## Open Elective Courses (OEC)

### Open Elective-1

<table>
<thead>
<tr>
<th>S. No</th>
<th>Offering Department</th>
<th>Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Civil Engineering</td>
<td>Disaster Preparedness &amp; Planning Management</td>
</tr>
<tr>
<td>2</td>
<td>Electrical &amp; Electronics Engineering</td>
<td>Reliability Engineering</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Renewable Energy Sources</td>
</tr>
<tr>
<td>3</td>
<td>Mechanical Engineering</td>
<td>Quantitative Techniques for Business Decisions</td>
</tr>
<tr>
<td>4</td>
<td>Electronics &amp; Communication Engineering</td>
<td>System Design through IoT</td>
</tr>
<tr>
<td>5</td>
<td>Computer Science &amp; Engineering</td>
<td>Data Structures</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Java Programming</td>
</tr>
<tr>
<td>6</td>
<td>Metallurgical Engineering</td>
<td>Engineering Materials</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Metallurgy for Non Metallurgists</td>
</tr>
<tr>
<td>7</td>
<td>Chemical Engineering</td>
<td>Solid Waste Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Basics of Nanotechnology</td>
</tr>
<tr>
<td>8</td>
<td>Humanities &amp; Social Sciences</td>
<td>Professional Practice, Law and Ethics</td>
</tr>
<tr>
<td>9</td>
<td>Mathematics</td>
<td>Numerical Techniques</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Open Elective-2

<table>
<thead>
<tr>
<th>S. No</th>
<th>Offering Department</th>
<th>Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Civil Engineering</td>
<td>Remote Sensing &amp; GIS</td>
</tr>
<tr>
<td>2</td>
<td>Electrical &amp; Electronics Engineering</td>
<td>Utilization of Electric Energy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Electric Drives and Control</td>
</tr>
<tr>
<td>3</td>
<td>Mechanical Engineering</td>
<td>Basic Mechanical Engineering</td>
</tr>
<tr>
<td>4</td>
<td>Electronics &amp; Communication Engineering</td>
<td>Electronic Sensors</td>
</tr>
<tr>
<td>5</td>
<td>Computer Science &amp; Engineering</td>
<td>Artificial Intelligence</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Python Programming</td>
</tr>
<tr>
<td>6</td>
<td>Metallurgical Engineering</td>
<td>Corrosion Process and Control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Testing of Materials</td>
</tr>
<tr>
<td>7</td>
<td>Chemical Engineering</td>
<td>Industrial Pollution Control Engineering</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Design and Analysis of Experiments</td>
</tr>
<tr>
<td>8</td>
<td>Humanities &amp; Social Sciences</td>
<td>Entrepreneurship</td>
</tr>
<tr>
<td>9</td>
<td>Mathematics</td>
<td>Finite Element Methods</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Open Elective-3

<table>
<thead>
<tr>
<th>S. No</th>
<th>Offering Department</th>
<th>Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Civil Engineering</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>2</td>
<td>Electrical &amp; Electronics Engineering</td>
<td>Power Plant Engineering</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Energy Sources &amp; Applications</td>
</tr>
<tr>
<td>3</td>
<td>Mechanical Engineering</td>
<td>Energy Storage Devices</td>
</tr>
<tr>
<td>4</td>
<td>Electronics &amp; Communication Engineering</td>
<td>Principles of Communications</td>
</tr>
<tr>
<td>5</td>
<td>Computer Science &amp; Engineering</td>
<td>Machine Learning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mobile Application Development</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Scripting Languages</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Database Management Systems</td>
</tr>
<tr>
<td>6</td>
<td>Metallurgical Engineering</td>
<td>Alloy Steels</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High Temperature Materials</td>
</tr>
<tr>
<td>7</td>
<td>Chemical Engineering</td>
<td>Industrial Safety and Hazard Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Energy Engineering</td>
</tr>
<tr>
<td>8</td>
<td>Humanities &amp; Social Sciences</td>
<td>Project Management</td>
</tr>
<tr>
<td>9</td>
<td>Mathematics</td>
<td>Z Transforms and Special Functions</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course Objectives:
The objectives of the course are

- To Understand basic concepts in Disaster Management
- To Understand Definitions and Terminologies used in Disaster Management
- To Understand Types and Categories of Disasters
- To Understand the Challenges posed by Disasters
- To understand Impacts of Disasters

Key Skills

UNIT I:
Introduction - Concepts and definitions: disaster, hazard, vulnerability, resilience, risks severity, frequency and details, capacity, impact, prevention, mitigation.

UNIT II
Disasters - Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

UNIT III
Disaster Impacts - Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

UNIT IV
Disaster Risk Reduction (DRR) - Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

UNIT V
Disasters, Environment and Development - Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, landuse changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods.

Course Outcomes:
The student will develop competencies in

- the application of Disaster Concepts to Management
- Analyzing Relationship between Development and Disasters.
- Ability to understand Categories of Disasters and
- realization of the responsibilities to society
Text Books:

Reference Books:
1. http://ndma.gov.in/ (Home page of National Disaster Management Authority)
RELIABILITY ENGINEERING

(EEE)
OPEN ELECTIVE - I

Prerequisite: Mathematics-III (Laplace Transforms, Numerical Methods and Complex variables)

Course Objectives:
- To introduce the basic concepts of reliability, various models of reliability
- To analyze reliability of various systems
- To introduce techniques of frequency and duration for reliability evaluation of repairable systems

Course Outcomes: After completion of this course, the student will be able to
- model various systems applying reliability networks
- evaluate the reliability of simple and complex systems
- estimate the limiting state probabilities of repairable systems
- apply various mathematical models for evaluating reliability of irreparable systems

UNIT-I:
BASIC PROBABILITY THEORY: Elements of probability, probability distributions, Random variables, Density and Distribution functions- Mathematical expected – variance and standard deviation –
BINOMIAL DISTRIBUTION: Concepts, properties, engineering applications.

UNIT-II:
NETWORK MODELING AND EVALUATION OF SIMPLE SYSTEMS: Basic concepts- Evaluation of network Reliability / Unreliability - Series systems, Parallel systems - Series-Parallel systems- Partially redundant systems- Examples.
NETWORK MODELING AND EVALUATION OF COMPLEX SYSTEMS
Conditional probability method- tie set, Cut-set approach- Event tree and reduced event tree methods- Relationships between tie and cut-sets- Examples.

UNIT-III:
NETWORK RELIABILITY EVALUATION USING PROBABILITY DISTRIBUTIONS:

UNIT-IV:
Continuous Markov Processes: Modeling concepts- State space diagrams- Unreliability evaluation of single and two component repairable systems.
UNIT-V:
FREQUENCY AND DURATION TECHNIQUES: Frequency and duration concepts, application to multi state problems, Frequency balance approach.

APPROXIMATE SYSTEM RELIABILITY EVALUATION: Series systems – Parallel systems- Network reduction techniques- Cut set approach- Common mode failures modeling and evaluation techniques- Examples.

TEXT BOOKS:

REFERENCES:
RENEWABLE ENERGY SOURCES

(EEE)
OPEN ELECTIVE - I

Pre-requisites: None

Course Objectives:
- To recognize the awareness of energy conservation in students
- To identify the use of renewable energy sources for electrical power generation
- To collect different energy storage methods
- To detect about environmental effects of energy conversion

Course Outcomes: At the end of the course the student will be able to:
- Understand the principles of wind power and solar photovoltaic power generation, fuel cells.
- Assess the cost of generation for conventional and renewable energy plants
- Design suitable power controller for wind and solar applications
- Analyze the issues involved in the integration of renewable energy sources to the grid

UNIT-I: INTRODUCTION

WIND POWER PLANTS:
Appropriate Location -Evaluation of Wind Intensity -Topography -Purpose of the Energy Generated -General Classification of Wind Turbines-Rotor Turbines-Multiple-Blade Turbines Drag Turbines -Lifting Turbines-Generators and Speed Control used in Wind Power Energy Analysis of Small Generating Systems.

UNIT-II: PHOTOVOLTAIC POWER PLANTS


UNIT-III: INDUCTION GENERATORS
UNIT-IV:
STORAGE SYSTEMS

UNIT-V:
INTEGRATION OF ALTERNATIVE SOURCES OF ENERGY
INTERCONNECTION OF ALTERNATIVE ENERGY SOURCES WITH THE GRID:
Interconnection Technologies -Standards and Codes for Interconnection-Interconnection Considerations - Interconnection Examples for Alternative Energy Sources.

TEXT BOOKS:

REFERENCES:
**Course Objective:**
To prepare engineering students to analyze cost/revenue/financial data and to make economic and financial analysis in decision making process and to examine the performance of companies engaged in engineering.

**Course Outcome:**
To perform and evaluate present and future worth of the alternate projects and to appraise projects by using traditional and DCF Methods. To carry out cost benefit analysis of projects and to calculate BEP of different alternative projects.

**UNIT- I:**

**UNIT- II:**

**UNIT- III:**
Production, Cost, Market Structures & Pricing:

**UNIT- IV:**

**UNIT- V:**
Introduction to Accounting: Accounting Principles (GAPP), concepts, conventions- - Double entry system of Book keeping – Accounting rules- Journal- ledger- Trial balance- Trading and Profit and Loss account- Balance Sheet. (Simple Problems)

**Text Books:**

**Reference Books:**
1. Accounting by Jain and Narang, Kalyani Publishers.
SYSTEM DESIGN THROUGH IOT

(ECE)
OPEN ELECTIVE - I

Pre-requisite:

Course Objectives
The objectives of the course are to
1. understand the concepts of Internet of Things and able to build IoT applications.
2. Learn the programming and use of Arduino and Raspberry Pi boards.
3. Known about data handling and analytics in SDN.

Course Outcomes
Upon completing this course, the student will be able to
1. Known basic protocols in sensor networks.
2. Program and configure Arduino boards for various designs.
3. Python programming and interfacing for Raspberry Pi.
4. Design IoT applications in different domains.

UNIT I

UNIT II
Machine-to-Machine Communications, Difference between IoT and M2M, Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino,

UNIT III
Introduction to Python programming, Introduction to Raspberry Pi, Interfacing Raspberry Pi with basic peripherals, Implementation of IoT with Raspberry Pi

UNIT IV
Implementation of IoT with Raspberry Pi, Introduction to Software defined Network (SDN), SDN for IoT, Data Handling and Analytics,

UNIT V
Cloud Computing, Sensor-Cloud, Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT.

Case Study- Agriculture, Healthcare, Activity Monitoring.

TEXT BOOKS

REFERENCES
1. Internet of Things: A Hands-on Approach, by Arshdeep Bahga and Vijay Madisetti.
DATA STRUCTURES
(CSE)
OPEN ELECTIVE – I

Prerequisites
1. A course on “Programming for Problem Solving“

Objectives
1. Exploring basic data structures such as stacks and queues.
2. Introduces a variety of data structures such as hash tables, search trees, tries, heaps, graphs.
3. Introduces sorting and pattern matching algorithms

Outcomes
1. Ability to select the data structures that efficiently model the information in a problem.
2. Ability to assess efficiency trade-offs among different data structure implementations or combinations.
3. Implement and know the application of algorithms for sorting and pattern matching.
4. Design programs using a variety of data structures, including hash tables, binary and general tree structures, search trees, tries, heaps, graphs, and AVL-trees.

UNIT - I
Introduction to Data Structures, abstract data types, Linear list – singly linked list implementation, insertion, deletion and searching operations on linear list, Stacks-Operations, array and linked representations of stacks, stack applications, Queues-operations, array and linked representations.

UNIT - II
Dictionaries: linear list representation, skip list representation, operations - insertion, deletion and searching.
Hash table representation: hash functions, collision resolution-separate chaining, open addressing-linear probing, quadratic probing, double hashing, rehashing, extendible hashing.

UNIT - III

UNIT - IV
Graphs: Graph Implementation Methods. Graph Traversal Methods.
Sortings: Heap Sort, External Sorting- Model for external sorting, Merge Sort.

UNIT - V
Pattern matching and Tries: Pattern matching algorithms-Brute force, the Boyer –Moore algorithm, the Knuth-Morris-Pratt algorithm, Standard Tries, Compressed Tries, Suffix tries.

Textbooks

References
Prerequisites
1. A course on “Computer Programming & Data Structures”

Objectives
1. Introduces object oriented programming concepts using the Java language.
2. Introduces the principles of inheritance and polymorphism; and demonstrates how they relate to the design of abstract classes
3. Introduces the implementation of packages and interfaces
4. Introduces exception handling, event handling and multithreading
5. Introduces the design of Graphical User Interface using applets and AWT

Outcomes
1. Develop Programs with reusability
2. Develop programs to handle multitasking
3. Develop programs to handle exceptions
4. Develop applications for a range of problems using object-oriented programming techniques
5. Design simple Graphical User Interface applications

UNIT - I
Object oriented thinking and Java Basics - Need for oop paradigm, summary of oop concepts, History of Java, Java buzzwords, data types, variables, scope and life time of variables, arrays, operators, expressions, control statements, type conversion and casting, simple java program, concepts of classes, objects, constructors, methods, access control, this keyword, garbage collection, overloading methods and constructors, parameter passing, recursion, nested and inner classes, exploring string class.

UNIT - II
Inheritance, Packages and Interfaces – Hierarchical abstractions, Base class object, subclass, subtype, substitutability, forms of inheritance- specialization, specification, construction, extension, limitation, combination, benefits of inheritance, costs of inheritance. Member access rules, super uses, using final with inheritance, polymorphism- method overriding, abstract classes, the Object class.
Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages, differences between classes and interfaces, defining an interface, implementing interface, applying interfaces, variables in interface and extending interfaces.
Exploring java.io.

UNIT - III
Exception handling and Multithreading-- Concepts of exception handling, benefits of exception handling, exception hierarchy, usage of try, catch, throw, throws and finally, built in exceptions, creating own exception sub classes.
String handling, Exploring java.util.

UNIT - IV
Event Handling: Events, Event sources, Event classes, Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes.
The AWT class hierarchy, user interface components- labels, button, canvas, scrollbars, text components, check box, check box group, choices, lists, dialog box, handling menus, layout manager: layout manager types – border, grid, flow, card and grid bag.

**UNIT - V**

**Multi Threading:** Differences between multi threading and multitasking, thread life cycle, creating threads, thread priorities, synchronizing threads, interthread communication, thread groups, daemon threads.

**Applets** – Concepts of Applets, differences between applets and applications, life cycle of an applet, types of applets, creating applets, passing parameters to applets.

**Text Books**
1. Java the complete reference, 7th edition, Herbert Schildt, TMH.
2. Understanding OOP with Java, updated edition, T. Budd, Pearson Education.

**References**
2. Introduction to Java programming, Y. Daniel Liang, Pearson Education.
3. An introduction to Java programming and object oriented application development, R.A. Johnson- Thomson.
ENGINEERING MATERIALS

(MET)
OPEN ELECTIVE – I

Pre-Requisites: Nil.

Course Objectives:
1. To gain knowledge about the uses and application of various ferrous metals and alloys.
2. To gain knowledge about the uses and application of various non ferrous alloys.
3. To gain knowledge about the uses and application of various ceramics, polymers and composites for different engineering applications.

UNIT-I
Ferrous Alloys: Introduction, Designations and classifications, Properties and applications of Carbon Steels: Low, medium and high carbon steels, Stainless steels and Cast Irons

UNIT-II
Nonferrous Alloys: Introduction, properties and applications of Aluminum Alloys, Magnesium Alloys, Copper Alloys and Titanium Alloys.

UNIT-III

UNIT-IV
Polymers: Introduction, Classification, Properties and Applications of Polymers, Polymerization, Degree of Polymerization, Typical Thermoplastics and Thermosets.

UNIT-V
Composites: Introduction, Classification, Properties and Applications of Polymer matrix, Metal Matrix Ceramic Matrix and Laminar composites.

Text Books:

Reference Books:
Course Outcomes:

At the end of the course, student would be able to recommend
1. At the end of the course the student will be able to understand the importance of ferrous alloys and their classification and apply the knowledge of heat treatment and analyze the effect of alloying elements.
2. Describe the properties of NFA and choose a particular alloy for a given application.
3. Correlate the structure, property and applications of ceramics and polymers.
4. Understand the importance of composite and select a particular composite for a given application.
5. Able to analyze the properties of different metallic and non metallic materials and justify their choice.
6. Able to gain knowledge on different non-ferrous alloys for a given engineering applications and service conditions.
METALLURGY FOR NON METALLURGISTS

(MET)
OPEN ELECTIVE – I

Pre-Requisites: Nil.

Course Objectives:
1. To describe the basic principles of metallurgy and the importance of metallurgy in various disciplines of engineering.
2. Gain thorough knowledge about heat treatment of steels.
3. Gain knowledge about properties and uses of cast irons and non ferrous metals.
4. Gain working knowledge of basic testing methods for metals.

UNIT-I
Introduction: Crystal structure and defects, Crystal structure of metals, Classification of steels, Carbon steels.

UNIT-II

UNIT-III
Cast irons: Properties and applications of Ductile irons, Malleable irons, Compacted graphite iron.

UNIT-IV
Non Ferrous Metals: Properties and applications of Light Metals (Al, Be, Mg, Ti), Super alloys.

UNIT-V

Text Books:

Reference Books:
1. Engineering Physical Metallurgy and Heat treatment – Y Lakhtin
4. Metallurgy for Engineers- Clark and Varney.
Course Outcomes:

At the end of the course Student would be able:
1. Classify steels and understand the different crystal structures of metals and defects.
2. Establish heat treatment process – structure – properties correlation.
3. Know the metallurgical and mechanical properties of various cast iron and their applications.
4. Justify the choice of light metals and super alloys based on their properties.
5. Evaluate the various mechanical properties in materials by different methods.
6. Able to understand the areas and domains of metallurgy and materials.
SOLID WASTE MANAGEMENT

(CHEM)
OPEN ELECTIVE – I

Pre Requisites: NIL

Course Objectives:
1. To understand the sense of onsite handling storage and collection systems including transportation
2. To understand the various processing technologies with mechanical volume reduction and thermal
   volume reduction corporate land filling, deep well injections.
3. Learn to estimate material recovery a energy recovery from a given waste data using case standing

UNIT I
Introduction: Definition, characteristics and perspectives of solid waste. Types of solid waste. Physical
and chemical characteristics. Variation of composition and characteristics. Municipal, industrial, special
and hazardous wastes.

General aspects: Overview of material flow in society. Reduction in raw material usage. Reduction in
solid waste generation. Reuse and material recovery. General effects on health and environment.
Legislations.

UNIT II
Engineered systems: Typical generation rates. Estimation and factors effecting generation rates. On site
handling. Storage and processing. Collection systems and devices. Transfer and transport.

UNIT III
Processing Techniques: Mechanical volume reduction. Thermal volume reduction. Component

UNIT IV
Material recovery: Mechanical size alteration. Electromagnetic separation. Drying and dewatering.
Other material recovery systems. Recovery of biological conversion products. Recovery of thermal
conversion products.

Energy recovery: Energy recovery systems and efficiency factors. Determination of output and
efficiency. Details of energy recovery systems. Combustion incineration and heat recovery. Gasification
and pyrolysis. Refuse derived fuels (RDF).

UNIT V
Case studies: Major industries and management methods used in typical industries – Coal fired power
stations, textile industry, oil refinery, distillery, sugar industry, and radioactive waste generation units.
TEXT BOOKS:

REFERENCE BOOKS:

Course Outcomes:
At the end of the course, student will be able to
1. Apply the knowledge of characterization of waste and develop a suitable management plan
2. Describe various transfer and transportation techniques.
3. Describe various processing techniques.
4. Suggest processing waste for material for energy recovery.
5. Application of solid waste management techniques in various industries.
BASICS OF NANOTECHNOLOGY

(CHEM)
OPEN ELECTIVE – I

Pre Requisites: NIL

Course Objectives:

1. Discuss about the basics of nanotechnology
2. Classify and explain the various properties of nano materials
3. Describe the various methods for synthesis of nano materials and their applications

UNIT I

UNIT II


UNIT III

UNIT IV
Synthesis Routes: Bottom up approaches: Physical Vapor Deposition, Inert Gas Condensation, Laser Ablation, Chemical Vapor Deposition, Molecular Beam Epitaxy, Sol-gel method, Self assembly

UNIT V
Top down approaches: Mechanical alloying, Nano-lithography.
Consolidation of Nano powders: Shock wave consolidation, Hot isostatic pressing and Cold isostatic pressing Spark plasma sintering.

TEXT BOOKS:
**REFERENCE BOOKS:**

**Course Outcomes:**
At the end of the course, student will be able to
1. Describe the importance of nano structured materials.
2. Explain the effect of nano dimensions on material behavior properties.
3. Explain the various magnetic properties of nano materials.
4. Describe the various routes for nano material preparation.
5. Describe about the nano powders and application of nano materials in various fields.
PROFESSIONAL PRACTICE, LAW AND ETHICS

(HSS)
(Open Elective)

Course Objective:
- To make the students understand the types of roles they are expected to play in the society as practitioners of the civil engineering profession
- To develop some ideas of the legal and practical aspects of their profession.

Course Outcome: The students will understand the importance of professional practice, Law and Ethics in their personal lives and professional careers. The students will learn the rights and responsibilities as an employee, team member and a global citizen

Unit- I:
Professional Practice and Ethics: Definition of Ethics, Professional Ethics - Engineering Ethics, Personal Ethics; Code of Ethics - Profession, Professionalism, Professional Responsibility, Conflict of Interest, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistle blowing, protected disclosures. Introduction to GST- Various Roles of Various Stake holders

Unit: II

Unit- III
Arbitration, Conciliation and ADR (Alternative Dispute Resolution) system: Arbitration – meaning, scope and types –International commercial arbitration; Arbitration agreements – essential and kinds, validity, reference and interim measures by court; Arbitration tribunal – appointment, challenge, jurisdiction of arbitral tribunal, powers, grounds of challenge, procedure and court assistance; Dispute Resolution Boards; Lok Adalats.

Unit- IV:
Engagement of Labour and Labour & other construction-related Laws: Role of Labour in Civil Engineering; Methods of engaging labour- on rolls, labour sub-contract, piece rate work;; Building & Other - Construction Workers (regulation of employment and conditions of service) Act (1996) and Rules (1998); RERA Act 2017, NBC 2017.

Unit- V
Law relating to Intellectual property: Introduction – meaning of intellectual property, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Law relating to Copyright in India including Historical evolution of Copy Rights Act, 1957, Meaning of copyright – computer programs, Ownership of copyrights and assignment, Criteria of infringement, Piracy in Internet – Remedies and procedures in India; Law relating to Patents under Patents Act, 1970

Suggested Readings:
2. RERA Act, 2017.
NUMERICAL TECHNIQUES

(MATHS)
OPEN ELECTIVE – I

Pre-requisites: Mathematics courses in first two years of study

Objectives: To learn

- The importance of numerical methods.
- Identifying the root of an equation geometrically and finding its approximate value by different techniques.
- The concept of interpolation and fitting a interpolating polynomial.
- Implementing proper schemes based on the nature of the data points.
- Finding the derivatives and proper integrals of given functions using finite differences.
- Fitting linear, non-linear and exponential curves for the given data.
- Solving initial value problems using numerical methods.
- Solving boundary value problems involving PDE’s using finite difference methods.

UNIT-I: Solution of Algebraic, Transcendental Equations and System of Linear Equations

UNIT-II: Interpolation
- Finite differences: Forward, Backward and Central differences, Other difference operators and relations between them, Differences of a polynomial, Missing terms, Newton’s interpolation formulae, Central difference interpolation formulae: Gauss’s forward and backward interpolation formulae, Interpolation with unequal intervals: Lagrange’s interpolation formula.

UNIT-III: Numerical Differentiation, Integration and Curve fitting
- Numerical differentiation: Derivatives using Newton’s interpolation formulae. Numerical integration: Newton-cotes quadrature formula, Trapezoidal rule, Simpson’s one-third rule, Simpson’s three-eighth rule. Curve Fitting: Method of least squares, Fitting a straight line, Second degree parabola and Non-linear curves of the form \( y = ae^{bx} \), \( y = ab^x \), \( y = ax^b \) by the method of least squares.

UNIT-IV: Numerical Solution of Ordinary Differential Equations of First Order

UNIT-V: Numerical Solution of Partial Differential Equations
- Finite difference approximations to partial derivatives, Elliptic equations: Solution of Laplace equation by Liebmann’s iteration process, Parabolic equations: Solution of one dimensional Heat equation by Schmidt explicit method and Crank-Nicolson implicit method.
Course outcomes:
After learning the contents of this paper the student is able to
- Find a better approximate root of a given equation.
- Find the finite difference operators and find the missing terms in a given data or value of the dependent variable for a given independent variable.
- Evaluate the derivative at a given value and integral of a function.
- Solve the initial value problems and apply predictor and corrector methods.
- Solve Laplace equations, parabolic equations with given boundary conditions.

Text Books

References
Course Objectives:
The objectives of the course are to

- Know the concepts of Remote Sensing, its interpreting Techniques and concepts of Digital images
- know the concept of Geographical Information System (GIS), coordinate system GIS Data and its types
- Understand the students managing the spatial Data Using GIS.
- Understand Implementation of GIS interface for practical usage.

UNIT – I

UNIT- II:
Introduction to GIS: Introduction, History of GIS, GIS Components, GIS Applications in Real life, The Nature of geographic data, Maps, Types of maps, Map scale, Types of scale, Map and Globe, Co-ordinate systems, Map projections, Map transformation, Geo-referencing,
Spatial Database Management System: Introduction: Spatial DBMS, Data storage, Database structure models, database management system, entity-relationship model, normalization
Data models and data structures: Introduction, GIS Data model, vector data structure, raster data structure, attribute data, geo-database and metadata,

UNIT- III:
Spatial Data input and Editing: Data input methods – keyboard entry, digitization, scanning, conversion of existing data, remotely sensed data, errors in data input, Data accuracy, Micro and Macro components of accuracy, sources of error in GIS.
Spatial Analysis: Introduction, topology, spatial analysis, vector data analysis, Network analysis, raster data analysis, Spatial data interpolation techniques

UNIT- IV: Implementing a GIS and Applications
Implementing a GIS: Awareness, developing system requirements, evaluation of alternative systems, decision making using GIS
Applications of GIS
GIS based road network planning, Mineral mapping using GIS, Shortest path detection using GIS, Hazard Zonation using remote sensing and GIS, GIS for solving multi criteria problems, GIS for business applications.

Course Outcomes
After the completion of the course student should be able to

- **Describe** different concepts and terms used in Remote Sensing and its data
- **Understand** the Data conversion and Process in different coordinate systems of GIS interface
- **Evaluate** the accuracy of Data and implementing a GIS
- **Understand** the applicability of RS and GIS for various applications.

TEXT BOOKS

REFERENCES

Textbook of Remote Sensing and Geographical Information systems by M.Anji Reddy,
UTILIZATION OF ELECTRICAL ENERGY

(EEE)
OPEN ELECTIVE - II

Pre-requisites: Electrical Machines-I and Electrical Machines-II

Course Objectives: Objectives of this course are
• To understand the fundamentals of illumination and good lighting practices
• To understand the methods of electric heating and welding.
• To understand the concepts of electric drives and their application to electrical traction systems.

Course Outcomes: At the end of the course the student will be able to:
• Understand basic principles of electric heating and welding.
• Determine the lighting requirements for flood lighting, household and industrial needs.
• Calculate heat developed in induction furnace.
• Evaluate speed time curves for traction

UNIT-I:
ELECTRICAL HEATING
Advantages and methods of electric heating, resistance heating, induction heating and dielectric heating.

UNIT-II:
ELECTRIC WELDING
Electric welding equipment, resistance welding and arc welding, comparison between AC and DC welding. Electrolysis process: principle of electrolysis, electroplating, metal extraction and metal processing, electromagnetic stirs.

UNIT-III:
ILLUMINATION
Terminology, Laws of illumination, coefficient of Utilization and depreciation, Polar curves, Photometry, integrating sphere, sources of light, fluorescent lamps, compact fluorescent lamps, LED lamps discharge lamps, mercury vapor lamps, sodium vapor lamps and neon lamps, comparison between tungsten filament lamps and fluorescent tubes. Basic principles of light control, Types and design of lighting scheme, lighting calculations, factory lighting, street lighting and flood lighting.

UNIT-IV:
ELECTRIC TRACTION
Systems of electric traction and track electrification- DC system, single phase and 3-phase low frequency and high frequency system, composite system, kando system, comparison between AC and DC systems, problems of single phase traction with current unbalance and voltage unbalance. Mechanics of traction movement, speed – time curves for different services, trapezoidal and quadrilateral speed – time curves, tractive effort, power, specific energy consumption, effect of varying acceleration and braking, retardation, adhesive weight and braking retardation, coefficient of adhesion.

UNIT-V:
SYSTEMS OF TRAIN LIGHTING
special requirements of train lighting, methods of obtaining unidirectional polarity constant output- single battery system, Double battery parallel block system, coach wiring, lighting by making use of 25KV AC supply.
TEXT BOOKS:

REFERENCES:
ELECTRIC DRIVES AND CONTROL

(EEE)
OPEN ELECTIVE - II

Pre-requisites: Electrical Machines-I, Electrical Machines-II, Power Electronics

Course Objectives:
- To understand basics of electric drives
- To know the dynamics and control of various drive mechanisms
- To know the principle of operations of DC and AC motor drives
- To understand the energy conversion in electric drives

Course Outcomes: At the end of the course the student will be able to:
- Understand the various drive mechanisms and methods for energy conservation.
- Apply power electronic converters to control the speed of DC motors and induction motors.
- Evaluate the motor and power converter for a specific application.
- Develop closed loop control strategies of drives

UNIT-I:
INTRODUCTION TO ELECTRIC DRIVES
Electrical Drives, Advantages of Electric drives, Parts of Electrical Drives, Electric Motors, Power Modulators, Sources, Control unit, Choice of Electric Drives and Losses.

UNIT-II:
DYNAMICS OF ELECTRICAL DRIVES

CONTROL OF ELECTRICAL DRIVES
Modes of operation, speed control and drive classifications, closed loop control of drives.

UNIT-III:
DC MOTOR DRIVES
Starting, Braking, Speed control of DC motors using single phase fully controlled and half controlled rectifiers. Three phases fully controlled and half controlled converter fed DC motor drives. Chopper controlled DC drives.

UNIT-IV:
INDUCTION MOTOR DRIVES
Speed control using pole changing, stator voltage control, AC voltage controllers. Variable frequency and variable voltage control from inverter. Different types of braking, dynamic, regenerative and plugging.

UNIT-V:
ENERGY CONSERVATION IN ELECTRIC DRIVES
Losses in Electric drive systems, measurement of Energy conservation in Electric drives. Use of efficient converters, energy efficient operation of drives, Improvement of p.f., improvement of quality of supply, maintenance of motors
TEXT BOOKS:

REFERENCES:
BASIC MECHANICAL ENGINEERING

(MECH)
OPEN ELECTIVE - II

Instructional Objectives

- To familiarize with the basic machine elements
- To familiarize with the Sources of Energy and Power Generation
- To familiarize with the various manufacturing processes

UNIT-I:
**Machine Elements**: Helical and leaf springs – Springs in series and parallel. Cams: Types of cams and followers – Cam profile.

UNIT-II:

UNIT-III:
**Energy**: Sources: Renewable and non-renewable (various types, characteristics

UNIT-IV:

UNIT-V:

**Text Books**:

**Reference Books**:
Course Objectives
1. Learn the characterization of sensors.
2. Known the working of Electromechanical, Thermal, Magnetic and radiation sensors.
3. Understand the concepts of Electro analytic and smart sensors.
4. Able to use sensors in different applications.

Course Outcomes
Upon completing this course, the student will be able to
1. Learn about sensor Principle, Classification and Characterization.
2. Explore the working of Electromechanical, Thermal, Magnetic, radiation and Electro analytic sensors.
3. Understand the basic concepts of Smart Sensors.
4. Design a system with sensors.

UNIT I
Sensors / Transducers
Principles, Classification, Parameters, Characteristics, Environmental Parameters (EP), Characterization

Electromechanical Sensors

UNIT II
Thermal Sensors

UNIT III
Magnetic sensors

UNIT IV
Radiation Sensors
Introduction ,Basic Characteristics ,Types of Photo resistors/ Photo detectors, X-ray and Nuclear Radiation Sensors, Fibre Optic Sensors.
Electro analytical Sensors
UNIT V
Smart Sensors
Introduction, Primary Sensors, Excitation, Amplification, Filters, Converters, Compensation, Information Coding/Processing - Data Communication, Standards for Smart Sensor Interface, the Automation

Sensors Applications

TEXT BOOKS

REFERENCES
Prerequisites
1. A course on “Computer Programming and Data Structures”
2. A course on “Advanced Data Structures”
3. A course on “Design and Analysis of Algorithms”
4. A course on “Mathematical Foundations of Computer Science”
5. Some background in linear algebra, data structures and algorithms, and probability will all be helpful

Objectives
1. To learn the distinction between optimal reasoning Vs. human like reasoning
2. To understand the concepts of state space representation, exhaustive search, heuristic search together with the time and space complexities.
3. To learn different knowledge representation techniques.
4. To understand the applications of AI, namely game playing, theorem proving, and machine learning.

Outcomes
1. Ability to formulate an efficient problem space for a problem expressed in natural language.
2. Select a search algorithm for a problem and estimate its time and space complexities.
3. Possess the skill for representing knowledge using the appropriate technique for a given problem.
4. Possess the ability to apply AI techniques to solve problems of game playing, and machine learning.

UNIT - I
Problem Solving by Search-I
Introduction to AI, Intelligent Agents
Problem Solving by Search -II:

UNIT - II
Problem Solving by Search-II and Propositional Logic
Adversarial Search:
Games, Optimal Decisions in Games, Alpha–Beta Pruning, Imperfect Real-Time Decisions.
Constraint Satisfaction Problems:
Defining Constraint Satisfaction Problems, Constraint Propagation, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems.
Propositional Logic:
Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic, Propositional Theorem Proving: Inference and proofs, Proof by resolution, Horn clauses and definite clauses, Forward and backward chaining, Effective Propositional Model Checking, Agents Based on Propositional Logic.

UNIT - III
Logic and Knowledge Representation
First-Order Logic:
Representation, Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic.
Inference in First-Order Logic:
Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution.
Knowledge Representation:
Ontological Engineering, Categories and Objects, Events. Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information.

UNIT - IV
Planning
Classical Planning:
Planning and Acting in the Real World:
Time, Schedules, and Resources, Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Multi agent Planning.

UNIT - V
Uncertain knowledge and Learning
Uncertainty:
Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Independence, Bayes’ Rule and Its Use,
Probabilistic Reasoning:
Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Approximate Inference in Bayesian Networks, Relational and First-Order Probability, Other Approaches to Uncertain Reasoning; Dempster-Shafer theory.
Learning:
Forms of Learning, Supervised Learning, Learning Decision Trees.Knowledge in Learning: Logical Formulation of Learning, Knowledge in Learning, Explanation-Based Learning, Learning Using Relevance Information, Inductive Logic Programming.

Text Books

References
3. Artificial Intelligence, Shivani Goel, Pearson Education.
4. Artificial Intelligence and Expert systems – Patterson, Pearson Education.
**PYTHON PROGRAMMING**

**(CSE)**

**OPEN ELECTIVE – II**

**Objectives**
This course will enable students to
1. Learn Syntax and Semantics and create Functions in Python.
2. Handle Strings and Files in Python.
3. Understand Lists, Dictionaries and Regular expressions in Python.
4. Implement Object Oriented Programming concepts in Python.

**Outcomes**
The students should be able to:
1. Examine Python syntax and semantics and be fluent in the use of Python flow control and functions.
2. Demonstrate proficiency in handling Strings and File Systems.
3. Create, run and manipulate Python Programs using core data structures like Lists, Dictionaries and use Regular Expressions.
4. Interpret the concepts of Object-Oriented Programming as used in Python.
5. Implement exemplary applications related to Network Programming, Web Services and Databases in Python.

**UNIT – I**
Python Basics, Objects- Python Objects, Standard Types, Other Built-in Types, Internal Types, Standard Type Operators, Standard Type Built-in Functions, Categorizing the Standard Types, Unsupported Types
Numbers - Introduction to Numbers, Integers, Floating Point Real Numbers, Complex Numbers, Operators, Built-in Functions, Related Modules
Sequences - Strings, Lists, and Tuples, Mapping and Set Types

**UNIT – II**
Modules: Modules and Files, Namespaces, Importing Modules, Importing Module Attributes, Module Built-in Functions, Packages, Other Features of Modules

**UNIT – III**
Regular Expressions: Introduction, Special Symbols and Characters, Res and Python

**UNIT – IV**
GUI Programming: Introduction, Tkinter and Python Programming, Brief Tour of Other GUIs, Related Modules and Other GUIs
UNIT – V
Database Programming:
Introduction, Python Database Application Programmer’s Interface (DB-API), Object Relational Managers (ORMs), Related Modules

Textbook

CORROSION PROCESS AND CONTROL

(MET)
OPEN ELECTIVE – II

Pre-Requisites: Nil

Course Objectives:
1. To list out various atmospheres responsible for corrosion and understand the various corrosion combating techniques.
2. To determine corrosion rate/resistance of metals and alloys.
3. To demonstrate electrometallurgy principles in deposition winning and the efficiency of the bath.
4. To explain corrosion protection methods and tests.

UNIT-I
Introduction, Electro Chemistry principles, Corrosion, Introduction and Definition, electrochemical reactions, Polarization, passivity, environmental effects (oxygen, oxidizers, velocity, temperature, corrosive concentration, Galvanic coupling).

UNIT-II
Forms of corrosion, uniform corrosion, Two metal corrosion: Sacrificial anode, EMF and Galvanic Series, Environmental effects, Pitting corrosion: Pit shape and growth, Autocatalytic Nature of pitting, Crevice corrosion.

UNIT-III
Intergranular corrosion: Sensitization, weld decay, Knife-Line attack, Stress corrosion cracking: crack morphology, stress effects, environmental factors, metallurgical factors, Erosion corrosion: cavitation damage, fretting corrosion, Corrosion fatigue.

UNIT-IV

UNIT-V
Modern theory and applications of corrosion: Introduction, free energy, cell potentials, emf series, applications of thermodynamics to corrosion, Corrosion rate expressions and measurements, corrosion testing.

Text Books:

Reference Books:
Course Outcomes:
At the end of the course the student will be able:
1. Able to interpret electro chemical phenomenon.
2. Can explain different types of corrosion and their causes and effect.
3. Able to identify the different remedial measures to be taken.
4. Able to design corrosion resistant structures and materials.
5. Determine the thermodynamic causes of corrosion.
6. Conduct corrosion tests and able to quantify the corrosion processes.
7. Able to graphically represent and interpret Eh-pH, pourbix extrapolation techniques.
TESTING OF MATERIALS

(MET)
OPEN ELECTIVE – II

Pre-requisites: Nil

Course Objectives:
1. To gain an understanding of the response of various metals under the application of stress and/or temperature.
2. Obtain a working knowledge of various hardness testing machines BHN, VHN, RHN.
3. Obtain a working knowledge of creep and fatigue and analysis of data.

UNIT–I
Introduction, Importance of testing.
Hardness Test: Methods of hardness testing – Brinell, Vickers, Rockwell hardness tests.
The Impact Test: Notched bar impact test and its significance, Charpy and Izod Tests, fracture toughness testing - COD and CTOD tests, significance of transition temperature curve.

UNIT–II

UNIT-III

UNIT–IV
Creep and Stress Rupture: Introduction, The creep curve, Stress-rupture test, Structural changes during creep, Mechanism of creep deformation, theories of creep. Fracture at elevated temperature.

UNIT–V
NDT: Principle, Operation, Advantages and Limitations of Liquid Penetrant, Magnetic Particle, Radiography and Ultrasonic tests.

Text Books:
2. Mechanical behavior - Ed. Wulf.

Reference Books:
Course Outcomes:
At the end of the course the student will be able to:
1. Understand and interpret the results of various hardness tests and impact tests.
2. Evaluate various tensile properties of ferrous and Non Ferrous Metals and solve problems related to the tensile tests.
3. Analyze the modes of failure occurring due to fatigue and suggest remedial measures.
4. Analyze the methods of failure of materials at high temperature by creep and strength rupture and the mechanisms responsible for fracture.
5. Determine appropriate tests to be employed to determine the given mechanical properties using both destructive and non-destructive techniques.
6. Knowledge of various testing methods based on destructive & Non destructive techniques and their importance in enhancing service life of the component.
INDUSTRIAL POLLUTION CONTROL ENGINEERING

(CHEM)
OPEN ELECTIVE – II

Pre Requisites: NIL

Course Objectives:

1. To understand various air pollution control techniques.
2. To understand various biological treatment methods of waste water.
3. To understand various physical treatment methods of waste water.

UNIT-I
Introduction to industrial pollution and types of pollution from chemical industries, Effects of pollution as environment and ecosystems-global warming-green house effect; Environmental legislation-standards and guidelines, water act 1974, air act 1981.

UNIT –II
Air pollution-Meteorological aspects of pollution dispersion-adiabatic lapse rate-Environmental lapse rate-Turbulence and stability of atmosphere, Richardson number-Plume raise-plume behavior and characteristics, effective stack height. Major air pollutants and their sources, measurement of air pollutants

UNIT -III

UNIT -IV
Introduction to water pollution – water pollutants classification –characteristics of liquid effluents from fertilizer, pulp & paper and petroleum industries, estimation of oxygen demands – DO, BOD, COD, TOC – BOD curves, oxygen sag curve – modeling of BOD curves


UNIT -V

TEXT BOOKS:
1. Pollution control in process industries by S.P. Mahajan TMH.,1985
REFERENCE BOOKS:


Course Outcomes:

At the end of the course, student will be able to
1. Understand the different types of wastes generated in an industry, their effects on living and non-living things.
2. Understand environmental regulatory legislations and standards and climate changes.
3. Understand the atmospheric dispersion of air pollutants, and operating principles, design calculations of particulate control devices.
4. Understand about the quantification and analysis of wastewater and treatment.
5. Understand the different unit operations and unit processes involved in conversion of highly polluted water to potable standards.
DESIGN AND ANALYSIS OF EXPERIMENTS

(CHEM)
OPEN ELECTIVE – II

Pre Requisites: Mathematics-III

Course Objectives:
1. Review on how the design of experiments is useful during research and finds the most significant factor for an experiment.
2. Calculate the factor levels that optimize the outcome of an experiment.
3. Explain about the Factorial Design of experiments.

UNIT I
Introduction to the role of experimental design; basic statistical concepts; sampling and sampling distribution; Testing of hypotheses about differences in means- randomized designs and paired comparison designs; testing of hypotheses about variances.

UNIT II
Analysis of variance (ANOVA) –one-way classification ANOVA; analysis of fixed effects model; comparison of individual treatment means; the random effects model; the randomized complete block design

UNIT III
Factorial design of experiments; two-factor factorial design-fixed effects and random effects model; General factorial design; analysis of $2^k$ and $3^k$ factorial designs.

UNIT IV
Conforming in the $2^k$ factorial design in $2^p$ block; confounding in the $3^k$ factorial design in $3^p$ block; Fractional replication of the $2^k$ factorial design and the $3^k$ factorial design.

UNIT V
Regression analysis- Simple and multiple linear regression and hypothesis testing; response surface methodology-the method of steepness ascent: response surface designs for first-order and second-order models. Evolutionary operation (EVOP).

TEXT BOOKS:

REFERENCE BOOKS:
Course Outcomes:

At the end of the course, student will be able to

1. Explain the basic concepts and models of experimental design.
2. Analyze the results of a designed experiment in order to conduct appropriate statistical analysis of data.
3. Perform factorial design of experiments
4. Illustrate the strategy in planning and conducting experiments.
5. Apply response surface methodology to optimize the process by considering the curvature.
ENTREPRENEURSHIP

(HSS)
OPEN ELECTIVE – II

Course Objective: The aim of this course is to have a comprehensive perspective of inclusive learning, ability to learn and implement the Fundamentals of Entrepreneurship.

Course Outcome: It enables students to learn the basics of Entrepreneurship and entrepreneurial development which will help them to provide vision for their own Start-up.

Unit – 1: Entrepreneurial Perspectives:

Unit – 2: New Venture Creation:
Introduction, Mobility of Entrepreneurs, Models for Opportunity Evaluation; Business plans – Purpose, Contents, Presenting Business Plan, Procedure for setting up Enterprises, Central level - Startup and State level - T Hub, Other Institutions initiatives.

Unit – 3: Management of MSMEs and Sick Enterprises
Challenges of MSME s , Preventing Sickness in Enterprises – Specific Management Problems; Industrial Sickness; Industrial Sickness in India – Symptoms, process and Rehabilitation of Sick Units.

Units – 4: Managing Marketing and Growth of Enterprises:

Units – 5: Strategic perspectives in Entrepreneurship:

Suggested Readings:
3. Entrepreneurship, Arya Kumar, 4 e, Pearson 2015.
FINITE ELEMENT METHODS

(MATHS)
OPEN ELECTIVE – II

Pre-requisites: Mathematics courses in first two years of study
Objectives: To learn
  • The fundamental concepts of finite element methods.
  • Assembly elementary stiffness matrices and load vectors.
  • Shape functions.
  • Formulation of constant strain triangle.
  • The heat transfer problems.

UNIT-I: Fundamental FEM concepts
Discrete and continuous systems, Stress and Equilibrium, Boundary conditions, Strain-displacement relations, stress-strain relations, potential energy and equilibrium, The Rayleigh-Ritz method, Formulation of Finite Element Equations.

UNIT-II: Axially Loaded Bars
Fundamental concepts, two node bar element, Shape functions, Element Stiffness Matrix and Load Vectors, Assembly of element stiffness matrices and load vectors, treatment of boundary conditions, Temperature effects, Examples of Axially Loaded Members.

UNIT-III: Analysis of Beams
Two nodes beam Element, shape functions, element stiffness matrix and load vectors, simple problems on beams with distributed and point loads.

UNIT-IV: Two Dimensional Problems

UNIT- V : One Dimensional Scalar Field Problems
Heat transfer: equilibrium equations, heat conduction in plane walls, convection heat transfer in fins, finite element formulation, simple problems.

Course outcomes:
After learning the contents of this paper the student is able to
  • Form finite element equations.
  • Analyse the problems of axially loaded bars.
  • Analyse two nodes beam element with distributed and point loads.
  • Model two dimensional problems and finding their solutions.
  • Solve heat transfer problems.

Text Books
References

ENVIRONMENTAL IMPACT ASSESSMENT

(CIVIL)
OPEN ELECTIVE – III

Course Objectives: The objectives of the course are to

- Define and Classify Environmental Impacts and the terminology
- Understand the environmental Impact assessment procedure
- Explain the EIA methodology
- List and describe environmental audits

UNIT-I

UNIT-II
EIA Methodologies: Environmental attributes-Criteria for the selection of EIA methodology, impact identification, impact measurement, impact interpretation & Evaluation, impact communication, Methods-Adhoc methods, Checklists methods, Matrices methods, Networks methods, Overlays methods. EIA review- Baseline Conditions -Construction Stage Impacts, post project impacts.

UNIT-III
Environmental Management Plan: EMP preparation, Monitoring Environmental Management Plan, Identification of Significant or Unacceptable Impacts Requiring Mitigation, Mitigation Plans and Relief & Rehabilitation, Stipulating the Conditions, Monitoring Methods, Pre- Appraisal and Appraisal.

UNIT-IV

UNIT-V
Case Studies: Preparation of EIA for developmental projects-Factors to be considered in making assessment decisions, Water Resources Project, Pharmaceutical industry, thermal plant, Nuclear fuel complex, Highway project, Sewage treatment plant, Municipal Solid waste processing plant, Air ports.

Course Outcomes: At the end of the course the student will be able to

- Identify the environmental attributes to be considered for the EIA study
- Formulate objectives of the EIA studies
- Identify the methodology to prepare rapid EIA
- Prepare EIA reports and environmental management plans
Text Books:

References:
Prerequisite: Power System-I

Course Objectives:
- To provide an overview of power plants and the associated energy conversion issues

Course Outcomes: Upon completion of the course, the students can
- Understand the principles of operation for different power plants and their economics

UNIT-I:
COAL BASED THERMAL POWER PLANTS
Basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam and heating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems.

UNIT-II:
GAS TURBINE AND COMBINED CYCLE POWER PLANTS
Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

UNIT-III:
BASICS OF NUCLEAR ENERGY CONVERSION
Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

UNIT-IV:
HYDROELECTRIC POWER PLANTS
Classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems

UNIT-V:
ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES
Power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

TEXT BOOKS:

REFERENCES:
ENERGY SOURCES AND APPLICATIONS
(EEE)
OPEN ELECTIVE - III

Pre-requisites: None

Course Objectives:
- To introduce various types of energy sources available.
- The technologies of energy conversion from these resources and their quantitative analysis.
- To know the applications of various energy sources

Course Outcomes: At the end of the course, the student will be able to
- List and generally explain the main sources of energy and their primary applications nationally and internationally
- Have basic understanding of the energy sources and scientific concepts/principles behind them
- Understand effect of using these sources on the environment and climate
- Describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the impact on the environment.
- List and describe the primary renewable energy resources and technologies.
- To quantify energy demands and make comparisons among energy uses, resources, and technologies.
- Collect and organize information on renewable energy technologies as a basis for further analysis and evaluation.
- Understand the Engineering involved in projects utilizing these sources

UNIT-I:
INTRODUCTION TO ENERGY SCIENCE:
Scientific principles and historical interpretation to place energy use in the context of pressing societal, environmental and climate issues Introduction to energy systems and resources; Introduction to Energy, sustainability & the environment

UNIT-II:
ENERGY SOURCES:
Overview of energy systems, sources, transformations efficiency, and storage. Fossil fuels (coal, oil, oil-bearing shale and sands, coal gasification) -past, present & future, Remedies & alternatives for fossil fuels - biomass, wind, solar nuclear, wave, tidal and hydrogen;

UNIT-III:
SUSTAINABILITY AND ENVIRONMENTAL TRADE-OFFS OF DIFFERENCE ENERGY SYSTEMS:
Possibilities for energy storage or regeneration (Ex. Pumped storage hydro Power projects, superconductor-based energy storages, high efficiency batteries)

UNIT-IV:
ENERGY & ENVIRONMENT:
Energy efficiency and conservation; introduction to clean energy technologies and its importance in sustainable development; Carbon footprint, energy consumption and sustainability; introduction to the economics of energy; How the economic system determines production and consumption; linkages between economic and environmental outcomes; How future energy use can be influenced by economic environmental, trade, and research policy.
UNIT-V:
ENGINEERING FOR ENERGY CONSERVATION:
Concept of Green Building and Green Architecture; Green building concepts (Green building encompasses everything from the choice of building materials to where a building is located, how it is designed and operated) LEED ratings; Identification of energy related enterprises that represent the breadth of the industry and prioritizing these as candidates; Embodied energy analysis and use as a tool for measuring sustainability. Energy Audit of Facilities and optimization of energy consumption

TEXT BOOKS:

REFERENCES:
2. Jean-Philippe; Zaccour, Georges (Eds.), (2005), Energy and Environment Set: Mathematics of Decision Making, Loulou, Richard; Waaub, XVIII,
5. Related papers published in international journals
ENERGY STORAGE DEVICES

(MECH)
OPEN ELECTIVE - III

Objectives:
To understand the concept of understand/analyse the various types of energy storage.
To study the various applications of energy storage systems.

Course Outcomes:
Students will be:
Able to analyse various types of energy storage devices and perform the selection based on techno-economic view point.

UNIT – I:
Necessity of Energy Storage: Types of energy storage - comparison of energy storage technologies - Applications.

UNIT – II:
Thermal Storage: Types - Modeling of thermal storage units - Simple water and rock bed storage.

UNIT – III:
System Pressurized Water Storage System: Modeling of phase change storage system - Simple units - Packed bed storage units - Modeling using porous medium approach - Use of Transys.

UNIT – IV:
Fundamental Concepts of Batteries: Measuring of battery performance - Charging and discharging of a battery - Storage density - Energy density - Safety issues - Types of batteries - Lead Acid, Nickel, Cadmium, Zinc Manganese dioxide and modern batteries for example (i) Zinc-Air (ii) Nickel Hydride (iii) Lithium Battery.

UNIT – V:

TEXT BOOKS:
1. Solar Engineering, Thermal Procession by Buffa & Buckman
2. Solar Energy by G.D Rai

REFERENCE BOOKS:
1. Solar Energy by Sukhame
3. Renewable Energy Technologies by Ramesh & Kumar, Narosa.
PRINCIPLES OF COMMUNICATIONS

(ECE)
OPEN ELECTIVE - III

Pre-requisite: Nil

Course Objectives
1. Basic understanding of all communication systems
2. Introduce the basic definitions of different modulation techniques.
3. Known about satellite and optical communications.
4. Learn the fundamentals of wireless technologies.

Course Outcomes
Upon completing this course, the student will be able to
1. Understand the need of modulation and distinguish various modulation techniques.
2. Known the communication concepts using satellite and optical fiber.
3. Have a basic understanding of cellular, mobile and telephone communication systems.

UNIT I
Simple description on Modulation

UNIT II Satellite Communication
Satellite Orbits, Ground Stations, Satellite Applications, basics of Global Positioning systems.

UNIT III
Optical Communication
Propagation mechanism, Types of optical fiber, LED source, PIN detector

UNIT IV
Telecommunication Systems
Telephone system, Paging systems, Internet Telephony.

Networking and Local Area Networks
Network fundamentals, Ethernet LANs, Token Ring LAN.

UNIT V
Cellular and Mobile Communications
Basic concepts of Cellular telephone systems, Evolution and standard - AMPS, GSM, CDMA, and WCDMA.

Wireless Technologies
Fundamentals - Wireless LANs, PANs and MANs.
TEXT BOOKS
2. Kennedy, Davis, Electronic Communications systems, 4e, TMH, 1999.

REFERENCES
MACHINE LEARNING

(CSE)
OPEN ELECTIVE – III

Prerequisites
1. Data Structures
2. Knowledge on statistical methods

Objectives
1. This course explains machine learning techniques such as decision tree learning, Bayesian learning etc.
2. To understand computational learning theory.
3. To study the pattern comparison techniques.

Outcomes
1. Understand the concepts of computational intelligence like machine learning
2. Ability to get the skill to apply machine learning techniques to address the real time problems in different areas
3. Understand the Neural Networks and its usage in machine learning application.

UNIT - I
Introduction - Well-posed learning problems, designing a learning system, Perspectives and issues in machine learning
Concept learning and the general to specific ordering – introduction, a concept learning task, concept learning as search, find-S: finding a maximally specific hypothesis, version spaces and the candidate elimination algorithm, remarks on version spaces and candidate elimination, inductive bias
Decision Tree Learning – Introduction, decision tree representation, appropriate problems for decision tree learning, the basic decision tree learning algorithm, hypothesis space search in decision tree learning, inductive bias in decision tree learning, issues in decision tree learning.

UNIT - II
Artificial Neural Networks-1– Introduction, neural network representation, appropriate problems for neural network learning, perceptions, multilayer networks and the back-propagation algorithm.
Evaluation Hypotheses – Motivation, estimation hypothesis accuracy, basics of sampling theory, a general approach for deriving confidence intervals, difference in error of two hypotheses, comparing learning algorithms.

UNIT - III
Bayesian learning – Introduction, Bayes theorem, Bayes theorem and concept learning, Maximum Likelihood and least squared error hypotheses, maximum likelihood hypotheses for predicting probabilities, minimum description length principle, Bayes optimal classifier, Gibbs algorithm, Naïve Bayes classifier, an example: learning to classify text, Bayesian belief networks, the EM algorithm.
Computational learning theory – Introduction, probably learning an approximately correct hypothesis, sample complexity for finite hypothesis space, sample complexity for infinite hypothesis spaces, the mistake bound model of learning.
Instance-Based Learning- Introduction, k-nearest neighbour algorithm, locally weighted regression, radial basis functions, case-based reasoning, remarks on lazy and eager learning.
UNIT- IV

**Genetic Algorithms** – Motivation, Genetic algorithms, an illustrative example, hypothesis space search, genetic programming, models of evolution and learning, parallelizing genetic algorithms.


**Reinforcement Learning** – Introduction, the learning task, \(Q\)-learning, non-deterministic, rewards and actions, temporal difference learning, generalizing from examples, relationship to dynamic programming.

UNIT-V

**Analytical Learning-1**- Introduction, learning with perfect domain theories: PROLOG-EBG, remarks on explanation-based learning, explanation-based learning of search control knowledge.

**Analytical Learning-2**- Using prior knowledge to alter the search objective, using prior knowledge to augment search operators.

**Combining Inductive and Analytical Learning** – Motivation, inductive-analytical approaches to learning, using prior knowledge to initialize the hypothesis.

**Text Books**
1. Machine Learning – Tom M. Mitchell, - MGH

**References**
MOBILE APPLICATION DEVELOPMENT

(CSE)
OPEN ELECTIVE – III

Prerequisites
1. Acquaintance with JAVA programming
2. A Course on DBMS

Objectives
1. To demonstrate their understanding of the fundamentals of Android operating systems
2. To improve their skills of using Android software development tools
3. To demonstrate their ability to develop software with reasonable complexity on mobile platform
4. To demonstrate their ability to deploy software to mobile devices
5. To demonstrate their ability to debug programs running on mobile devices

Outcomes
1. Student understands the working of Android OS Practically.
2. Student will be able to develop Android user interfaces
3. Student will be able to develop, deploy and maintain the Android Applications.

UNIT - I
Introduction to Android Operating System: Android OS design and Features – Android development framework, SDK features, Installing and running applications on Android Studio, Creating AVDs, Types of Android applications, Best practices in Android programming, Android tools
Android application components – Android Manifest file, Externalizing resources like values, themes, layouts, Menus etc, Resources for different devices and languages, Runtime Configuration Changes
Android Application Lifecycle – Activities, Activity lifecycle, activity states, monitoring state changes

UNIT - II
Android User Interface: Measurements – Device and pixel density independent measuring UNIT s
Layouts – Linear, Relative, Grid and Table Layouts
User Interface (UI) Components – Editable and non editable TextViews, Buttons, Radio and Toggle Buttons, Checkboxes, Spinners, Dialog and pickers
Event Handling – Handling clicks or changes of various UI components
Fragments – Creating fragments, Lifecycle of fragments, Fragment states, Adding fragments to Activity, adding, removing and replacing fragments with fragment transactions, interfacing between fragments and Activities, Multi-screen Activities

UNIT - III
Intents and Broadcasts: Intent – Using intents to launch Activities, Explicitly starting new Activity, Implicit Intents, Passing data to Intents, Getting results from Activities, Native Actions, using Intent to dial a number or to send SMS
Broadcast Receivers – Using Intent filters to service implicit Intents, Resolving Intent filters, finding and using Intents received within an Activity
Notifications – Creating and Displaying notifications, Displaying Toasts

UNIT - IV
Persistent Storage: Files – Using application specific folders and files, creating files, reading data from files, listing contents of a directory
Shared Preferences – Creating shared preferences, saving and retrieving data using Shared Preference
UNIT - V
Database – Introduction to SQLite database, creating and opening a database, creating tables, inserting retrieving and etindelg data, Registering Content Providers, Using content Providers (insert, delete, retrieve and update)

Text Books
1. Professional Android 4 Application Development, Reto Meier, Wiley India, (Wrox), 2012

References
1. Beginning Android 4 Application Development, Wei-Meng Lee, Wiley India (Wrox), 2013
SCRIPTING LANGUAGES

(CSE)
OPEN ELECTIVE – III

Prerequisites
1. A course on “Computer Programming and Data Structures”
2. A course on “Object Oriented Programming Concepts”

Objectives
1. This course provides an introduction to the script programming paradigm
2. Introduces scripting languages such as Perl, Ruby and TCL.
3. Learning TCL

Outcomes
1. Comprehend the differences between typical scripting languages and typical system and application
   programming languages.
2. Gain knowledge of the strengths and weakness of Perl, TCL and Ruby; and select an appropriate language
   for solving a given problem.
3. Acquire programming skills in scripting language

UNIT - I
Introduction : Ruby ,Rails, The structure and Execution of Ruby Programs ,Package Management with
RUBYGEMS, Ruby and web : Writing CGI scripts , cookies, Choice of Webservers ,SOAP and
webservices
RubyTk – Simple Tk Application ,widgets , Binding events , Canvas ,scrolling

UNIT - II
Extending Ruby : Ruby Objects in C , the Jukebox extension, Memory allocation ,Ruby Type System ,
Embedding Ruby to Other Languages , Embedding a Ruby Interperter

UNIT - III
Introduction to PERL and Scripting
Scripts and Programs, Origin of Scripting , Scripting Today, Characteristics of Scripting Languages,Uses for
Scripting Languages, Web Scripting, and the universe of Scripting Languages. PERL- Names and Values, Variables,
Scalar Expressions, Control Structures, arrays, list, hashes, strings, pattern and regular expressions, subroutines.

UNIT - IV
Advanced perl
Finer points of looping, pack and unpack, filesystem, eval, datastructures, packages, modules, objects,
interfacing to the operating system, Creating Internet ware applications, Dirty Hands Internet
Programming, security Issues.

UNIT - V
TCL
TCL Structure, syntax, Variables and Data in TCL, Control Flow, Data Structures, input/output,
procedures , strings , patterns, files, Advance TCL- eval, source, exec and uplevel commands, Name
spaces, trapping errors, event driven programs, making applications internet aware, Nuts and Bolts
Internet Programming, Security Issues, C Interface.

Tk
Tk-Visual Tool Kits, Fundamental Concepts of Tk, Tk by example, Events and Binding , Perl-Tk.

Text Books
1. The World of Scripting Languages , David Barron,Wiley Publications.
2. Ruby Programming language, David Flanagan and Yukihiro Matsumoto, O’Reilly

References
1. Open Source Web Development with LAMP using Linux Apache, MySQL, Perl and PHP,J.Lee and B.Ware(Addison Wesley) Pearson Education.
2. Perl by Example, E.Quigley, Pearson Education.
3. Programming Perl,Larry Wall,T.Christiansen and J.Orwant, O’Reilly, SPD.
4. Tcl and the Tk Tool kit, Ousterhout, Pearson Education.
DATABASE MANAGEMENT SYSTEMS

(CSE)
OPEN ELECTIVE – III

Prerequisites
1. A course on “Data Structures”

Objectives
1. To understand the basic concepts and the applications of database systems.
2. To master the basics of SQL and construct queries using SQL.
3. Topics include data models, database design, relational model, relational algebra, transaction control, concurrency control, storage structures and access techniques.

Outcomes
1. Gain knowledge of fundamentals of DBMS, database design and normal forms
2. Master the basics of SQL for retrieval and management of data.
3. Be acquainted with the basics of transaction processing and concurrency control.
4. Familiarity with database storage structures and access techniques

UNIT - I
Database System Applications: A Historical Perspective, File Systems versus a DBMS, the Data Model, Levels of Abstraction in a DBMS, Data Independence, Structure of a DBMS

Introduction to Database Design: Database Design and ER Diagrams, Entities, Attributes, and Entity Sets, Relationships and Relationship Sets, Additional Features of the ER Model, Conceptual Design With the ER Model

UNIT - II
Introduction to the Relational Model: Integrity constraint over relations, enforcing integrity constraints, querying relational data, logical database design, introduction to views, destroying/altering tables and views.
Relational Algebra, Tuple relational Calculus, Domain relational calculus.

UNIT - III
SQL: Queries, Constraints, Triggers: Form of basic SQL query, UNION, INTERSECT, and EXCEPT, Nested Queries, aggregation operators, NULL values, complex integrity constraints in SQL, triggers and active data bases.

Schema refinement: Problems caused by redundancy, decompositions, problems related to decomposition, reasoning about functional dependencies, FIRST, SECOND, THIRD normal forms, BCNF, lossless join decomposition, multi-valued dependencies, FOURTH normal form, FIFTH normal form.

UNIT - IV
UNIT - V

Text Books

References
2. SQL The Complete Reference, James R. Groff, Paul N. Weinberg, 3rd Edition,
3. Oracle for Professionals, The X Team, S.Shah and V. Shah, SPD.
ALLOY STEELS

(MET)
OPEN ELECTIVE – III

Pre-Requisites: Nil

Course Objectives:
This course deals with:
1. Describe the physical metallurgy of steels and alloy steels.
2. Explain the microstructure and properties of steels and alloy steels.
3. Make judgments on microstructural evolution and properties developed in alloy steels.

UNIT – I
Low-carbon Mild steels: Introduction. Cold forming steels, High strength packing steels; HSLA steels;
Low-carbon Ferrite pearlite steels, structure property relationships, strengthening mechanisms,
Formability of HSLA steels.

UNIT – II
Medium- High carbon ferrite-pearlite steels – structure property relationships, Bainitic steels, Low-carbon
bainitic steels requirements, development and choice of alloying elements, Mechanical properties,
microstructure and impact properties, High-Carbon bainitic steels.

UNIT – III
Ultra-high strength steels: Classification and applications. Description steels tempered at low
temperatures, secondary hardening, thermo-mechanical treatments, rapid austenitizing treatments,
structure-property relationships in tempered martensite, cold-drawn pearlite steels, maraging steels.

UNIT – IV
Stainless steels: Classification, Composition, role of alloying elements, Heat treatment, microstructure
and applications.

UNIT- V
Tool steels and Heat resistant steels: Classification, Composition, role of alloying elements, Heat
treatment, microstructure and applications.

Text Books:
Reference Books:

Course Outcomes:
1. Develop an appreciation for the micro structural complexity in alloys and how simple analytical solutions are often adequate to cope with these problems and know their limitations.
2. Know the importance of structure - property correlation study in HSLA, Ultra high strength steels etc., and their suitable applications.
3. Select suitable materials for corrosion resistance applications.
4. Analyze the importance of composition, heat treatment and microstructure effects on properties and uses of tool steels and heat resistant steels.
5. Able to apply the knowledge gained on micro structural evolution and its stability to optimize the processing routes for specific applications.
HIGH TEMPERATURE MATERIALS

(MET)
OPEN ELECTIVE – III

Pre-Requisites: Nil

Course objectives:
1. To learn and design material’s microstructure for high temperature applications.
2. To learn scientific issues related to high temperature such as creep, oxidation and material degradation.
3. To study the properties which improve high temperature resistance.

UNIT-I

UNIT-II
Fatigue, thermal fatigue, ageing, structural changes, material damage, crack propagation, damage mechanics, life time analysis, Creep-Fatigue interaction.

UNIT-III

UNIT-IV
Super alloys: their processing, high temperature mechanical properties, Corrosion behaviour, Ceramics for applications in refractory technology, Properties and applications of high temperature polymers.

UNIT-V
Refractory metals and alloys, Intermetallics, Carbon-Carbon composites, Ceramic matrix composites for refractory applications, Industrial, defence and nuclear applications.

Text Books:

Reference Books:
1. Introduction to the High Temperature Oxidation of Metals by Neil Birks, Gerald H. Meier, and Frederick S. Pettit (Paperback - Jul 23, 2009)
Course Outcomes:
1. Outline the different processes responsible for failure of materials at high temperature.
2. Able to relate the causes for creep failure and choice of creep resistant materials.
3. Able to interpret the structural changes taking place during fatigue and aging and carry out analysis of data.
4. Able to interpret the chemical causes for failure at high temperature.
5. Distinguish the role of ceramics, polymers, super alloys etc., at high temperature.
6. Analysis of data available for design and improve the existing materials.
INDUSTRIAL SAFETY AND HAZARD MANAGEMENT

(CHEM)
OPEN ELECTIVE – III

Pre Requisites: NIL

Course Objectives:
1. To describe awareness of different hazards in process industries
2. To show classification of hazards and their identifications
3. To demonstrate precautions in chemical storage and handling

UNIT I
Introduction, Factors Contributing to the Costs of Accidents, List of some Notable accidents in the process industry/selected case histories, some common features of high cost accidents, reasons for high priority towards safety.

UNIT II

UNIT III
Material hazards 2: Fire balls, Fire damage, run away chemical reaction, incompatible materials, material safety and data sheets
Process and plant Hazards: Hazards of pressure, causes of over pressures, flow deviations, effects of leakages/releases, hazards of temperatures.

UNIT IV
Hazard analysis: process safety management, process hazards analysis, hazards analysis methods, check list, preliminary hazard analysis, what-if / check list, hazard and operability analysis, FMEA, Fault tree analysis, cause and consequence analysis.

UNIT V
Preventive and protective measures: Safety options, process safety approaches, inherent safety and design, plant layout, inherent security, explosion prevention and protection, personal protective systems, plant modifications and management change, relief valves and rupture discs, breather vents for storage tanks, explosions vents, flame arresters, flare systems

TEXT BOOKS:
2. Chemical process Safety by Crowl

REFERENCE BOOKS:
1. Chemical process safety by Sanders
Course Outcomes:

At the end of the course, student will be able to
1. Illustrate the history accidents and priority towards safety.
2. Categorize hazards in industries
3. Prepare material safety and data sheet
4. Practice HAZOP, Fault tree analysis and other loss prevention techniques.
5. Devise and design safety equipments in a planned manner
ENERGY ENGINEERING

(CHEM)
OPEN ELECTIVE – III

Pre Requisites: NIL

Course Objectives:
1. Explain about the conventional energy sources and their utilization.
2. Describe the importance of heat recovery and energy conservation methods and energy audit
3. Identify different types of fuel sources for energy production.

UNIT I
Sources of energy, types of fuels- energy and relative forms. Calorific value- gross and net value, calculation of calorific value from fuel analysis, experimental determination energy resources present and future energy demands with reference to India.
Coal: origin, occurrence, reserves, petrography, classification, ranking, analysis, testing, storage, coal carbonization and byproduct recovery, liquefaction of coal, gasification of coal, burning of coal and firing mechanism, burning of pulverized coal.

UNIT II
Liquid fuels: petroleum: origin, occurrence, reserves, composition, classification, characteristics, fractionation, reforming, cracking, petroleum products, specification of petroleum products, burning of liquid fuels.
Natural gas, coke oven gas, producer gas, water gas, LPG, burning of gaseous fuels, hydrogen (from water) as future fuel, fuel cells, flue gas, analysis: orsat apparatus.

UNIT III
Steam Plant: Run time cycle, boiler plant, steam cost, steam distribution and utilization, combined heat and power systems, energy from biomass and biogas plants, gas purification, solar energy, wind energy, energy storage.

UNIT IV
Waste heat recovery, sources of waste heat and potential application, various types of heat recovery systems, regenerators, recuperators, waste heat boilers
Energy conservation: conservation methods in process industries, theoretical analysis, practical limitations.

UNIT V
Energy auditing: short term, medium term, long term schemes, energy conversion, energy index, energy cost, representation of energy consumption, Sankey diagram, energy auditing.

TEXT BOOKS:
1. Fuels, Furnaces and Refractories, O.P.Gupta
REFERENCE BOOKS:

Course Outcomes:
At the end of the course, student will be able to
1. Describe about conventional energy sources and discuss about various types of fuels.
2. Explain the importance and applications of liquid fuels.
3. Illustrate about the importance of steam along with various energy sources.
4. Explain the various waste heat recovery techniques.
5. Analyze energy audits applying various schemes.
**PROJECT MANAGEMENT**

**(HSS)**

**OPEN ELECTIVE – III**

**Course Objective:** The objective of this course is to lay an important foundation to students in managing projects with a special focus on every phase such as project planning, execution, monitoring and evaluation.

**Course Outcome:** Students will be able to understand

a) Importance of Project Management  
b) Project Planning, Execution and implementation  
c) Significance of teams in projects  
d) Project evaluation techniques.


**UNIT-IV: Project Planning and Control:** Planning Steps - Scheduling - Network Diagrams, Network Analysis, Critical Path, Quality Management, Project Execution, Monitoring and control, Agile project Management, Scrum, Lean Production and project management.

**UNIT-V: Organizational Behavior and Project Management:** Organizational Structure and Integration, Role of project manager, Roles in the project team, Project stakeholder engagement, Leadership in project management, participative management, team building approach, Conflict Management in Projects, Stress Management.

**Suggested Readings:**

- John M, Nicholas and Herman Steyn, Project Management for Engineering, Business and Technology, 5e, Routledge, 2017.
Z TRANSFORMS AND SPECIAL FUNCTIONS
(MATHS)
OPEN ELECTIVE – III

Pre-requisites: Mathematics courses in first two years of study

Objectives: To learn
- Criteria for applying Z transforms and solving difference equations by Z Transforms.
- Classification of singular points and finding series solutions to ODE.
- Solving Bessel Equation and study of its solution.
- Solving Hermite Equations and study of its solution.

UNIT- I : Z-Transforms
Definition, Some standard Z-transforms, Damping rule, Shifting rule, Multiplication by $n$, Initial and final value theorems. Inverse Z-transforms using partial fractions, Convolution theorem, Solution of difference equations by Z - transforms.

UNIT-II: Series Solutions of Second Order Ordinary Differential Equations
Classification of Singularities, series solutions to Differential Equations around zero, Frobenius Method around zero.

UNIT-III: Bessel Functions
Bessel’s Differential equation, Recurrence formulae for $J_n(x)$, Generating function for $J_n(x)$, Orthogonality of Bessel functions.

UNIT-IV: Legendre Functions
Legendre’s Differential equation, Rodrigue’s formula, Legendre Polynomials, Generating function for $P_n(x)$, Recurrence formulae for $P_n(x)$, Generating function for $P_n(x)$, Orthogonality of Legendre functions.

UNIT-V: Hermite Functions
Hermite’s equation, Generating function of Hermite Polynomials, Orthogonal Property, Recurrence formulae for $H_n(x)$.

Course outcomes:
After learning the contents of this paper the student must be able to
- Solve difference equation by employing Z-transforms.
- Applying Frobenius method to find series solutions of ODE.
- Obtain solution of Bessel and Hermite equations.
- Study properties of $J_n(x)$, $P_n(x)$, $H_n(x)$

Text Books
References