<td>Demonstrate the roles, skills and functions of management</td>
</tr>
<tr>
<td>CO 3</td>
<td>Analyze effective application of PPM knowledge to diagnose and solve organizational problems and develop optimal managerial decisions</td>
</tr>
<tr>
<td>CO 4</td>
<td>Understand the complexities associated with management of human resources in the organizations and integrate the learning in handling these complexities</td>
</tr>
</tbody>
</table>

### Module 1: Basic concepts of management (5 Hours)

- Definition – Essence, Functions, Roles, Level.
- Functions of Management: Planning – Concept, Nature, Types, Analysis, Management by objectives; Organization Structure – Concept, Structure, Principles, Centralization, Decentralization, Span of Management; Organizational Effectiveness

### Module 2: Management and Society (5 Hours)

- Concept, External Environment, CSR, Corporate Governance, Ethical Standards.
- People Management – Overview, Job design, Recruitment & Selection, Training & Development, Stress Management. Managerial Competencies – Communication, Motivation, Team Effectiveness, Conflict Management, Creativity, Entrepreneurship

### Module 3: Leadership (5 Hours)

<table>
<thead>
<tr>
<th>Module 4: Customer Management (5 Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market Planning &amp; Research, Marketing Mix, Advertising &amp; Brand Management.</td>
</tr>
<tr>
<td>Operations &amp; Technology Management – Production &amp; Operations Management, Logistics &amp; Supply Chain Management, TQM, Kaizen &amp; Six Sigma, MIS.</td>
</tr>
</tbody>
</table>

**Text/Reference Books:**

<table>
<thead>
<tr>
<th>Course Code: OE-EE601A</th>
<th>Category: Open Elective Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: Database Management Systems</td>
<td>Semester: Sixth</td>
</tr>
<tr>
<td>L-T-P : 3-0-0</td>
<td>Credit: 3</td>
</tr>
<tr>
<td>Pre-Requisites: DBMS and computer knowledge</td>
<td></td>
</tr>
</tbody>
</table>

**Course Objectives:**

- The objective of the course is to present an introduction to database management systems, with an emphasis on how to organize, maintain and retrieve - efficiently, and effectively - information from a DBMS.
- To explain basic database concepts, applications, data models, schemas and instances.
- To demonstrate the use of constraints and relational algebra operations.
- Describe the basics of SQL and construct queries using SQL.
- To emphasize the importance of normalization in databases.
- To facilitate students in Database design
- To familiarize issues of concurrency control and transaction management.

**Course Outcomes:**

**CO 1:** Describe the fundamental elements of relational database management systems

**CO 2:** Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL

**CO 3:** Design ER-models to represent simple database application scenarios

**CO 4:** Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data

**CO 5:** Improve the database design by normalization

**CO 6:** Familiar with basic database storage structures and access techniques: file and page organizations, indexing methods including B tree, and hashing

**Module 1: Introduction (4 hours)**

Concept & Overview of DBMS, Data model, Database language, Database administrator, Database users, Three Schema architecture of DBMS.

**Module 2: Entity-Relationship Model (5 Hours)**

Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity sets, Extended E-R features.
<table>
<thead>
<tr>
<th>Module 3: Relational Model (5 Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure of relational Databases, Relational Algebra, Relational; calculus, Extended Relational Algebra operations, Views, Modification of the Database.</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Module 4: SQL and Integrity Constraints (6 Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept of DDL, DML, DCL. Basic structure, Set operations, Aggregate functions, Null values, Domain constraints, Referential integrity, Constraints, assertions, views, Nested sub queries, Database security application development using SQL, Stored procedures and triggers.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 5: Relational Database design (9 Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional dependency, Different anomalies in designing a Database, Normalization using functional dependencies, Decomposition, Boyce-Codd normal form, 3NF, Normalization using multi-valued dependencies, 4NF, 5 NF.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 6: Internal of RDBMS (6 Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical data structures, Query optimization: join algorithm, statistics and cost base optimization, Transaction processing, Concurrency control and recovery management: transaction model properties, state serializability, look base protocols, two phase locking.</td>
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</table>

<table>
<thead>
<tr>
<th>Module 6: File organization &amp; index structures (5 Hours)</th>
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<tbody>
<tr>
<td>File &amp; records concepts, Placing file records on disk, Fixed and variable sized records, Types of single–Level index (primary, Secondary, clustering), Multilevel Indexes, Dynamic multilevel indexes using B tree and B+ tree.</td>
</tr>
</tbody>
</table>

**Text Books:**

2. Database Management system, Ramakrishnan, Mc Graw Hill.

**Reference Books:**

Course Code: OE-EE 601B | Category: Open Elective Courses
Course Title: Object Oriented Programming | Semester: Sixth
L-T-P: 3-0-0 | Credit: 3
Pre-Requisites: Codes basic programs in Java programming language

Course Objectives:
- Defines arrays in Java and uses them
- Makes relational operations in Java

Course Outcomes:
CO 1: Codes basic programs in Java programming language
CO 2: Apply knowledge and Makes relational operations in Java
CO 3: Defines arrays in Java and uses them
CO 4: Analyze and Uses objects and classes
CO 5: Design and declares objects and classes
CO 6: Evaluate and distinguishes classes and objects

Module 1: Object oriented Design (10 hours)
Concept of Object oriented programming language, Major and minor elements, Object, Class, relationship among objects, aggregation, links, relationship among classes association, aggregation using instantiation, meta-class, grouping constructs.

Module 2: Object oriented concept (4 Hours)
Difference between OOP and other conventional programming, advantages and disadvantages. Class, object, message passing, inheritance, encapsulation, polymorphism

Module 3: Basic concepts of Object oriented programming using Java (26 Hours)
Class & Object properties: Basic concepts of Java programming-advantages of Java, byte code & JVM, data types, access specifies, operators, control statements & loops, array, creation of class, object, constructor, finalize and garbage collection, use of method overloading, this keyword, use of objects as parameter & methods returning objects, call by value & call by reference, static variables & methods, garbage collection, nested and inner classes, basic string handling concepts, -String (discuss char(), compare(), equals(), equals Ignore case (), index Of (), length(), substring(), to Char Array(),to Lower Case (), to string (), methods), concept of mutable and immutable string, command line arguments, basics of I/O operations-keyboard input using Buffered Reader & Scanner classes.
Reusability properties: Super class & subclasses including multilevel hierarchy, process of constructor calling in inheritance, use of super and final keywords with super() method, dynamic method dispatch, use of abstract classes, & methods, interfaces. Creation of packages, importing
packages, member access for packages.

**Exception handling & Multithreading:** Exception handling basics, different types of exception classes, use of try & catch with throw, throws & finally, creation of user defined exception classes. Basics of multithreading, main thread, thread life cycle, creation of multiple threads, thread synchronization, inter thread communication, deadlocks for threads, suspending & resuming threads.

**Text Books:**

1. Object Oriented Modeling and design, James Rambaugh & Michael Blaha, PHI.
2. Object Oriented Programming with C++ and Java, D. Samanta, PHI
3. Programming with Java: A Primer, E. Balagurusamy, TMH.

**Reference Books:**

2. The complete reference Java2, Patrick Naughton & Herbert Schildt, TMH
<table>
<thead>
<tr>
<th>Course Code: OE-EE601C</th>
<th>Category: Open Elective Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: Data Science with Python</td>
<td>Semester: Sixth</td>
</tr>
<tr>
<td>L-T-P: 3-0-0</td>
<td>Credit: 3</td>
</tr>
<tr>
<td>Pre-Requisites: Knowledge of basic data science algorithms, Python, C, C++, Object Oriented Programming</td>
<td></td>
</tr>
</tbody>
</table>

**Course Objectives:**
- Basic process of data science
- Python and Jupyter notebooks
- An applied understanding of how to manipulate and analyze uncurated datasets
- Basic statistical analysis and machine learning methods
- How to effectively visualize results

**Course Outcomes:**
- CO 1: Develop relevant **programming** abilities.
- CO 2: Demonstrate proficiency with statistical **analysis of data**.
- CO 3: Develop the ability to build and assess data-based **models**.
- CO 4: Execute statistical analyses with professional statistical **software**.
- CO 5: Demonstrate skill in **data management**.
- CO 6: Apply data science concepts and methods to **solve** problems in real-world contexts and will **communicate** these solutions effectively

**Module 1: Introduction to Programming (5 hours)**
History of Computers, Understanding Hardware Writing First Program
**Variables & Data Types:** Strings, Integers, Integers, Floats, Boolean, etc., Assigning Variables, Operators

**Module 2: Control Flow (6 Hours)**
Define motivation behind control flow If, If-Else, Elif, Switch Statements
**Complex Data Types:** Initializing Lists, Printing Lists, List functions such as length, append, pop, etc., Introduction to Dictionaries & their structures
**Loops:** Define the motivation behind using a loop, For While, Do-While, For Each loops Error Handling
**Functions:** Identify when to use a function, Syntax & Implementation, Arguments & Return values

**Module 3: Object Oriented Programming (6 Hours)**
Introduction to O.O.P paradigm, Introduction to Objects, Classes, Instances Inheritance, Abstraction, and Sets
<table>
<thead>
<tr>
<th>Module 4: Advanced Python (6 Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>File Input, User Input, List Comprehension, Packages</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 5: Data Science (9 Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Data Science, Review Python Fundamentals, Understanding the data science discipline, Pandas, Data set reading Filtering, Cleaning, Manipulating Data, Excel vs Python</td>
</tr>
</tbody>
</table>

**Data Visualization:** Matplotlib Package, Understanding motivations between different graphs

**Machine Learning:** Sci-Kit Learn package, Understand motivation and definition of machine learning

<table>
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<th>Module 6: Internal of RDBMS (6 Hours)</th>
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<tbody>
<tr>
<td>Physical data structures, Query optimization: join algorithm, statistics and cost base optimization, Transaction processing, Concurrency control and recovery management: transaction model properties, state serializability, look base protocols, two phase locking.</td>
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<td>File &amp; records concepts, Placing file records on disk, Fixed and variable sized records, Types of single –Level index (primary, Secondary, clustering), Multilevel Indexes, Dynamic multilevel indexes using B tree and B+ tree.</td>
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</tbody>
</table>

**Text / Reference Books:**

1. Intro to Python for Computer Science and Data Science by by Harvey Deitel, PAUL. DEITEL DEITEL (HARVEY.), and Paul Deitel
## Curriculum Structure for B.Tech courses in Electrical Engineering

### (Applicable from the academic session 2020-2021)

<table>
<thead>
<tr>
<th>Course Code: PE-EE 601A</th>
<th>Category: Professional Elective Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: Digital Control Systems</td>
<td>Semester: Sixth</td>
</tr>
<tr>
<td>L-T-P : 3-0-0</td>
<td>Credit: 3</td>
</tr>
<tr>
<td>Pre-Requisites: Automatic Control, Microcontroller Systems</td>
<td></td>
</tr>
</tbody>
</table>

### Course Objective:
- This course provides the students with the needed background for analyzing, designing, and implementing digital controllers. Emphasis will be given to real-time control of mechatronic systems.

### Course Outcome:
- CO 1: Understand the basic concepts of digital control theory.
- CO 2: Analyze and solve mathematical problems related to digital control theory.
- CO 3: Analyze the response of closed-loop systems.
- CO 4: Design digital controllers.
- CO 5: Program and simulate digital controllers using MATLAB.
- CO 6: Represent digital control systems using state space models.

### Module 1: Introduction (4 hours)
Review: Modeling and Analog Control

### Module 2: Sampled Data Systems and Z-Transform (10 Hours)
Sampling Process; Linear Difference Equations; Z-Transform; Z-transform method for solving difference equations, Discrete Functions; Pulse Transfer Functions; Block Diagrams.

### Module 3: System Response Characteristics (6 Hours)
Introduction, System Time Response, Time Domain Specifications; Mapping s-domain to z-domain, Steady State Accuracy.

### Module 4: Discrete equivalence (4 Hours)
Bilinear Transformation; Zero-order-Hold; Pole-zero matching

### Module 5: System Stability (6 Hours)
Introduction, The Routh Hurwitz Criterion, Jury’s Stability Test; Root Locus, The Nyquist Criterion.

### Module 6: Discrete Controller Design (8 Hours)
Module 7: State Variable Analysis (10 hours)

Numerical problems are to be solved in the tutorial classes.

Text /Reference Books:

1. Digital Control of Dynamic Systems by Franklin, Powel, and Workman. 3rd edition. Addison-Wesley Publisher
**Course Code**: PE-EE 601B  
**Category**: Professional Elective Courses

<table>
<thead>
<tr>
<th><strong>Course Title</strong></th>
<th><strong>Semester</strong></th>
<th><strong>L-T-P</strong>: 3-0-0</th>
<th><strong>Credit</strong>: 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Control System</td>
<td>Sixth</td>
<td>3-0-0</td>
<td>3</td>
</tr>
</tbody>
</table>

**Pre-Requisites**: Basic knowledge of Control system and Physical system

**Course Objectives**:
- To learn the advanced methods for analyzing the behavior of control systems and designing of control systems.

**Course Outcomes**:

**CO 1**: Acquire knowledge of state space and state feedback in modern control systems, pole placement, design of state observers and output feedback controllers.

**CO 2**: Demonstrate non-linear system behavior by phase plane and describing function methods.

**CO 3**: Perform the stability analysis of nonlinear systems by Lyapunov method and develop design skills in optimal control problems.

**CO 4**: Develop skill to design sliding mode controller for control system.

**CO 4**: Derive discrete-time mathematical models in both time domain (difference equations, state equations) and z-domain (transfer function using z-transform).

**CO 5**: Predict and analyze transient and steady-state responses and stability and sensitivity of both open-loop and closed-loop linear, time-invariant, discrete-time control systems.

**Module 1: State Feedback Control (8 hours)**  

**Module 1: Nonlinear Control Systems (10 hours)**  
Introduction to Nonlinear systems and their properties, Common Non-linearities, Describing functions, Phase plane method, Lyapounov’s method for stability study, concept of Limit Cycle

**Module 2: Optimal Control Theory (8 Hours)**  
Introduction, Optimal control problems, Mathematical procedures for optimal control design: Calculus of variations, Pontryagin’s optimum policy, Bang-Bang Control, Hamilton-Jacobi Principle

**Module 3: Sliding Mode Control (6 Hours)**  
Introduction and the concept, Sliding surface, Equivalent Control.

**Module 3: z-Plane Analysis of Discrete-Time Control Systems (10 Hours)**  
Introduction, Impulse sampling and data hold, Reconstructing original signal from sampled signals, concept of pulse transfer function, Realization of digital controllers.
Module 4: Design of Discrete-time Control Systems (8 Hours)
Introduction, Stability analysis of closed-loop systems in the z-plane, Transient and steady state response analysis, Design based on the root-locus method, Design based on the frequency response method.

Numerical problems are to be solved in the tutorial classes.

Text /Reference Books:

### Course Code: PC-EE 691  
**Category:** Professional Core Course

<table>
<thead>
<tr>
<th><strong>Course Title:</strong> Power System-II Laboratory</th>
<th><strong>Semester:</strong> 6th</th>
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</table>

<table>
<thead>
<tr>
<th><strong>L-T-P:</strong></th>
<th>0-0-2</th>
<th><strong>Credit:</strong> 1</th>
</tr>
</thead>
</table>

**Pre-Requisites:** Power Systems-I, Electrical Machine and Control System, Mathematics.

### Course Outcomes:

**CO 1:** Identify relevant information learned from previous courses that can be applied to power systems.

**CO 2:** Apply the previously gained knowledge to interpret different aspects of power systems and identify the different parameters which can be used to control the operation of power systems.

**CO 3:** Develop testing and experimental procedures to simulate and verify the theoretical knowledge.

**CO 4:** Practice different types of simulations and study the effect of changing different control parameters on the operation of power systems and identify any discrepancy with theoretical knowledge.

**CO 5:** Prepare professional quality textual and graphical presentations of laboratory data and computational results, incorporating accepted data analysis and synthesis methods, mathematical software, and word-processing tools.

**CO 6:** Primarily via team-based laboratory activities, students will demonstrate the ability to interact effectively on a social and interpersonal level with fellow students, and will demonstrate the ability to divide up and share task responsibilities to complete assignments.

### List of Experiments:

1. Formation of Bus Admittance Matrix.
2. Study of AC load flow using Gauss-Seidal Method.
4. Study on Economic Load Dispatch.
5. Transient stability analysis of single machine connected to infinite bus.
6. Voltage control using STATCOM.
7. Study on the reliability of power system using Power world.
9. Study the effect of transformers in power flow.
## Haldia Institute of Technology, West Bengal
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology)

**Curriculum Structure for B.Tech courses in Electrical Engineering**
*(Applicable from the academic session 2020-2021)*

<table>
<thead>
<tr>
<th>Course Code: PC-EE 692</th>
<th>Category: Professional Core Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course Title:</strong> Power Electronics Laboratory</td>
<td><strong>Semester:</strong> Six</td>
</tr>
<tr>
<td><strong>L-T-P:</strong> 0-0-2</td>
<td><strong>Credit:</strong> 1</td>
</tr>
<tr>
<td><strong>Pre-Requisites:</strong> Basic Electrical Engineering and Analog Electronics</td>
<td></td>
</tr>
</tbody>
</table>

### Course Outcomes:

**CO 1:** Identify relevant information to supplement to the Power Electronics (PCEE603) course.

**CO 2:** Set up testing strategies and select proper instruments to evaluate performance characteristics of Power devices and power electronics circuits and analyze their operation under different loading conditions.

**CO 3:** Practice different types of wiring and devices connections keeping in mind technical, economical, safety issues.

**CO 4:** Realize the limitations of computer simulations for verification of circuit behavior apply these techniques to different power electronic circuits and evaluate possible causes of discrepancy in practical experimental observations in comparison to theory.

**CO 5:** Prepare professional quality textual and graphical presentations of laboratory data and computational results, incorporating accepted data analysis and synthesis methods, mathematical software, and word-processing tools.

**CO 6:** Primarily via team-based laboratory activities, students will demonstrate the ability to interact effectively on a social and interpersonal level with fellow students, and will demonstrate the ability to divide up and share task responsibilities to complete assignments.

### List of Experiments:

1. Study of the characteristics of an SCR.
2. Study of the characteristics of a TRIAC.
3. Study of different triggering circuits of an SCR.
5. Study of performance of single phase half controlled bridge converters.
7. Study of performance of step up chopper.
8. Study of performance of PWM bridge inverter.
Haldia Institute of Technology, West Bengal
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology)
Curriculum Structure for B.Tech courses in Electrical Engineering
(Applicable from the academic session 2020-2021)

<table>
<thead>
<tr>
<th>Course Code: PC-EE 693</th>
<th>Category: Professional Core Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course Title:</strong> Micro-processor and Microcontroller laboratory</td>
<td><strong>Semester:</strong> 6th</td>
</tr>
<tr>
<td><strong>L-T-P:</strong> 0-0-2</td>
<td><strong>Credit:</strong> 1</td>
</tr>
</tbody>
</table>

**Pre-Requisites:** Physics and Basic Electrical and Electronics Engineering (Theory and Laboratory)

**Course Objectives:**
- To expose students to the operation of typical microprocessor (8085) trainer kit.
- To prepare the students to be able to solve different problems by developing different programs.
- To develop the quality of assessing and analyzing the obtained data.

**Course Outcomes:**

<table>
<thead>
<tr>
<th>CO 1:</th>
<th>Identify relevant information to supplement to the Microprocessor and Microcontroller course.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO 2:</td>
<td>Set up programming strategies and select proper mnemonics and run their program on the training boards.</td>
</tr>
<tr>
<td>CO 3:</td>
<td>Practice different types of programming keeping in mind technical issues and evaluate possible causes of discrepancy in practical experimental observations in comparison.</td>
</tr>
<tr>
<td>CO 4:</td>
<td>Develop testing and experimental procedures on Microprocessor and Microcontroller analyze their operation under different cases.</td>
</tr>
<tr>
<td>CO 5:</td>
<td>Prepare professional quality textual and computational results, incorporating accepted data analysis and synthesis methods, simulation software, and word-processing tools.</td>
</tr>
<tr>
<td>CO 6:</td>
<td>Primarily via team-based laboratory activities, students will demonstrate the ability to interact effectively on a social and interpersonal level with fellow students, and will demonstrate the ability to divide up and share task responsibilities to complete assignments.</td>
</tr>
</tbody>
</table>

**List of Experiments (perform any ten):**

1. Familiarization with 8085 trainer kit, process of storing and viewing of data.
2. Familiarization with 8085 simulator
3. Assembly language programming using 8085 trainer kit/simulator.
4. Arithmetic operation (e.g. Addition of two 8-bit numbers, Addition of two 16-bit numbers, 8-bit subtraction etc.)
5. Assembly language programming using 8085 trainer kit/simulator. Logical operation (eg. AND, OR etc.)
6. Assembly language programming using 8085 trainer kit/simulator. 1’s and 2’s complement of a 8 bit number
7. Assembly language programming using 8085 trainer kit/simulator. Branch operations
8. Assembly language programming using 8085 trainer kit/simulator
To find the largest number among a group of data.
9. Assembly language programming using 8085 trainer kit/simulator
To find the smallest number among a group of data.
10. Assembly language programming using 8085 trainer kit/simulator Sequence a group of number in ascending and descending order.
11. Assembly language programming using 8085 trainer kit/simulator for Addition of three or more 8-bit numbers.
12. Assembly language programming using 8085 trainer kit/simulator
13. Familiarization with 8086 trainer kit, process of storing and viewing of data.
14. Assembly language programming for Addition, Subtraction using 8086 trainer kit/simulator
15. Assembly language programming for Multiplication, Division using 8086 trainer kit/simulator
16. Assembly language programming for data transfer using 8086 trainer kit/simulator
17. Transfer a block of data from one memory location to another memory location.
18. Study of interfacing devices(ex.RS232)
19. Program using subroutine calls and using IN/OUT instruction using 8255 PPI on the trainer kit e.g.
   subroutine for delay, reading switch state and glowing LEDs accordingly, finding out frequency of pulse train etc.
20. Interfacing any 8-bit latch (74LS373) with trainer kit as a peripheral mapped output port with absolute address decoding.
22. Assembly language programming using 8051 trainer kit/simulator
23. Arithmetic operation
24. Logical operation
25. Assembly language programming using 8051 trainer kit/simulator a) Interfacing with keyboard
   Interfacing with dc motor
   Interfacing with stepper motor
   Interfacing with ADC, DAC
Curriculum Structure for B.Tech courses in Electrical Engineering
(Applicable from the academic session 2020-2021)

**Course Code:** OE-EE 691 A  
**Category:** Open Elective Courses

<table>
<thead>
<tr>
<th><strong>Course Title:</strong> Database Management Systems Laboratory</th>
<th><strong>Semester:</strong> Six</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>L-T-P:</strong> 0-0-2</td>
<td><strong>Credit:</strong> 1</td>
</tr>
</tbody>
</table>

**Pre-Requisites:** Basic database concepts, applications, data models, schemas and instances

**Course Outcomes:**

**CO 1:** Apply the basic concepts of Database Systems and Applications

**CO 2:** Use the basics of SQL and construct queries using SQL in database creation and interaction

**CO 3:** Design a commercial relational database system (Oracle, MySQL) by writing SQL using the system

**CO 4:** Analyze and Select storage and recovery techniques of database system

**List of Experiments:**

1. Creating Database:
   - Creating a Database
   - Creating a table
   - Specifying Relational Data Types
   - Specifying Constraints
   - Creating Indexes.

2. Table and record Handling
   - INSERT statement
   - Using SELECT and INSERT together
   - DELETE, UPDATE, TRUNCATE statements
   - DROP, ALTER statements

3. Retrieving Data from Database
   - The SELECT statement
- Using the WHERE clause
- Using Logical Operators in the WHERE clause
- Using IN, BETWEEN, LIKE, ORDER, BY GROUP BY and HAVING

4. Clause
   - Using AGGREGATE function
   - Combining Tables using JOINS
   - Sub queries

5. Database Management.
   - Creating views
   - Creating Column Aliases
   - Creating Database Users
   - Using GRANT and REVOKE
Curriculum Structure for B.Tech courses in Electrical Engineering  
(Applicable from the academic session 2020-2021)

<table>
<thead>
<tr>
<th>Course Code: OE-EE 691B</th>
<th>Category: Open Elective Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: Object Oriented Programming laboratory</td>
<td>Semester: 6th</td>
</tr>
<tr>
<td>L-T-P : 0-0-2</td>
<td>Credit: 1</td>
</tr>
</tbody>
</table>

Pre-Requisites: Codes basic programs in Java programming language

**Course Objectives:**
- Defines arrays in Java and uses them
- Makes relational operations in Java

**Course Outcomes:**

**CO 1:** Codes basic programs in Java programming language

**CO 2:** Apply knowledge and Makes relational operations in Java

**CO 3:** Defines arrays in Java and uses them

**CO 4:** Analyze and Uses objects and classes

**CO 5:** Design and declares objects and classes

**List of Experiments:**

1. Assignments on class, constructor, overloading, inheritance, overriding
2. Assignments on wrapper class, arrays
3. Assignments on developing interfaces- multiple inheritance, extending interfaces
4. Assignments on creating and accessing packages
5. Assignments on multithreaded programming
6. Assignments on applet programming

Note: Use Java for programming Preferably download "java_ee_sdk-6u4-jdk7-windows.exe" from http://www.oracle.com/technetwork/java/javaee/downloads/java-ee-sdk-6u3-jdk-7u1-downloads-523391.html
Curriculum Structure for B.Tech courses in Electrical Engineering  
(Applicable from the academic session 2020-2021)

<table>
<thead>
<tr>
<th>Course Code: OE-EE 691C</th>
<th>Category: Open Elective Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: Data Science with Python Laboratory</td>
<td>Semester: 6th</td>
</tr>
<tr>
<td>L-T-P : 0-0-2</td>
<td>Credit: 1</td>
</tr>
<tr>
<td>Pre-Requisites: Knowledge of basic data science algorithms, Python, C, C++, Object Oriented Programming</td>
<td></td>
</tr>
</tbody>
</table>

**Course Objectives:**

- Basic process of data science
- Python and Jupyter notebooks
- An applied understanding of how to manipulate and analyze uncurated data sets
- Basic statistical analysis and machine learning methods
- How to effectively visualize results

**Course Outcomes:**

**CO 1:** Install python on windows/ ubuntu operating system. Use editor- pycharm to execute python programs

**CO 2:** Use operations on lists, tuples, sets, dictionary data types to solve given programing problem.

**CO 3:** Apply object-oriented concepts in python programing to solve given real world problem.

**CO 4:** Analyze mathematical and simple real world problems and device programming solutions using python programming language.

**CO 5:** Apply python as testing tool.

**CO6:** Understand use of python programming in simple IOT based application.

**List of Experiments:**

1. Python and Pycharm Installation
2. Python Lists
3. Python Sets
4. Python Dictionary
5. File Handling
6. Exception Handling
7. Testing
8. Object Oriented Programming
9. Self Study and creative presentation
<table>
<thead>
<tr>
<th>Course Code: PE-EE 701A</th>
<th>Category: Professional Elective Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course Title:</strong> Electrical Drives</td>
<td><strong>Semester:</strong> 7th</td>
</tr>
<tr>
<td>L-T-P : 3-0-0</td>
<td><strong>Credit:</strong> 3</td>
</tr>
<tr>
<td><strong>Pre-Requisites:</strong> Power Electronics, Electrical Machine and Control System</td>
<td></td>
</tr>
</tbody>
</table>

**Course Outcomes:**

**CO 1:** Examine various applications in industrial and domestic areas where use of electric drives are essential.

**CO 2:** Classify types of electric drives systems based on nature of loads, control objectives, performance and reliability.

**CO 3:** Combine concepts of previously learnt courses such as, electrical machines, Control and power electronics to cater to the need of automations in industries.

**CO 4:** Select most suitable type and specification of motor drive combination for efficient conversion and control of electric power.

**CO 5:** Identify the critical areas in application levels, and derive typical solutions.

**CO 6:** Design and justify new control and power conversion schemes for implementing alternative solutions considering the critical and contemporary issues.

**Module 1: Introduction to Electric Drives (8 Hours)**


Motor power rating: Thermal model of motor for heating and cooling, classes of motor duty, determination of motor rating for continuous, short time and intermittent duty, equivalent current, torque and power methods of determination of rating for fluctuating and intermittent loads. Effect of load inertia & environmental factors.

**Module 2: Basics of Electric Drives (08 hours)**


### Module 3: DC motor drives (06 hours)
Modeling of DC motors, State space modeling, block diagram & Transfer function, Single phase, 
three phases fully controlled and half controlled DC drives. Dual converter control of DC drives. 
Power factor, supply harmonics and ripple in motor current chopper controlled DC motor drives.

### Module 4: Induction motor drives (06 hours)
Stator voltage variation by three phase controllers, Speed control using chopper resistance in the rotor 
circuit, slip power recovery scheme. Pulse width modulated inverter fed and current source inverter 
fed induction motor drive. Volts/Hertz Control, Vector or Field oriented control.

### Module 5: Synchronous motor drives (4 hours)
Variable frequency control, Self Control, Voltage source inverter fed synchronous motor drive, Vector 
control.

### Module 6: Industrial application: (4 hours)
Introduction to Solar and Battery Powered Drive, Stepper motor, Switched Reluctance motor drive, 
Drive consideration for Textile mills, Steel rolling mills, Cement mills, Paper mills, Machine tools. 
Cranes & hoist drives.

#### Text Books:

2. Electric Drives, Vedam Subrahmanyam, TMH

#### Reference Books:

1. Electric motor drives, R. Krishnan, PHI
### Course Code: PE-EE 702A

**Category:** Professional Elective Courses  
**Semester:** 7th  
**Credit:** 3

<table>
<thead>
<tr>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>High Voltage Engineering</td>
</tr>
</tbody>
</table>

**L-T-P:** 3-1-0

**Pre-Requisites:** Power System, Basic Electrical Engineering, control system

### Course Outcomes:

**CO 1:** Understand physical processes involved in operation of high voltage systems.

**CO 2:** Evaluate different high voltage generation, measurement and testing of high voltage apparatus schemes using modern simulation tools.

**CO 3:** Assess relevant high voltage generation and measurement schemes for use as per customer requirements.

**CO 4:** Arrange testing schemes for the apparatus used in high voltage system following national and international standard guidelines.

**CO 5:** Diagnose the fault situations in high voltage apparatus due to environmental disturbances.

**CO 6:** Provide the suitable solution for protection of the high voltage apparatus against the fault and unwanted disturbances.

### Module 1: Breakdown phenomena (12 hours)


Partial Discharge: definition and development in solid dielectric.


Breakdown of Liquid: Intrinsic Break down, Cavitation Theory, Suspended particle Theory.

Breakdown in Vacuum: Nonmetallic electron emission mechanism, Clump mechanism, Effect of pressure on breakdown voltage.

### Module 2: Generation of High Voltage (10 hours)

Generation of high AC voltages: Testing transformer, Cascaded transformer, Series resonant circuit, single stage and multi stage. Advantages of Series Resonant Circuit in testing of cables.

Generation of DC high voltage: Cockcroft Walton doubler and multistage circuit. Electrostatic generator.

Definition of Impulse Voltage as per Indian Standard Specification, wave front and wave tail time.

Generation of Impulse Voltage, Multistage Impulse generator, triggering of Impulse Generator.
### Module 3: Measurement of High Voltage (6 hours)
Sphere gap voltmeter, AC, DC and impulse high voltage measurement as per Indian Standard Specifications. Resistance and Capacitance Potential dividers, Peak voltmeters for measurement of high AC voltage in conjunction with capacitance dividers. Capacitance Voltage Transformer, Rotating Voltmeter for the measurement of DC high voltage, Electrostatic Voltmeter

### Module 4: Transient in power systems (8 hours)
Lightning Phenomena, Electrification of cloud, Development of Lightning Stroke, lightning induced over voltage, direct stroke, indirect stroke. Protection of Electrical Apparatus against over voltage, Lightning Arrestors, Valve Type, Metal Oxide arresters, Expulsion type. Effect of location of lightning arresters on protection of transformer. Protection of substation, Ground wires. Insulation Coordination, Basic Insulation level. Basic Impulse level, Switching Impulse level. Volt time characteristics of protective devices, Determination of Basic Impulse level of substation equipment.

### Module 5: High Voltage Testing (4hours)
High Voltage testing, Testing as per Indian Standard Specifications, Power frequency withstand, induced over voltage and impulse test on transformers, Power frequency wet withstand test and impulse test on insulators

### Text Books:

### Reference Books:
1. High-voltage Engineering, E. Kuffel, W. S. Zaengl, Pregamon Press,
Course Code: PE-EE 702B  
Category: Professional Elective Courses

Course Title: Utilization of Electric power
Semester: 7th

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

Pre-Requisites: Basic knowledge on Electric Machine, Basic concepts of different laws on Electrostatic and Electromagnetism

Course Objective:
- To understand the basic principles of light control and types of light schemes.
- To impart how to design the traction system considering economic and technology upgradation.

Course Outcomes:

CO 1: Illustrate working principle electric power utilization and their application in real life.

CO 2: Choose proper traction systems depending upon application considering economic and technology up-gradation.

CO 3: Employ mathematical and graphical analysis considering different practical issues to design of traction system; analyze the performance parameter of the traction system.

CO 4: Examine various applications in indoor and outdoor application areas where use of light sources are essential.

CO 5: Classify types of electric light sources based on nature of operation and their objectives, performance and reliability.

CO 6: Select most suitable type and specification of illumination source for efficient conversion and Recognize different process of utilizing electric energy for heating and electrolytic process in industries purposes mostly in commercial along with few house hold applications.

Module 1: Electric Traction (16 hours)

Requirement of an ideal traction system, Supply system for electric traction, Train movement (speed time curve, simplified speed time curve, average speed and schedule speed), Mechanism of train movement (energy consumption, tractive effort during acceleration, tractive effort on a gradient, tractive effort for resistance, power & energy output for the driving axles, factors affecting specific energy consumption, coefficient of adhesion).

Electric traction motor & their control: Parallel and series operation of Series and Shunt motor with equal and unequal wheel diameter, effect of sudden change of in supply voltage, Temporary interruption of supply, Tractive effort and horse power.

Use of AC series motor and Induction motor for traction.

Traction motor control: DC series motor control, Multiple unit control, Braking of electric motors, Electrolysis by current through earth, current collection in traction system, Power electronic
controllers in traction system.

<table>
<thead>
<tr>
<th>Module 2: Illumination (8 hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The nature of radiation, Polar curve, Law of illumination, Photometry (Photovoltaic cell, distribution photometry, integrating sphere, brightness measurement), Types of Lamps: Conventional and energy efficient, Basic principle of light control, Different lighting scheme &amp; their design methods, Flood and Street lighting.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 3: Electric Heating welding (8 hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types of heating, Resistance heating, Induction heating, Arc furnace, Dielectric heating, Microwave heating.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 4: Electrolytic processes (8 hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic principles, Faraday’s law of Electrolysis, Electro deposition, Extraction and refining of metals, Power supply of Electrolytic processes.</td>
</tr>
</tbody>
</table>

Numerical problems are to be solved in the tutorial classes.

**Text / Reference Books:**

## Curriculum Structure for B.Tech courses in Electrical Engineering

*(Applicable from the academic session 2020-2021)*

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
<th>L-T-P:3-1-0</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE-EE 702C</td>
<td>Professional Elective Courses</td>
<td></td>
<td>3</td>
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</table>

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Power Systems</td>
<td>7th</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pre-Requisites</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Power System, power system control</td>
<td></td>
</tr>
</tbody>
</table>

### Course Outcomes:

**CO 1:** To discuss different techniques dealing with sparse matrix for large scale power systems.

**CO 2:** To explain different methods of power flow solutions.

**CO 3:** To solve optimal power flow problem.

**CO 4:** To analyze various types of short circuit faults.

**CO 5:** To demonstrate different numerical integration methods and factors influencing transient stability.

### Module 1: Objectives of Power System Operation (6 hours)

Power Systems in Restructured Environment; Distributed and Dispersed Generation; Environment Aspects of Electric Power Generation.

### Module 2: Economic Operation of Energy Generation Systems (10 hours)

Generation Cost Curves; Economic Operation of Thermal System; Plant Scheduling; Transmission Loss and Penalty Factor; Hydro-Thermal Scheduling; Concept of Reserves and Constraints; Unit Commitment.

### Module 3: Automatic Generation Control (8 hours)

Concept of AVR and ALFC Loops, Significance of Double Loop in ALFC; Exciter and VAR Control; Single Area Load Frequency Control; Two Area Load Frequency Control; Frequency Response.

### Module 4: Compensation in Power System (8 hours)

Reactive Power Sensitivity and Voltage Control; Load Compensation with Capacitor Banks; Line Compensation with Reactors; Shunt and Series Compensation; Fixed Series Capacitors; Thyristor Controlled Series Capacitors; Introduction to SVC and STATCOM.

### Module 5: Power System Transients (8 hours)

High Voltage testing, testing as per Indian Standard Specifications, Power frequency withstand, induced over voltage and impulse test on transformers, Power frequency wet withstand test and impulse test on insulators.
Text Books:
2. Power System Analysis, Granger and Stevenson, Mc Graw Hill

Reference Books:
3. Power system Analysis, Nagsarkar & Sukhija, Pearson
4. Power system analysis, operation and control, Chakrabarti and Halder, PHI
5. Book of Elgand.
**Haldia Institute of Technology, West Bengal**  
*(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology)*  
*Curriculum Structure for B.Tech courses in Electrical Engineering*  
*(Applicable from the academic session 2020-2021)*

<table>
<thead>
<tr>
<th>Course Code: PE-EE 702D</th>
<th>Category: Professional Elective Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course Title</strong>: Embedded Systems</td>
<td><strong>Semester</strong>: 7th</td>
</tr>
<tr>
<td><strong>L-T-P</strong>:3-0-0</td>
<td><strong>Credit</strong>: 3</td>
</tr>
<tr>
<td><strong>Pre-Requisites</strong>: Microprocessor, Microcontroller</td>
<td></td>
</tr>
</tbody>
</table>

**Course Outcomes:**

CO 1: To discuss different techniques of microprocessor, microcontroller and embedded system.

CO 2: To explain different methods of embedded system.

CO 3: To solve the problem of microprocessor, microcontroller and embedded system.

CO 4: To analyze various types of disturbances of embedded system.

CO 5: To demonstrate different mathematical tools and introduce logics for design of Programmable Devices.

**Module 1: Introduction to Embedded systems (8 hours)**


Microcontroller: characteristics and Features, Overview and architectures of Atmel 89C52 and Microchip PIC16F877 and 18F452.


**Module: 2 PIC Microcontroller (6 hours)**

PIC Microcontrollers: 16F877 Architecture and Instruction Set. External Interrupts, Timers, watch-dog timer, I/O port Expansion, analog-to-digital converter, UART, I2C and SPI Bus for Peripheral Chips, Accessories and special features

**Module: 3 Software architecture and RTOS (6 hours)**

Software Architecture: Round Robin- Round Robin with interrupts -Function Queue.

Scheduling Architecture RTOS: Architecture -Tasks and Task States -Tasks and Data -Semaphores and Shared Data - Message Queues -Mail Boxes and pipes -Timer Functions -Events -Memory Management Interrupt Routines

**Module: 4 Basic design using a real time operating system (6 hours)**

Overview. General principles. Design of an embedded system.

**Module: 5 Software development tools and debugging techniques (6 hours)**

Text Books:

Reference Books:
## Course Code: OE-EE 702A
**Category:** Open Elective Courses  
**Course Title:** Power Plant Engineering  
**Semester:** 7th  
**L-T-P:** 3-0-0  
**Credit:** 3

### Pre-Requisites:
- Engineering Thermodynamics,  
- Thermal Power Engineering

### Course Outcomes:

<table>
<thead>
<tr>
<th>CO</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Describe and analyze different types of sources and mathematical expressions related to thermodynamics and various terms and factors involved with power plant operation.</td>
</tr>
<tr>
<td>2</td>
<td>Analyze the working and layout of steam power plants and the different systems comprising the plant and discuss about its economic and safety impacts.</td>
</tr>
<tr>
<td>3</td>
<td>Combine concepts of previously learnt courses to define the working principle of diesel power plant, its layout, safety principles and compare it with plants of other types.</td>
</tr>
<tr>
<td>4</td>
<td>Describe the working principle and basic components of the nuclear power plant and the economic and safety principles involved with it.</td>
</tr>
<tr>
<td>5</td>
<td>Discuss the working principle and basic components of the hydro electric plants and the economic principles and safety precautions involved with it.</td>
</tr>
<tr>
<td>6</td>
<td>Discuss and analyze the mathematical and working principles of different electrical equipments involved in the generation of power.</td>
</tr>
</tbody>
</table>

### Module 1: Introduction (8 hours)
- Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion calculations. Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant.  
- Power plant economics and selection: Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor’s profit; depreciation and replacement, theory of rates. Economics of plant selection, other considerations in plant selection.

### Module 2: Steam power plant (8 hours)
- General layout of steam power plant, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories, Different systems such as coal handling system, pulverizers and coal burners, combustion system, draft, ash handling system, Dust collection system, Feed water treatment and condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, feed heating, reheating, flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency, Site selection of a steam power

### Module 3: Diesel power plant (8 hours)
- General layout, Components of Diesel power plant, Performance of diesel power plant, fuel system,
lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant, Comparative study of diesel power plant with steam power plant.

**Gas turbine power plant:**
Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants, Site selection of gas turbine power plant.

<table>
<thead>
<tr>
<th>Module 4: Nuclear power plant (9 hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principles of nuclear energy, Lay out of nuclear power plant, Basic components of nuclear reactions, nuclear power station, Nuclear waste disposal, Site selection of nuclear power plants.</td>
</tr>
<tr>
<td>Hydro electric station Hydrology, Principles of working, applications, site selection, classification and arrangements, hydro-electric plants, run off size of plant and choice of units, operation and maintenance, hydro systems, interconnected systems.</td>
</tr>
<tr>
<td>Non Conventional Power Plants Introduction to non-conventional power plants (Solar, wind, geothermal, tidal) etc.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 5: Electrical system (7 hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generators and their cooling, transformers and their cooling.</td>
</tr>
<tr>
<td>Instrumentation Purpose, classification, selection and application, recorders and their use, listing of various control rooms. Pollution due to power generation.</td>
</tr>
</tbody>
</table>

**Text Books:**

**Reference Books:**

Haldia Institute of Technology, West Bengal
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology)
**Curriculum Structure for B.Tech courses in Electrical Engineering**
(Applicable from the academic session 2020-2021)
<table>
<thead>
<tr>
<th>Course Code: OE-EE 702B</th>
<th>Category: Open Elective Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: Renewable Energy</td>
<td>Semester: 7th</td>
</tr>
<tr>
<td>L-T-P:3-0-0</td>
<td>Credit: 3</td>
</tr>
<tr>
<td>Pre-Requisites: Engineering Thermodynamics, Thermal Power Engineering, Machine I &amp; II</td>
<td></td>
</tr>
</tbody>
</table>

**Course Objectives:**
- To introduce students to different aspects of power plant engineering.
- To familiarize the students to the working of power plants based on different fuels.
- To expose the students to the principles of safety and environmental issues.

**Course Outcomes:**

**CO 1:** Describe and analyze different types of sources and mathematical expressions related to thermodynamics and various terms and factors involved with power plant operation.

**CO 2:** Analyze the working and layout of steam power plants and the different systems comprising the plant and discuss about its economic and safety impacts.

**CO 3:** Combine concepts of previously learnt courses to define the working principle of diesel power plant, its layout, safety principles and compare it with plants of other types.

**CO 4:** Describe the working principle and basic components of the nuclear power plant and the economic and safety principles involved with it.

**CO 5:** Discuss the working principle and basic components of the hydro-electric plants and the economic principles and safety precautions involved with it.

**CO 6:** Discuss and analyze the mathematical and working principles of different electrical equipments involved in the generation of power.

**Module 1: Introduction to Energy sources (3 hours)**
Renewable and non-renewable energy sources, energy consumption as a measure of Nation’s development; strategy for meeting the future energy requirements Global and National scenarios, Prospects of renewable energy sources. Impact of renewable energy generation on environment, Kyoto Protocol.

**Module 2: Solar Energy (8 hours)**
Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. flat plate collectors, concentrating collectors, Solar air heaters-types, solar driers, storage of solar energy-thermal storage, solar pond , solar water heaters, solar distillation, solar still, solar cooker, solar heating & cooling of buildings, photo voltaic - solar cells, different types of PV Cells, Monopoly Crystalline and amorphous Silicon solar cells. Design of PV array. Efficiency and cost of PV systems & its applications. PV hybrid systems.

**Module 3: Wind Energy (5 hours)**
Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations.
**Module 4: Energy from Biomass (3 hours)**
Biomass conversion technologies, Biogas generation plants, classification, advantages and disadvantages, constructional details, site selection, digester design consideration, filling a digester for starting, maintaining biogas production, Fuel properties of bio gas, utilization of biogas.

**Module 5: Geothermal Energy (3 hours)**
Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India.

**Module 6: Energy from Ocean (3 hours)**
Ocean Thermal Electric Conversion (OTEC) systems like open cycle, closed cycle, Hybrid cycle, prospects of OTEC in India. Energy from tides, basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy. Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of wave energy.

**Module 7: Magneto Hydrodynamic power generation (3 hours)**
Principle of MHD power generation, MHD system, Design problems and developments, gas conductivity, materials for MHD generators and future prospects.

**Module 8: Hydrogen Energy (3 hours)**

**Module 9: Fuel cell (3 hours)**
Introduction, Design principle and operation of fuel cell, Types of fuel cells, conversion efficiency of fuel cell, application of fuel cells.

Numerical problems to be solved in the class.

**Text Books:**
2. Renewable energy sources and conversion technology, Bansal Keemann, Meliss, Tata Mc Graw Hill.

**Reference Books:**
1. Renewable energy resources and emerging technologies, D.P. Kothari, Prentice Hall of India Pvt. Ltd.

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<table>
<thead>
<tr>
<th>Course Code: OE-EE 702C</th>
<th>Category: Open Elective Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: Electric Vehicle Technology</td>
<td>Semester: 7th</td>
</tr>
<tr>
<td>L-T-P:3-0-0</td>
<td>Credit: 3</td>
</tr>
<tr>
<td>Pre-Requisites: Basic Electrical and Electronics Engineering</td>
<td></td>
</tr>
</tbody>
</table>

**Course Objective:**
- To introduce students to different aspects of EV.
- To familiarize the students to the operation of EV along with charging systems.
- To expose the students to the principles of safety and environmental issues.

**Course Outcomes:**

- **CO 1:** To understand about basics of hybrid electric vehicle
- **CO 2:** To understand about drives and control.
- **CO 3:** Select battery, battery indication system for EV applications.
- **CO 4:** Design battery charger for an EV.

**Module 1: – Introduction to Hybrid Electric Vehicle (9 hours)**
Review of Conventional Vehicle: Introduction to Hybrid Electric Vehicles: Types of EVs, Hybrid Electric Drive-train, Tractive effort in normal driving

**Module 2: Electric Drives (9 hours)**
Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains, Electric Propulsion unit, Configuration and control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, switched reluctance motor

**Module 3: – Energy Storage (9 hours)**
Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles:- Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system, Design of Hybrid Electric Vehicle and Plug-in Electric Vehicle

**Module 4: Energy Management System (9 hours)**

**Module 5: Mobility and Connectors (9 hours)**
Connected Mobility and Autonomous Mobility- case study Emobility Indian Roadmap Perspective. Policy: EVs in infrastructure system, integration of EVs in smart grid, social dimensions of EVs. Connectors- Types of EV charging connector, North American EV Plug Standards, DC Fast Charge EV Plug Standards in North America, CCS (Combined Charging System), CHAdeMO, Tesla, European EV Plug Standards
Text / Reference Books:


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<table>
<thead>
<tr>
<th>Course Code: OE-EE 702D</th>
<th>Category: Open Elective Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: Power Plant Instrumentation and Control</td>
<td>Semester: 7th</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Name</td>
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</tr>
<tr>
<td></td>
<td>Course Outcomes:</td>
</tr>
<tr>
<td></td>
<td><strong>CO 1</strong>: To provide an overview of different methods of power generation with a particular stress on thermal power generation.</td>
</tr>
<tr>
<td></td>
<td><strong>CO 2</strong>: To bring out the various measurements involved in power generation plants.</td>
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<tr>
<td></td>
<td><strong>CO 3</strong>: To provide knowledge about the different types of devices used for analysis.</td>
</tr>
<tr>
<td></td>
<td><strong>CO 4</strong>: To part knowledge about the different types of controls and in control loops.</td>
</tr>
<tr>
<td></td>
<td><strong>CO 5</strong>: To familiarize the student with the methods of monitoring different parameters like speed, vibration of turbines and their control.</td>
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<tr>
<td></td>
<td><strong>CO 6</strong>:</td>
</tr>
</tbody>
</table>

**Module 1: OVERVIEW OF POWER GENERATION (8 hours)**
- Concepts of energy conversions and measurement requirements for power plants,
- Brief survey of methods of power generation – Hydro, thermal, nuclear, solar and wind power – Importance of instrumentation in power generation.

**Module 2: MEASUREMENTS IN POWER PLANTS (8 hours)**
- Electrical measurements – Current, voltage, power, frequency, power factor etc.
- Non electrical parameters – Flow of feed water, fuel, air and steam with correction factor for temperature
- Steam pressure and steam temperature
- Drum level measurement
- Radiation detector – Smoke density measurement
- Dust monitor, Analyser type instruments

**Module 3: ANALYSERS IN POWER PLANTS (8 hours)**
- Flue gas oxygen analyzer – Analysis of impurities in feed water and steam
- Dissolved oxygen analyzer
- Chromatography – pH meter
- Fuel analyzer
- Pollution monitoring instruments.

**Module 4: CONTROL LOOPS IN BOILER (8 hours)**
- Combustion control – Air/fuel ratio control
- Furnace draft control
- Drum level control
- Main steam and reheat steam temperature control
- Super heater control – Air temperature
- Deaerator control – Distributed control system in power plants
- Interlocks in boiler operation.

**Module 5 TURBINE – MONITORING AND CONTROL (8 hours)**
- Speed, vibration, shell temperature monitoring and control
- Steam pressure control
- Lubricant oil temperature control
- Cooling system.

**Text Books:**

**Reference Books:**
### Pre-Requisites:
Computer Knowledge, 
Hardware and software network

### Course Objectives:
- Describe how computer networks are organized with the concept of layered approach.
- Implement a simple LAN with hubs, bridges and switches.
- Describe how packets in the Internet are delivered.
- Analyze the contents in a given Data Link layer packet, based on the layer concept.
- Design logical sub-address blocks with a given address block.

### Course Outcomes:

| CO 1 | Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies. |
| CO 2 | Have a basic knowledge of the use of cryptography and network security. |
| CO 3 | Specify and identify deficiencies in existing protocols, and then go onto formulate new and better protocols. |
| CO 4 | Have a working knowledge of datagram and internet socket programming. |
| CO 5 | Ability to apply acquired knowledge of mathematics, science and Information Technology to solve engineering problems. |

### Module 1: Overview of Data Communication and Networking (10 hours)

- Introduction, Data communications: components, data representation (ASCII, ISO etc.), direction of data flow (simplex, half duplex, full duplex); network criteria, physical structure (type of connection, topology), categories of network (LAN, MAN, WAN); Internet: brief history, Protocols and standards; Reference models: OSI reference model, TCP/IP reference model, their comparative study.

#### Physical Level:

- Overview of data (analog & digital), signal (analog & digital), transmission (analog & digital) & transmission media (guided & unguided); Circuit Switching: time division & space division switch, TDM bus; Telephone Network.

### Module 2: Data link Layer and Medium Access sub layer (10 hours)

- Types of errors, framing (character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back-N ARQ, Selective repeat ARQ, HDLC;]

#### Medium Access sub layer:

- Point to Point Protocol, LCP, NCP, Token Ring; Reservation, Polling, Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA Traditional Ethernet, fast Ethernet (in brief).

### Module 3: Network layer and Transport layer (12 hours)


#### Transport layer:

- Process to Process delivery; UDP; TCP; Congestion Control: Open Loop, Closed Loop choke
packets; Quality of service: techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm,

**Module 4: Application Layer and Modern topics (8 hours)**
Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW; Security: Cryptography (Public, Private Key based), Digital Signature, Firewalls.

**Modern topics:**
ISDN services & ATM, DSL technology, Cable Modem: Architecture and operation in brief. Wireless LAN: IEEE 802.11, Introduction to blue-tooth.

**Numerical problems are to be solved in the class.**

**Text Books:**
1. Data Communications and Networking (3rd Ed.), A. Forouzan , TMH
3. Data and Computer Communications (5th Ed.), W. Stallings, PHI/ Pearson Education

**Reference Books:**
1. Computer Networking -A top down approach featuring the internet, Kurose and Rose Pearson Education
2. Communication Networks, Leon, Garica, Widjaja, TMH
3. Communication Networks, Walrand, TMH.

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<table>
<thead>
<tr>
<th>Course Code: OE-EE 701B</th>
<th>Category: Open Elective Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course Title:</strong> Artificial Intelligence and Machine Learning</td>
<td><strong>Semester:</strong> 7th</td>
</tr>
<tr>
<td>L-T-P:3-0-0</td>
<td><strong>Credit:</strong> 3</td>
</tr>
<tr>
<td><strong>Pre-Requisites:</strong> Basic math, Science and</td>
<td></td>
</tr>
</tbody>
</table>
Computer programming

**Course Objective:**
- To provide a strong foundation of fundamental concepts in Artificial Intelligence and Machine Learning
- To provide a basic exposition to the goals and methods of Artificial Intelligence and ML
- To enable the student to apply these techniques in applications which involve perception, reasoning and learning

**Course Outcomes:**

| CO 1 | Understand the various searching techniques, constraint satisfaction problem and example problems- game playing techniques. |
| CO 2 | Apply these techniques in applications which involve perception, reasoning and learning. |
| CO 3 | Explain the role of agents and how it is related to environment and the way of evaluating it and how agents can act by establishing goals. |
| CO 4 | Acquire the knowledge of real world Knowledge representation. |
| CO 5 | Analyze and design a real world problem for implementation and understand the dynamic behavior of a system. |
| CO 6 | Use different machine learning techniques to design AI machine and enveloping applications for real world problems. |

**Module 1: Introduction to AI (6 hours)**
Define Artificial Intelligence, Define AI techniques, Problem solving using state space search, apply Heuristics, Hill climbing, Search using BFS, DFS.

**Module 2: Knowledge representation and Logic Programming (6 hours)**
Representing Knowledge as Rules, Representing simple facts in logic, Computable functions and predicates, Procedural Vs Declarative knowledge, Forward Vs Backward reasoning, Logic Programming-predicate Logic.

**Module 3: Mathematical foundation (6 hours)**

**Module 4: Linear Regression (6 hours)**
Model representation of single variable, Single variable cost function, Gradient Decent for Linear Regression, Gradient Decent in practice.

**Module 5: Logistic Regression (6 hours)**
Classifications, Hypothesis Representation, Decision Boundary, Cost Function, Advanced Optimization, Multi-classification (one Vs all), Problem Over fitting.

**Module 6: Supervised and Unsupervised Learning (6 hours)**
Decision on Clustering and Classification algorithms, Naïve Bayes Theorem, Decision Tree, SVM.
Module 7: Applications (6 hours)

Text Books:

Reference Books:

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<table>
<thead>
<tr>
<th>Course Code: PE-EE-791A</th>
<th>Category: Professional Elective Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: Electrical Drives Laboratory</td>
<td>Semester: 7th</td>
</tr>
</tbody>
</table>
Pre-Requisites: Power Electronics, Electrical Machine and Control System

Course Outcomes:

CO 1: Identify relevant information to supplement to the Electric Drives (PE-EE-701) course

CO 2: Set up control strategies to synthesize the voltages in dc and ac motor drives.

CO 3: Develop testing and experimental procedures applying basic knowledge in electronics, electrical circuit analysis, electrical machines, microprocessors, and programmable logic controllers.

CO 4: Ability to use standard methods to determine accurate modeling/simulation parameters for various general-purpose electrical machines and power electronics devices required for designing a system and solve drives related problems

CO 5: Estimate constraints, uncertainties and risks of the system (social, environmental, business, safety issues etc.)

CO 6: Combine the use of computer-based simulation tools relevant to electrical Drives with practical laboratory experimentation

List of Experiments:

a. Study of thyristor controlled DC Drive.

b. PWM Inverter fed 3 phase Induction Motor control

c. Dynamic braking operation for DC Motor - Study using PSIM software

d. Regenerative braking operation for DC Motor - Study using PSIM software.

e. Single phase rectifier fed DC Motor - Study using PSIM software

f. Buck Chopper fed DC Motor - Study using PSIM software

g. Three phase SPWM inverter fed Three phase induction motor study using PSIM software.

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<table>
<thead>
<tr>
<th>Course Code</th>
<th>Category</th>
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</thead>
<tbody>
<tr>
<td>HM-EE 801</td>
<td>Core subject</td>
</tr>
<tr>
<td>Course Title</td>
<td>Semester</td>
</tr>
<tr>
<td>Organizational Behaviour</td>
<td>8th</td>
</tr>
<tr>
<td>L-T-P</td>
<td>Credit</td>
</tr>
<tr>
<td>2-0-0</td>
<td>2</td>
</tr>
<tr>
<td><strong>Pre-Requisites:</strong></td>
<td></td>
</tr>
<tr>
<td>Basic concept of management, Leadership skill</td>
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</tr>
<tr>
<td><strong>Course Outcomes:</strong></td>
<td></td>
</tr>
<tr>
<td>CO 1: To discuss the development of the field of organizational behaviour and explain the micro and macro approaches</td>
<td></td>
</tr>
<tr>
<td>CO 2: To analyze and compare different models used to explain individual behaviour related to motivation and rewards</td>
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<tr>
<td>CO 3: To identify the processes used in developing communication and resolving conflicts.</td>
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<tr>
<td>CO 4: To explain group dynamics and demonstrate skills required for working in groups (team building)</td>
<td></td>
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<tr>
<td>CO 5: To identify the various leadership styles and the role of leaders in a decision making process.</td>
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<tr>
<td>CO 6: To explain organizational culture and describe its dimensions and to examine various organizational designs.</td>
<td></td>
</tr>
<tr>
<td><strong>Module 1: Organizational Behaviour (2 hours)</strong></td>
<td></td>
</tr>
<tr>
<td>Definition, Importance, Historical Background, Fundamental Concepts of OB, Challenges and Opportunities for OB.</td>
<td></td>
</tr>
<tr>
<td><strong>Module 2: Personality and Attitudes (2 hours)</strong></td>
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</tr>
<tr>
<td>Meaning of personality, Personality Determinants and Traits, Development of Personality, Types of Attitudes, Job Satisfaction.</td>
<td></td>
</tr>
<tr>
<td><strong>Module 3: Perception (2 hours)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Module 4: Motivation (4 hours)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Module 5: Group Behaviour (2 hours)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Module 6: Communication (2 hours)</strong></td>
<td></td>
</tr>
<tr>
<td>Communication Process, Direction of Communication, Barriers to Effective Communication.</td>
<td></td>
</tr>
<tr>
<td><strong>Module 7: Leadership (2 hours)</strong></td>
<td></td>
</tr>
<tr>
<td>Definition, Importance, Theories of Leadership Styles.</td>
<td></td>
</tr>
<tr>
<td><strong>Module 8: Organizational Politics (2 hours)</strong></td>
<td></td>
</tr>
<tr>
<td>Definition, Factors contributing to Political Behaviour.</td>
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<tr>
<td><strong>Module 9: Conflict Management (2 hours)</strong></td>
<td></td>
</tr>
</tbody>
</table>
Module 10: Organizational Design (4 hours)
Various Organizational Structures and their Effects on Human Behaviour, Concepts of Organizational Climate and Organizational Culture.

Text / Reference Books:

3. Shukla, Madhukar: Understanding Organizations – Organizational Theory & Practice in India, PHI

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<table>
<thead>
<tr>
<th>Course Code: PE EE 801A</th>
<th>Category: Professional Elective Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: HVDC Transmission</td>
<td>Semester: 8th</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course Objective:</th>
</tr>
</thead>
<tbody>
<tr>
<td>To introduce students with the concept of HVDC Transmission system</td>
</tr>
<tr>
<td>To familiarize the students with the HVDC converters and their control system</td>
</tr>
<tr>
<td>To expose the students to the harmonics and faults occur in the system and their protection against over currents and over voltages, filter units, Surge arresters, smoothing reactors.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course Outcomes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO 1: To acquire knowledge of HVDC transmission and different converters, applicability and advantage of HVDC transmission over conventional AC transmission.</td>
</tr>
<tr>
<td>CO 2: Formulate and solve mathematical problems related to rectifier and inverter control methods and learn about different control schemes as well as starting and stopping of DC links. Able to identify the procedures for calculations of different circuit parameters.</td>
</tr>
<tr>
<td>CO 3: Analyze the different harmonics generated by the converters and their variation with the change in firing angles and overlap angle.</td>
</tr>
<tr>
<td>CO 4: Develop harmonic models and use the knowledge of circuit theory to develop filters and assess the requirement and type of protection for the filters.</td>
</tr>
<tr>
<td>CO 5: Evaluate and judge whether the nature of faults happening on both the AC and DC sides of the converters and formulate protection schemes are correct and matches the required parameters and characteristics.</td>
</tr>
<tr>
<td>CO 6: Review the existing HVDC systems along with MTDC systems and their controls and recognize the need to follow the advancements in both the existing systems and HVDC systems and determine the most economic coexistence of both.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 1: INTRODUCTION (8 Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction of DC power transmission technology, comparison of AC and DC transmission, advantages of HVDC transmission, limitation of HVDC transmission, reliability of HVDC systems, application of DC transmission, description of DC transmission system, planning for HVDC transmission, modern trends in DC transmission.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 2: ANALYSIS OF HDVC CONVERTERS (8 Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choice of converter configuration, simplified analysis of Graetz circuit, converter bridge characteristics, Characteristics of a twelve pulse converter, detailed analysis of converters.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 3: CONTROL OF HVDC CONVERTER AND SYSTEMS (8 Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principles and necessity of a DC link control, Converter control characteristics, System control hierarchy, inverter extinction angle control, pulse phase control, Effect of source inductance on the system, Starting and stopping of DC link, constant power control, control scheme of HVDC converters.</td>
</tr>
</tbody>
</table>
Module 4: HARMONICS AND FILTERS (8 Hours)
Generation of harmonics by converters, characteristics of harmonics on DC side, characteristics of current harmonics, characteristic variation of harmonic currents with variation of firing angle and overlap angle, effect of control mode on harmonics, non-characteristic harmonic. Harmonic model and equivalent circuit, use of filter, filter configuration, design of band pass and high pass filter, protection of filters, DC filters, power line communication and RI noise, filters with voltage source converter HDVC schemes.

Module 5: FAULT AND PROTECTION SCHEMES IN HVDC SYSTEMS (8 Hours)
Nature and types of faults, faults on AC side of the converter stations, converter faults, fault on DC side of the systems, protection against over currents and over voltages, protection of filter units, Surge arresters, smoothing reactors.

Module 6: MULTI TERMINAL HVDC SYSTEMS (8 Hours)
Types of multiterminal (MTDC) systems, parallel operation aspect of MTDC. Control of power in MTDC. Multilevel DC systems. Power upgrading and conversion of AC lines into DC lines, Parallel AC/DC systems, FACTS and FACTS converters.

Text Books:
1. HVDC Transmission, S. Kamakshaiah & V. Kamaraju, Tata McGraw hill education
2. HVDC Power transmission system, K.R.Padiyar, Wiley Eastern Limited
4. EHVAC and HVDC Transmission Engineering and Practice –S.Rao

Reference Books:

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<table>
<thead>
<tr>
<th>Course Code: PE-EE 801B</th>
<th>Category: Professional Elective Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: Energy management &amp; audit</td>
<td>Semester: 8th</td>
</tr>
<tr>
<td>Course Overview</td>
<td></td>
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<tr>
<td>-----------------</td>
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</tr>
<tr>
<td><strong>Pre-Requisites:</strong></td>
<td>Basic understanding about energy consumption patterns</td>
</tr>
<tr>
<td><strong>Course Objectives:</strong></td>
<td></td>
</tr>
<tr>
<td>• To facilitate the students to achieve a clear conceptual understanding of technical and commercial aspects of energy conservation and energy auditing.</td>
<td></td>
</tr>
<tr>
<td>• To enable the students to develop managerial skills to assess feasibility of alternative approaches and drive strategies regarding energy conservation and energy auditing.</td>
<td></td>
</tr>
<tr>
<td><strong>Course Outcomes:</strong></td>
<td></td>
</tr>
<tr>
<td>CO 1: Conceptual knowledge of the technology, economics and regulation related issues associated with energy conservation and energy auditing CO2, CO3, CO4.</td>
<td></td>
</tr>
<tr>
<td>CO 2: Ability to analyze the viability of energy conservation projects</td>
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</tr>
<tr>
<td>CO 3: Capability to integrate various options and assess the business and policy environment regarding energy conservation and energy auditing</td>
<td></td>
</tr>
<tr>
<td>CO 4: Advocacy of strategic and policy recommendations on energy conservation and energy auditing</td>
<td></td>
</tr>
<tr>
<td><strong>Module 1: Energy Management &amp; Audit (6 hours)</strong></td>
<td></td>
</tr>
<tr>
<td>Definition, Energy audit need, Types of energy audit, Energy management (audit) approach understanding energy costs, Benchmarking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments and intervals of EA regulation.</td>
<td></td>
</tr>
<tr>
<td><strong>Module 2: Energy Scenario (8 hours)</strong></td>
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<tr>
<td><strong>Module 3: Energy Conservation Act-2001 and related policies (6 hours)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Module 4: Energy Efficiency and Climate changes (6 hours)</strong></td>
<td></td>
</tr>
<tr>
<td>Energy and environment, Air pollution, Climate change, United Nations Framework Convention on climate change (UNFCCC), Kyoto Protocol, Clean Development Mechanism (CDM), CDM methodology and Procedures, Sustainable development Energy and environment, Air pollution, Climate change, United Nations Framework Convention on climate change (UNFCCC), Kyoto Protocol, Clean Development Mechanism (CDM), CDM methodology and Procedures, Sustainable development.</td>
<td></td>
</tr>
<tr>
<td><strong>Module 5: Non-Conventional Energy Sources (6 hours)</strong></td>
<td></td>
</tr>
<tr>
<td>Concept of renewable Energy and importance, Different types of renewable Energy, Solar energy, Wind energy, Biomass energy, Hydro-energy, Fuel cells, Energy from wastes, Wave, Tidal and geothermal. Concept of energy storing device.</td>
<td></td>
</tr>
</tbody>
</table>
Module 6: Energy Efficient Technologies in Electrical Systems (6 hours)

Maximum demand controllers, Automatic power factor controllers, Energy efficient motors, Soft starters with energy saver, Variable speed drives, Energy efficient transformers, Electronic ballast, Occupancy sensors, Energy efficient lighting controls, Energy saving potential of each technology

Text Books:
4. Energy Management Handbook, Wayne C, John Willey and Sons

Reference Books:
1. NPC energy audit manual and reports
4. www.bee.org

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<table>
<thead>
<tr>
<th>Course Code: PE-EE 801C</th>
<th>Category: Professional Elective Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title: Illumination Engineering</td>
<td>Semester: 8th</td>
</tr>
</tbody>
</table>
### Course Objectives:
- To provide an introduction to the fundamentals of illumination engineering and architectural lighting design.
- To impart lighting fundamentals, measurement, and technology and their application in the analysis and design of architectural lighting systems.

### Course Outcomes:
- **CO 1**: Identify the criteria for the selection of lamps and lighting systems for an indoor or outdoor space.
- **CO 2**: Perform calculations on photometric performance of light sources and luminaries for lighting design.
- **CO 3**: Evaluate different types of lighting designs and applications.
- **CO 4**: To part knowledge about the different types of lamps.

#### Module 1: Light, sight & color (6 hours)

#### Module 2: Measurement of light (6 hours)
Measurement of light - radiometric and photometric quantities, units of measurement, standardization. Measurement of light distribution, direct and diffused reflection, fundamental concepts of colurimetry and measurement of colour.

#### Module 3: Lamp, accessories & luminaries (12 hours)
Light production by gas discharge, fluorescence, incandescence, daylight principle of operation, light efficacy, color, electrical characteristics, typical applications, dimming condition of GLS filament, tungsten halogen lamps, fluorescent tubes, compact fluorescent lamp (CFL), low and high pressure sodium lamps, high pressure mercury lamp, metal halide lamp. Functions of luminaries, classification, Materials Used in luminaries manufacturing, reflection, refraction, diffusion, polarization and optical design, photometric measurements, application data and its use. LED.

#### Module 4: Interior lighting (8 hours)
Objectives quantity and quality of light, selection of lamps, luminaries section, placement. Design considerations for lighting of offices, conference rooms, hospitals, teaching places, house etc., design calculations.

#### Module 5: Lighting control (8 hours)
Types of lighting controls, strategy for selection, benefits of lighting control. Electric distribution system for lighting, maintenance strategies, group replacement schedule. Techniques of achieving energy efficient lighting design, role of computers in lighting design, advantages and limitations of computer aided lighting design.
Text / Reference Books:

1. Utilization of Electric Power, C.L. Wadha, New Age International Ltd.
2. Generation, Distribution and Utilization of electrical energy, C.L. Wadha, New Age International Ltd.

Haldia Institute of Technology, West Bengal
(An Autonomous Institution under Maulana Abul Kalam Azad University of Technology)
Curriculum Structure for B.Tech courses in Electrical Engineering
(Applicable from the academic session 2020-2021)

<table>
<thead>
<tr>
<th>Course Code: OE-EE 801C</th>
<th>Category: Open Elective Courses</th>
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<tbody>
<tr>
<td>Course Title: Sensors and Transducers</td>
<td>Semester: 8th</td>
</tr>
<tr>
<td>L-T-P : 3-0-0</td>
<td>Credit: 3</td>
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</table>
**Pre-Requisites:** Applied Physics, Basics of sensing elements

**Course Objective:**
- To gain knowledge about the measuring instruments and the methods of measurement and the use of different transducers

**Course Outcomes:**

<table>
<thead>
<tr>
<th>CO 1</th>
<th>Explain the classification and static characteristics of transducers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO 2</td>
<td>Describe various measurement standards and various errors and perform error analysis.</td>
</tr>
<tr>
<td>CO 3</td>
<td>Obtain and analyze dynamic characteristics of transducer.</td>
</tr>
<tr>
<td>CO 4</td>
<td>Describe construction, working principle, characteristics and applications of various resistance transducers.</td>
</tr>
<tr>
<td>CO 5</td>
<td>Explain the working principle of various inductance and capacitance transducers.</td>
</tr>
<tr>
<td>CO 6</td>
<td>Discuss the operation and applications of modern industrial transducers.</td>
</tr>
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</table>

**Module 1: Mechanical and Electromechanical sensor (12 hours)**
Definition, principle of sensing & transduction, classification.
Resistive (potentiometric type): Forms, material, resolution, accuracy, sensitivity.
Strain gauge: Theory, type, materials, design consideration, sensitivity, gauge factor, variation with temperature, adhesive, rosettes.
Inductive sensor: common types- Reluctance change type, Mutual inductance change type, transformer action type, Magnetstrictive type, brief discussion with respect to material, construction and input output variable, Ferromagnetic plunger type, short analysis.
LVDT: Construction, material, output input relationship, I/O curve, discussion.
Proximity sensor.

**Module 2: Capacitive sensors (8 hours)**
Variable distance-parallel plate type, variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type, calculation of sensitivity. Stretched diaphragm type: microphone, response characteristics. Piezoelectric element: piezoelectric effect, charge and voltage co-efficient, crystal model, materials, natural & synthetic type, their comparison, force& stress sensing, ultrasonic sensors.

**Module 3: Thermal sensors (11 hours)**
Material expansion type: solid, liquid, gas & vapor
Resistance change type: RTD materials, tip sensitive & stem sensitive type, Thermister material, shape, ranges and accuracy specification.
Thermo emf sensor: types, thermoelectric power, general consideration, Junction semiconductor type IC and PTAT type.
Radiation sensors: types, characteristics and comparison. Pyroelectric type.
Module 4: Magnetic sensors (9 hours)
Sensor based on Villari effect for assessment of force, torque, proximity, Wiedemann effect for yoke
coil sensors, Thomson effect, Hall effect, and Hall drive, performance characteristics.
Radiation sensors: LDR, Photovoltaic cells, photodiodes, photo emissive cell types, materials,
construction, response.
Geiger counters, Scintillation detectors, Introduction to smart sensors.

Numerical problems are to be solved in the class.

Text / Reference Books:

<table>
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<tbody>
<tr>
<td><strong>Pre-Requisites:</strong> Power System</td>
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</table>

**Course Outcomes:**

| CO 1 | Acquire the knowledge to design to design a system. |
| CO 2 | Understand and apply the various factors which influence the design |
| CO 3 | Get a General awareness of the National Electric Code and know it’s importance in designing a system. |
| CO 4 | Understand the principles of system design and carry out a basic design of a heating element, grounding reactor |
| CO 5 | Learn to use software tools to do complex design/calculations if needed. |
| CO 6 | Evaluate the require parameter to create an Electrical Layout for residential building |

The students would INDIVIDUALLY design the equipment and systems as per specifications provided by the class Teacher following established procedures. For each student, any three groups can be chosen.

For unspecified items of specification and or specifications of wires, cables etc., data should be taken by students from handbooks and Indian standard.

Students should spend the allotted periods for carrying out design computations. Their attendance shall be recorded.

Students should maintain a dedicated bound notebook for recording design activities like calculations, formulae used, sketches, flowcharts etc. The notebook should be regularly submitted to the class teacher for review and signature.

Evaluation would be based on (i) Class attendance (20%), (ii) Design Note Book (30%) (iii) Design Report (30%) (iv) End of semester viva (20%, preferably by an external examiner)

**Group-A**
Designing a heating element with specified wattage, voltage and ambient temperature. Designing an air core grounding reactor with specified operating voltage, nominal current and fault current.

**Group-B**
Designing the power distribution system for a small township.
Designing a double circuit transmission line for a given voltage level and power (MVA) transfer.
Wiring and installation design of a multistoried residential building (G+4 not less than 16 dwelling flats with a lift and common pump)
Designing of a substation

**Group-C**
General awareness of IS Codes (IS 3043, IS 732, IS2675, IS5216-P12, IS2309), The Indian Electricity Act 2003, National Electric Code (NEC 2011)-scope and safety aspects applicable to low and medium (domestic) voltage installations, Electric services in buildings, Classification of voltages, standards and specifications.
General aspects of the design of electrical installations for domestic dwellings as per NEC guidelines (low and medium voltage installations)—connected load calculation, sub circuit determination, selection of main distribution board, sub distribution board, MCB, ELCB, MCCB and cables for sub circuits. Pre-commissioning tests of domestic installations.

**Group-D**
Internal Electrification design: Electrical Layout in residential building using Auto CAD, Selection of house wiring, Sizing and Selection of Conduit, Sizing and selection of Switch Socket, Calculation of load on circuit, Design of sub circuit (Lighting Circuit and Power Circuit), Distribution of Power Circuit, Calculation of fan, Calculation of Earthing for residential buildings, Sizing and selection of low voltage switchgears (MCB, MCCB, RCB, RCBOMPCB)

**Group-E**

**Text Books:**

2. A Course in Electrical Installation Estimating and Costing - J.B. Gupta, Sk Kataria & Sons
<table>
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<tr>
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<th>Name of the Mooc websites</th>
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<td>Algorithms for Battery Management Systems</td>
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<td>Data Analysis and Presentation Skills: the PwC Approach Specialization</td>
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## List of MOOCs for UG Honours degree (AICTE Programmes) for ELECTRICAL ENGINEERING

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<tr>
<th>Sl. No</th>
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<td>Fabrication Techniques for MEMs- based sensors: clinical Perspective</td>
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# List of MOOCs for UG Honours degree (AICTE Programmes) for ELECTRICAL ENGINEERING

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<td>51</td>
<td>Industry 4.0: How to Revolutionize your Business</td>
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<td>Drones and Autonomous Systems I: Fundamentals</td>
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<td>Introduction to the Internet of Things (IoT)</td>
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<td>Electric Utilities Fundamentals and Future</td>
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<td>57</td>
<td>Solar Energy Codes, Permitting and Zoning</td>
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# List of MOOCs for UG Honours degree (AICTE Programmes) for ELECTRICAL ENGINEERING

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<tr>
<th>Sl. No</th>
<th>Course name</th>
<th>Duration (weeks)</th>
<th>Credits</th>
<th>Name of the Mooc websites</th>
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<td>Motors and Motor Control Circuits</td>
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<td>Introduction to solar cells</td>
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<td>61</td>
<td>Solar Energy System Design</td>
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<td>63</td>
<td>Python for Data Science and AI</td>
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<td>Data Processing Using Python</td>
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<td>Solar Energy Basics</td>
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<td>Energy Harvesting</td>
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<td>Medical Image Analysis</td>
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<td>Interfacing with the Arduino</td>
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<td>Excel Power Tools for Data Analysis</td>
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<td>Safety in the Utility Industry</td>
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<td>A brief Introduction to Micro-sensors</td>
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### List of MOOCs for UG Honours degree (AICTE Programmes) for ELECTRICAL ENGINEERING

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<td>73</td>
<td>Design and Simulation of Power Conversion using Open Source Tools</td>
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<td>Recent Advances in Transmission Insulator</td>
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<td>Electric Vehicles Part 1</td>
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<td>Real Time Operating System</td>
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<td>Python for Data Science</td>
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<td>Introduction to the Internet of Things (IoT) and embedded system</td>
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<td>82</td>
<td>IoT Networking and Fog Layer Devices</td>
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The proposed syllabus has been approved by the following Board of Studies’ members:

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<th>Name</th>
<th>Designation</th>
<th>University/Institute</th>
<th>Signature</th>
<th>Date</th>
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<tr>
<td>Dr. Dilip Dey</td>
<td>Professor</td>
<td>Haldia Institute of Technology</td>
<td></td>
<td>21-12-2021</td>
</tr>
<tr>
<td>Dr. Arabinda Das</td>
<td>Professor</td>
<td>Jadavpur University</td>
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<tr>
<td>Dr. Jitendranath Bera</td>
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<tr>
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<tr>
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<tr>
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<tr>
<td>Mr. Jaiyoti Dhar</td>
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<tr>
<td>Mr. Subhashish Sarkar</td>
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