Open Elective Courses (OEC)

Open Elective-1

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

Open Elective-2

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

Open Elective-3

S. No	Offering Department	Subjects
1	Civil Engineering	Environmental Impact Assessment
2	Electrical & Electronics Engineering	Power Plant Engineering
		Energy Sources & Applications
3	Mechanical Engineering	Energy Storage Devices
4	Electronics & Communication Engineering	Principles of Communications
5	Computer Science & Engineering	Machine Learning
		Mobile Application Development
		Scripting Languages
		Database Management Systems
6	Metallurgical Engineering	Alloy Steels
		High Temperature Materials
7	Chemical Engineering	Industrial Safety and Hazard Management
		Energy Engineering
8	Humanities & Social Sciences	Project Management
9	Mathematics	Z Transforms and Special Functions
10		

DISASTER PREPAREDNESS & PLANNING MANAGEMENT

(CIVIL)
OPEN ELECTIVE - I

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:

1. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
2. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
3. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation

Reference Books:

1. http://ndma.gov.in/ (Home page of National Disaster Management Authority)
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
3. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003
4. Inter Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC

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:

PROBABILITY DISTRIBUTIONS IN RELIABILITY EVALUATION: Distribution concepts, Terminology of distributions, General reliability functions, Evaluation of the reliability functions, shape of reliability functions –Poisson distribution – normal distribution, exponential distribution, Weibull distribution.

NETWORK RELIABILITY EVALUATION USING PROBABILITY DISTRIBUTIONS: Reliability Evaluation of Series systems, Parallel systems – Partially redundant systems- determination of reliability measure- MTTF for series and parallel systems – Examples.

UNIT-IV:

DISCRETE MARKOV CHAINS: Basic concepts- Stochastic transitional probability matrix- time dependent probability evaluation- Limiting State Probability evaluation- Absorbing states – Application.

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:

1. Roy Billinton and Ronald N Allan, Reliability Evaluation of Engineering Systems, Plenum Press.
2. E.Balagurusamy, Reliability Engineering by Tata McGraw-Hill Publishing Company Limited

REFERENCES:

1. Reliability Engineering: Theory and Practice by Alessandro Birolini, Springer Publications.
2. An Introduction to Reliability and Maintainability Engineering by Charles Ebeling, TMH Publications.
3. Reliability Engineering by Elsayed A. Elsayed, Prentice Hall Publications.

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
Renewable Sources of Energy-Grid-Supplied Electricity-Distributed Generation-Renewable Energy Economics-Calculation of Electricity Generation Costs –Demand side Management Options –Supply side Management Options-Modern Electronic Controls of Power Systems.

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
Solar Energy-Generation of Electricity by Photovoltaic Effect -Dependence of a PV Cell Characteristic on Temperature-Solar cell Output Characteristics-Equivalent Models and Parameters for Photovoltaic Panels-Photovoltaic Systems-Applications of Photovoltaic Solar Energy-Economical Analysis of Solar Energy.

FUEL CELLS: The Fuel Cell-Low and High Temperature Fuel Cells-Commercial and Manufacturing Issues Constructional Features of Proton Exchange-Membrane Fuel Cells –Reformers-Electro-lyzer Systems and Related Precautions-Advantages and Disadvantages of Fuel Cells-Fuel Cell Equivalent Circuit-Practical Determination of the Equivalent Model Parameters -Aspects of Hydrogen as Fuel.

UNIT-III:
INDUCTION GENERATORS
Principles of Operation-Representation of Steady-State Operation-Power and Losses Generated-Self-Excited Induction Generator-Magnetizing Curves and Self-Excitation Mathematical Description of the Self-Excitation Process-Interconnected and Stand-alone operation -Speed and Voltage Control - Economical Aspects.

UNIT-IV:

STORAGE SYSTEMS

Energy Storage Parameters-Lead–Acid Batteries-Ultra Capacitors-Flywheels –Superconducting Magnetic Storage System-Pumped Hydroelectric Energy Storage - Compressed Air Energy Storage -Storage Heat - Energy Storage as an Economic Resource.

UNIT-V:

INTEGRATION OF ALTERNATIVE SOURCES OF ENERGY

Principles of Power Injection-Instantaneous Active and Reactive Power Control Approach Integration of Multiple Renewable Energy Sources-Islanding and Interconnection Control-DG Control and Power Injection.

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:

1. Felix A. Farret, M. Godoy Simoes, "Integration of Alternative Sources of Energy", John Wiley& Sons, 2006.
2. Solanki: Renewable Energy Technologies: Practical Guide ForBeginneers, PHI Learning Pvt. Ltd., 2008.

REFERENCES:

1. D.Mukherjee: Fundamentals Of Renewable Energy Systems, New Age International publishers, 2007.
2. Remus Teodorescu, Marco Liserre, Pedro Rodríguez: Grid Converters for Photovoltaic and Wind Power Systems, John Wiley & Sons, 2011.
3. Gilbert M. Masters: Renewable and Efficient Electric Power Systems, John Wiley & Sons, 2004.

QUANTITATIVE TECHNIQUES FOR BUSINESS DECISIONS

(MECH)
OPEN ELECTIVE - I

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:
Introduction to Engineering Economics- Basic Principles and Methodology of Engineering Economics– Fundamental Concepts - Demand – Demand Determinants - Law of Demand- Demand Forecasting and Methods - Elasticity of Demand - Theory of Firm – Supply- Elasticity of Supply.

UNIT- II:
Macro Economic Concepts: National Income Accounting - Methods of Estimation- Various Concepts of National Income - Inflation – Definition – Causes of Inflation and Measures to Control Inflation - New Economic Policy 1991 (Industrial policy, Trade policy, and Fiscal policy) Impact on Industry.

UNIT- III:
Production, Cost, Market Structures & Pricing:
Production Analysis: Factors of Production, Production Function, Production Function with one variable input, two variable inputs, Returns to Scale, Different Types of Production Functions. Cost analysis: Types of Costs, Short run and Long run Cost Functions. Market Structures: Nature of Competition, Features of Perfect competition, Monopoly, Oligopoly, and Monopolistic Competition. Pricing: Types of Pricing, Product Life Cycle based Pricing, Break Even Analysis, Cost Volume Profit Analysis.

UNIT- IV:
Capital Budgeting Techniques: Significance of Capital Budgeting - cash flows-Time Value of Money-Choosing between alternative investment proposals- Methods of Appraisal Techniques- Pay Back Period - Average Rate of Return – Net Present Value- Internal Rate of Return – Profitability Index.

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:

1. Engineering Economics by Henry Malcom Steinar, Principles, Mc Graw Hill Pub.
2. Business Economics - Theory and Applications by D.D.Chaturvedi, S.L.Gupta, International Book House Pvt. Ltd. 2013.

Reference Books:

1. Accounting by Jain and Narang, Kalyani Publishers.
2. Cost Accounting by Arora, M.N., Vikas Publication.
3. Financial Management by S.N.Maheshwari, Vikas Publishing House.

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

Introduction to Internet of Things, Characteristics of IoT, Physical design of IoT, Functional blocks of IoT, Sensing, Actuation, Basics of Networking, Communication Protocols, Sensor Networks.

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

1. The Internet of Things: Enabling Technologies, Platforms, and Use Cases, by Pethuru Raj and Anupama C. Raman (CRC Press)
2. Make sensors: Terokarvinen, kemo, karvinen and villey valtokari, 1st Ed., Maker Media, 2014.

REFERENCES

1. Internet of Things: A Hands-on Approach, by Arshdeep Bahga and Vijay Madisetti.
2. Fundamentals of Wireless Sensor Networks: Theory and Practice - Waltenegus Dargie, Christian Poellabauer.
3. Beginning Sensor networks with Arduino and Raspberry Pi – Charles Bell, Apress, 2013.

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

Search Trees: Binary Search Trees, Definition, Implementation, Operations- Searching, Insertion and Deletion, AVL Trees, Definition, Height of an AVL Tree, Operations – Insertion, Deletion and Searching, Red –Black, Splay Trees.

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

1. Fundamentals of data structures in C, E.Horowitz, S.Sahni and Susan Anderson Freed, 2nd Edition, Universities Press.
2. Data structures using C – A.S.Tanenbaum, Y. Langsam, and M.J. Augenstein, PHI/pearson education.

References

1. Data structures: A Pseudocode Approach with C, R.F.Gilberg And B.A.Forouzan, 2nd Edition, Cengage Learning.
2. Introduction to data structures in C, Ashok Kamthane, 1st Edition.

JAVA PROGRAMMING

(CSE)
OPEN ELECTIVE – I

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 editon, Herbert Schildt, TMH.
2. Understanding OOP with Java, updated edition, T. Budd, Pearson Eduction.

References

1. An Introduction to programming and OO design using Java, J.Nino and F.A. Hosch, John Wiley & sons.
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

Ceramic Materials: Introduction, Properties and Applications of Ceramics, Glasses and Refractories.

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:

1. W.F.Smith, Principles of Materials Science and Engineering, Mc Graw Hill, New York, 1994.
2. William D. Callister Introduction to Material Science and Engineering, John Wiley and Sons, 2007.

Reference Books:

1. Donald R. Askland, Pradeep P. Phule, The Science and Engineering of Materials (4th Edition), Thomson Publishers, 2003.
2. Engineering materials- R.K. Rajput.
3. Engineering materials - Michael F. Ashby and David R.H.Jones.

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

Heat Treatment of Steels: The Iron carbon systems, Common phases in steels, Annealing, Normalizing, Hardening and tempering.

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

Testing of Metals: Hardness testing, Tensile Testing, Impact Testing, Fatigue Testing.

Text Books:

1. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
2. Introduction to Physical Metallurgy – SH Avner, TATA Mc GRAW HILL ,1997.

Reference Books:

1. Engineering Physical Metallurgy and Heat treatment – Y Lakhtin
2. C. Suryanarayana, Experimental Techniques in Mechanics and Materials, John Wiley, John Wiley, NJ, USA,2006.
3. Foundations of Materials Science and Engineering – WF Smith.
4. Metallurgy for Engineers- Clark and Varney.
5. Mechanical Metallurgy – G. E. Dieter.

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 separation. Land filling and land forming. Deep well injection.

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:

1. Howard S. Peavy, Environmental Engineering, McGraw Hill International Edition, 1986.
2. Dutta, Industrial Solid Water Management and Land Filling Practice, Narose Publishing House, 1999.

REFERENCE BOOKS:

1. Sastry C.A., Waste Treatment Plants, Narose Publishing House, 1995.
2. Lagrega, Hazardous Waste Management, McGraw Hill, 1994.

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

Introduction: History and Scope, Can Small Things Make a Big Difference? Classification of Nano structured Materials, Fascinating Nanostructures, Applications of Nano materials, Nature: The Best of Nanotechnologist, Challenges and Future Prospects.

UNIT II

Unique Properties of Nano materials: Microstructure and Defects in Nano crystalline Materials: Dislocations, Twins, stacking faults and voids, Grain Boundaries, triple and disclinations.

Effect of Nano-dimensions on Materials Behavior: Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, Enhanced solid solubility.

UNIT III

Magnetic Properties: Soft magnetic nano-crystalline alloy, Permanent magnetic nano-crystalline materials, Giant Magnetic Resonance, Electrical Properties, Optical Properties, Thermal Properties and Mechanical Properties.

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.

Applications of Nano materials: Nano-electronics, Nanosensors, Nanocatalysts, Structure and Engineering, Automotive Industry, Water- Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defence and Space Applications

TEXT BOOKS:

1. Text Book of Nano Science and Nano Technology – B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath and James Munday, University Press-IIM.
2. Introduction to Nanotechnology – Charles P. Poole, Jr., and Frank J. Owens, Wley India Edition, 2012.

REFERENCE BOOKS:

1. Nano: The Essentials by T.Pradeep, Mc Graw- Hill Education.
2. Nanomaterials, Nanotechnologies and Design by Michael F. Ashby, Paulo J. Ferreira and Daniel L.Schodek
3. Transport in Nano structures- David Ferry, Cambridge University press 2000.

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

Law of Contract: Nature of Contract and Essential elements of valid contract, Offer and Acceptance, Consideration, Capacity to contract and Free Consent, Legality of Object. Unlawful and illegal agreements, Contingent Contracts, Performance and discharge of Contracts, Remedies for breach of contract. Contracts-II: Indemnity and guarantee, Contract of Agency, Sale of goods Act -1930: General Principles, Conditions & Warranties, Performance of Contract of Sale.

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:

1. Professional Ethics: R. Subramanian, Oxford University Press, 2015. Ravinder Kaur, Legal Aspects of Business, 4e, Cengage Learning, 2016.
2. RERA Act, 2017.
3. Wadhera (2004), Intellectual Property Rights, Universal Law Publishing Co.
4. T. Ramappa (2010), Intellectual Property Rights Law in India, Asia Law House. O.P. Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers.

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
Bisection method, Regula-Falsi method, Iteration method, Newton-Raphson method. Iterative methods of solution of system of equations: Jacobi's iteration method, Gauss-Seidel iteration method.

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
Taylor's series method, Picard's method, Euler's and modified Euler's Method, Runge-Kutta method of fourth order, Predictor and Corrector methods: Milne's method, Adams-Bashforth-Moulton method.

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

1. S S Sastry, Introductory Methods of Numerical Analysis, Fifth Edition, PHI Learning Pvt. Ltd, New Delhi, 2012.
2. M K Jain and S R K Iyengar, Numerical Methods for Scientific and Engineering Computation, 5^{th}Edition, New Age International Publishers, New Delhi, 2007.

References

1. B S Grewal, Higher Engineering Mathematics, 43^{rd} Edition, Khanna Publishers, New Delhi, 2014.
2. B V Ramana, Higher Engineering Mathematics, Tata McGraw Hill Education Private Limited, New Delhi, 29^{th} Reprint, 2017.
3. T K V Iyengar, B Krishna Gandhi & Others, Numerical Methods, Second Revised Edition, New Delhi, S.Chand& Co. Ltd, 2013.

REMOTE SENSING & GIS

(CIVIL)
OPEN ELECTIVE - II

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

Concepts of Remote Sensing Basics of remote sensing- elements involved in remote sensing, electromagnetic spectrum, remote sensing terminology & units, energy resources, energy interactions with earth surface features & atmosphere, atmospheric effects, satellite orbits, Sensor Resolution, types of sensors. Remote Sensing Platforms and Sensors, IRS satellites.

Remote Sensing Data Interpretation Visual interpretation techniques, basic elements, converging evidence, interpretation for terrain evaluation, spectral properties of soil, water and vegetation. Concepts of Digital image processing, image enhancements, qualitative & quantitative analysis and pattern recognition, classification techniques and accuracy estimation.

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
- **U**nderstand the applicability of RS and GIS for various applications.

TEXT BOOKS

1. Remote Sensing and GIS by Basudeb Bhatta , Oxford University Press, 2nd Edition, 2011.
2. Introduction to Geographic Information systems by Kang-tsung Chang, McGrawHill Education (Indian Edition), 7th Edition, 2015.
3. Fundamentals of Geographic Information systems by Michael N. Demers, 4th Edition, Wiley Publishers, 2012.

REFERENCES

1. Remote Sensing and Image Interpretation by Thomas M. Lillesand and Ralph W.Kiefer, Wiley Publishers, 7th Edition, 2015.\
2. Geographic Information systems – An Introduction by Tor Bernhardsen, Wiley India Publication, 3rd Edition, 2010.
3. Advanced Surveying: Total Station, GIS and Remote Sensing by Satheesh Gopi, R.SathiKumar, N.Madhu, Pearson Education, 1st Edition, 2007.

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:

1. H. Partab: Modern Electric Traction, Dhanpat Rai & Co, 2007.
2. E. Openshaw Taylor: Utilisation of Electric Energy, Orient Longman, 2010.

REFERENCES:

1. H. Partab: Art & Science of Utilisation of Electric Energy, Dhanpat Rai & Sons, 1998.
2. N.V. Suryanarayana: Utilisation of Electrical power including Electric drives and Electric Traction, New Age Publishers, 1997.

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
Fundamental torque equation, components of load torque, load characteristics, modified torque equation, speed-torque convention & multi-quadrant operation. Equivalent values of drive parameters, load with rotational motion, loads with translational motion, measurement of moment of inertia, components of load torques, Nature and classification of load torque. Calculation of time and energy loss in transient operation, steady state stability, loads equalization.
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:

1. G.K. Dubey: Fundamentals of Electric Drives –Narosa Publishers, Second edition, 2007.
2. Vedam Subramanyam: Electric Drives Concepts & Applications –Tata McGraw Hill Edn. Pvt.Ltd, Second edition 2011.

REFERENCES:

1. NisitK.De and PrashantaK.Sen: Electric Drives, PHI., 2001
2. V. Subrahmanyam: Thyristor Control of Electric Drives, Tata McGraw Hill Edn. Pvt.Ltd, 2010.
3. Werner Leonhard: Control of Electric Drives, Springer international edition 2001.
4. NisitK.De and SwapanK.Dutta: Electric Machines and Electric Drives, PHI learning Pvt. Ltd 2011

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:
Power Transmission Elements: Gears terminology of spur, helical and bevel gears, gear trains. Belt drives (types). Chain drives.

UNIT-III:
Energy: Sources: Renewable and non-renewable (various types, characteristics Advantages/disadvantages). Power Generation: External and internal combustion engines Hydro, thermal and nuclear power plants (layouts, element/component description, advantages, disadvantages, applications). Simple Problems.

UNIT-IV:
Manufacturing Processes: Sheet Metal Work: Introduction – Equipments – Tools and accessories – Various processes(applications, advantages / disadvantages). Welding: Types – Equipments – Tools and accessories– Techniques employed -applications, advantages / disadvantages – Gas cutting – Brazing and soldering.

UNIT-V:
Machine Tools: Lathe machine: Types - Description of main components – Cutting tools – Work holding devices – Basic operations. Simple Problems. Drilling Machine: Introduction Types – Description – Tools. Simple Problems.

Text Books:
1. Basic Mechanical Engineering by Kumar, T., Leenus Jesu Martin and Murali, G., Suma Publications, Chennai,2007

Reference Books:

1. Basic Mechanical Engineering by Prabhu, T. J., Jai Ganesh, V. and Jebaraj, S., Scitech Publications, Chennai, 2000.
2. Elements of Workshop Technology by Hajra Choudhary, S.K. and HajraChoudhary, A. K., Vols.I & II, Indian Book Distributing Company Calcutta, 2007.
3. Power Plant Engineering by Nag P.K., Tata McGraw-Hill, New Delhi, 2008.
4. Theory of Machines by Rattan, S.S., Tata McGraw-Hill, New Delhi, 2010.

ELECTRONIC SENSORS

(ECE)
OPEN ELECTIVE - II

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

Introduction, Resistive Potentiometer, Strain Gauge, Resistance Strain Gauge, Semiconductor Strain Gauges -Inductive Sensors: Sensitivity and Linearity of the Sensor –Types-Capacitive Sensors: ,Electrostatic Transducer, Force/Stress Sensors Using Quartz Resonators ,Ultrasonic Sensors.

UNIT II

Thermal Sensors

Introduction ,Gas thermometric Sensors ,Thermal Expansion Type Thermometric Sensors ,Acoustic Temperature Sensor ,Dielectric Constant and Refractive Index thermo sensors ,Helium Low Temperature Thermometer ,Nuclear Thermometer ,Magnetic Thermometer ,Resistance Change Type Thermometric Sensors, Thermo emf Sensors, Junction Semiconductor Types, Thermal Radiation Sensors, Quartz Crystal Thermoelectric Sensors, NQR Thermometry, Spectroscopic Thermometry, Noise Thermometry, Heat Flux Sensors.

UNIT III

Magnetic sensors

Introduction ,Sensors and the Principles Behind ,Magneto-resistive Sensors ,Anisotropic Magneto resistive Sensing ,Semiconductor Magneto resistors, Hall Effect and Sensors ,Inductance and Eddy Current Sensors, Angular/Rotary Movement Transducers , Synchros.

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

The Electrochemical Cell ,The Cell Potential - Standard Hydrogen Electrode (SHE),Liquid Junction and Other Potentials, Polarization , Concentration Polarization, Reference Electrodes, Sensor Electrodes, Electro ceramics in Gas Media.

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

Introduction, On-board Automobile Sensors (Automotive Sensors), Home Appliance Sensors, Aerospace Sensors, Sensors for Manufacturing –Sensors for environmental Monitoring

TEXT BOOKS

1. "Sensors and Transducers - D. Patranabis" –PHI Learning Private Limited., 2003.
2. Introduction to sensors- John veteline, aravind raghu, CRC press,2011

REFERENCES

1. Sensors and Actuators , D. Patranabis ,2nd Ed., PHI, 2013.
2. Make sensors: Terokarvinen, kemo, karvinen and villey valtokari, 1st edition, maker media, 2014.
3. Sensors handbook- Sabrie soloman, 2nd Ed. TMH,2009.

ARTIFICIAL INTELLIGENCE

(CSE)
OPEN ELECTIVE – II

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 estimaate 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:

Problem-Solving Agents, Searching for Solutions, Uninformed Search Strategies: Breadth-first search, Uniform cost search, Depth-first search, Iterative deepening Depth-first search, Bidirectional search, Informed (Heuristic) Search Strategies: Greedy best-first search, A* search, Heuristic Functions, Beyond Classical Search: Hill-climbing search, Simulated annealing search, Local Search in Continuous Spaces, Searching with Non-Deterministic Actions, Searching wih Partial Observations, Online Search Agents and Unknown Environment .

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:

Definition of Classical Planning, Algorithms for Planning with State-Space Search, Planning Graphs, other Classical Planning Approaches, Analysis of Planning approaches.

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

1. Artificial Intelligence A Modern Approach, Stuart Russell and Peter Norvig, 3rd Edition, Pearson Education.

References

1. Artificial Intelligence, E.Rich and K.Knight, , 3rd Edition, TMH
2. Artificial Intelligence, Patrick Henny Winston, 3rd Edition, Pearson Education.
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.
5. Build Web Services and introduction to Network and Database Programming 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

FILES: File Objects,File Built-in Function [open()], File Built-in Methods, File Built-in Attributes, Standard Files, Command-line Arguments, File System, File Execution, Persistent Storage Modules, Related Modules

Exceptions: Exceptions in Python, Detecting and Handling Exceptions, Context Management, *Exceptions as Strings, Raising Exceptions, Assertions, Standard Exceptions, *Creating Exceptions, Why Exceptions (Now)?, Why Exceptions at All?, Exceptions and the sys Module, Related Modules

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

Multithreaded Programming: Introduction, Threads and Processes, Python, Threads, and the Global Interpreter Lock, Thread Module, Threading Module, Related Modules

UNIT – IV

GUI Programming: Introduction, Tkinter and Python Programming, Brief Tour of Other GUIs, Related Modules and Other GUIs

WEB Programming: Introdution, Wed Surfing with Python, Creating Simple Web Clients, Advanced Web Clients, CGI-Helping Servers Process Client Data, Building CGI Application

Advanced CGI,Web (HTTP) Servers

UNIT – V

Database Programming:

Introduction, Python Database Application Programmer's Interface (DB-API), Object Relational Managers (ORMs), Related Modules

Textbook

1. Core Python Programming, Wesley J. Chun, 2nd Edition, Pearson.

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

Corrosion prevention methods: Alteration of Environment (Inhibitors), Design, Coatings, cathodic and anodic protection. Material selection, Metallurgical aspects, Hydrogen damage (hydrogen blistering, Hydrogen embrittlement, Prevention).

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:

1. Corrosion Engineering, M. G. Fontana, 3rd edition, McGraw-Hill, 1985.
2. Corrosion and Corrosion Control, H. H. Uhlig, Wiley, 1985.

Reference Books:

1. Theory of Corrosion and Protection of Metals, N. D. Tomashov, Macmillan, 1967.
2. Introduction to Electrometallurgy & Corrosion by Sharan – Narayan.
3. Corrosion Engineering 1st Edition Principles and Solved Problems by Branko Popov.
4. Handbook of Corrosion Engineering, Second Edition by: Pierre R. Roberge, Ph.D.

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, pourbiax extrapolation techniques.

TESTING OF MATERIALS

(MET)
OPEN ELECTIVE – II

Pre-requisites: Nil

Course Objectives:

1. To gain and 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

The Tension Test: Engineering stress-strain and True stress-strain curves. Tensile properties, conditions for necking. Stress-Strain diagrams for steel, Aluminum and cast iron.

UNIT-III

Fatigue Test: Introduction, Stress cycles, S-N Curve, Effect of mean stress, Mechanism of fatigue failure, Effect of stress concentration, size, surface condition and environments on fatigue.

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:

1. Mechanical Metallurgy – G. E. Dieter, Third edition, published by Newyork Mc Graw Hill,1986.
2. Mechanical behavior - Ed. Wulf.

Reference Books:

1. Mechanical Metallurgy – White & Lemay.
2. Testing of Metallic Materials - A.V.K. Suryanarayana.

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

General methods of control air pollutants removal of sulphur dioxide, oxides of nitrogen and organic vapors from gaseous effluents; Removal of particulate matter – principle and working of setting chambers, cyclone separators, fabric and fibre filters – electro static precipitators, Treatment of gaseous effluents.

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

Biological treatment of waste waters – aerobic and anaerobic methods– suspended and attached growth processes – bacteria – Reproduction in bacterial – Bacterial growth crushes, conventional activated sludge process – Trickling filters, Aerated lagoons – stabilization ponds – fluidized bed contractors.

UNIT -V

Physical Treatment methods : Principle and working of screening –sedimentation – flotation – filtration – flocculation, Tertiary Treatment methods – carbon adsorption – lon exchange – Reverse Osmosis, Boralin Chlorinating – Ultra filtration, Sludge treatment and disposal , removal of chromium and phenol from liquid effluents.

TEXT BOOKS:

1.Pollution control in process industries by S.P. Mahajan TMH.,1985
2. Waste water treatment by M.Narayana Rao and A.K.Datta, Oxford and IHB publisher, New Delhi.

REFERENCE BOOKS:

1. Environmental pollution and control engineering by Rao C. S. –Wiley EasternLimited, India, 1993.
2. Air pollution control by P. Prathapmouli and N. Venkatasubbayya. Divya Jyothi Prakashan, Jodhpur.

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 2p block; confounding in the 3^k factorial design in 3p 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:

1. Design and analysis of experiments, 2^{nd}edn.,D.C.Montgomery, John Wileyand Sons, New York, 2003.

REFERENCE BOOKS:

1. Design and Analysis of Experiments, Narayan C Giri, New Age International, 1988.

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:
Introduction to Entrepreneurship – Evolution - Concept of Entrepreneurship - Types of Entrepreneurs - Entrepreneurial Competencies, Capacity Building for Entrepreneurs.Entrepreneurial Training Methods - Entrepreneurial Motivations - Models for Entrepreneurial Development - The process of Entrepreneurial Development.

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:
Essential Marketing Mix of Services, Key Success Factors in Service Marketing, Cost and Pricing, Branding, New Techniques in Marketing, International Trade.

Units – 5: Strategic perspectives in Entrepreneurship:
Strategic Growth in Entrepreneurship, The Valuation Challenge in Entrepreneurship, The Final Harvest of New Ventures, Technology, Business Incubation, India way – Entrepreneurship; Women Entrepreneurs – Strategies to develop Women Entrepreneurs, Institutions supporting Women Entrepreneurship in India.

Suggested Readings:

1. Entrepreneurship Development and Small Business Enterprises, Poornima M.Charantimath, 2e, Pearson, 2014.
2. Entrepreneurship, a South – Asian Perspective, D.F.Kuratko and T.V.Rao, 3e, Cengage, 2012.
3. Entrepreneurship, Arya Kumar, 4 e, Pearson 2015.

The Dynamics of Entrepreneurial Development and Management, Vasant Desai, Himalaya Publishing House, 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.
- Tehe 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
Finite Element Modeling, isoperimetric formulation Constant Strain Triangle (CST) Element Stiffness, Force terms, Stress calculation, Problem modeling and boundary conditions. Plane Stress and plane Strain Problems using CST Element, formulation of 4-noded quadrilateral element. Problems on isoperimetric formulation of 4-noded quadrilateral element.

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 beem element with distributed and point loads.
- Model two dimensional problems and finding their solutions.
- Solve heat transfer problems.

Text Books

1. An introduction to the Finite Element Method, by J.N. Reddy, McGraw Hill, New Delhi.
2. Finite Element procedures in engineering analysis",(2nd edition), by K J Bathe, Prentice- Hall India Pvt. Ltd., 1996.

References

1. Introduction to Finite Elements in Engineering (revised 4th edition), by Tirupathi R., Chandrupatla, Ashok D. Belegundu, Pearson Education Limited, 2011.
2. Finite Element Analysis, (1st edition) by G. Lakshmi Narasaiah", BS Publications, 2009.
3. Concepts and Applications of Finite Element Analysis", (4th edition), by Cook, Robert Davis et al", Wiley, John & Sons, 2001.
4. A first course in the finite element method" (4th edition), by Daryl L. Logan, Cengage Learning India, 2007.

ENVIRONMENTAL IMPACT ASSESSMENT

(CIVIL)
OPEN ELECTIVE – III

Course Objectives: The objectives of the course are to

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

UNIT-I

Introduction: The Need for EIA, Indian Policies Requiring EIA, The EIA Cycle and Procedures, Screening, Scoping, Baseline Data, Impact Prediction, Assessment of Alternatives, Delineation of Mitigation Measure and EIA Report, Public Hearing, Decision Making, Monitoring the Clearance Conditions, Components of EIA, Roles in the EIA Process. Government of India Ministry of Environment and Forest Notification (2000), List of projects requiring Environmental clearance, Application form, Composition of Expert Committee, Ecological sensitive places, International agreements.

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 Plansand Relief & Rehabilitation, Stipulating the Conditions, Monitoring Methods, Pre- Appraisal andAppraisal.

UNIT-IV

Environmental Legislation and Life cycle Assessment: Environmental laws and protection acts, Constitutional provisions-powers and functions of Central and State government, The Environment (Protection) Act 1986, The Water Act 1974, The Air act 1981, Wild Life act 1972, Guidelines for control of noise, loss of biodiversity, solid and Hazardous waste management rules.
Life cycle assessment: Life cycle analysis, Methodology, Management, Flow of materials-cost criteria-case studies.

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:

1. Anjaneyulu.Yand Manickam.V., Environmental Impact Assessment Methodologies,B.S. Publications, Hyderabad,2007
2. Barthwal, R. R., Environmental Impact Assessment, New Age International Publishers2002

References:

1. Jain, R.K., Urban, L.V., Stracy, G.S., Environmental Impact Analysis, Van Nostrand Reinhold Co., New York, 1991.
2. Rau, J.G. and Wooten, D.C., Environmental Impact Assessment, McGraw Hill Pub. Co., New York, 1996.

POWER PLANT ENGINEERING

(EEE)
OPEN ELECTIVE - III

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:

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.

REFERENCES:

1. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill,1998.

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 breath 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:

1. Boyle, Godfrey (2004), Renewable Energy (2nd edition). Oxford University Press
2. Boyle, Godfrey, Bob Everett, and Janet Ramage (Eds.) (2004), Energy Systems and Sustainability: Power for a Sustainable Future. Oxford University Press.

REFERENCES:

1. Schaeffer, John (2007), Real Goods Solar Living Sourcebook: The Complete Guide to Renewable Energy Technologies and Sustainable Living, Gaiam
2. Jean-Philippe; Zaccour, Georges (Eds.), (2005), Energy and Environment Set: Mathematics of Decision Making, Loulou, Richard; Waaub, XVIII,
3. Ristinen, Robert A. Kraushaar, Jack J. AKraushaar, Jack P. Ristinen, Robert A. (2006) Energy and the Environment, 2nd Edition, John Wiley UNDP (2000), Energy and the Challenge of Sustainability, World Energy assessment
4. E H Thorndike (1976), Energy & Environment: A Primer for Scientists and Engineers, Addison-Wesley Publishing Company
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:
Hybrid Storage Devices: Flywheel - Super capacitors - Principles & Methods - Applications - Compressed air Energy storage - Concept of Hybrid Storage - Applications.
Hydrogen Storage Devices: Hydrogen storage options - Compressed gas - Liquid hydrogen - Hydride - Chemical Storage - Comparisons - Safety and management of hydrogen - Applications of Hydrogen.

TEXT BOOKS:

1. Solar Engineering, Thermal Procession by Buffa & Buckman
2. Solar Energy by G.D Rai
3. Engineering Technology by S.Rao & D.B Parulkar

REFERENCE BOOKS:

1. Solar Energy by Sukhame
2. Fuel Cells: Principles and Applications by Viswanathan B and M Aulice Scibioh, Universities Press (2006).
3. Renewable Energy Technologies by Ramesh & Kumar, Narosa.
4. Hydrogen and Fuel Cells: A Comprehencsive Guide by Rebecca L and Busby, Penn Well Coporation, Oklahoma (2005).

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.
4. Known fundamentals of wireless networks.

UNIT I

Simple description on Modulation

Need for Modulation, Electromagnetic spectrum, Analog Modulation-AM, FM, Pulse Modulation-PAM, PWM, PCM, Digital Modulation Techniques-ASK, FSK, PSK, QPSK modulation and demodulation schemes.

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

1. Principles of Electronic Communication Systems, Louis E. Frenzel, 3e, McGraw Hill publications, 2008.
2. Kennedy, Davis, Electronic Communications systems, 4e, TMH, 1999.

REFERENCES

1. Tarmo Anttalainen, Introduction to Telecommunications Network Engineering, Artech House Telecommunications Library.
2. Theodore Rappaport, Wireless Communications-Principles and practice, Printice Hall, 2002.
3. Roger L. Freeman, Fundamentals of Telecommunications, 2e, Wiley publications.
4. Wayne Tomasi, Introduction to data communications and networking, Pearson Education, 2005.

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.

Artificial Neural Networks-2- Remarks on the Back-Propagation algorithm, An illustrative example: face recognition, advanced topics in artificial neural networks.

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, Gibs 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.

Learning Sets of Rules – Introduction, sequential covering algorithms, learning rule sets: summary, learning First-Order rules, learning sets of First-Order rules: FOIL, Induction as inverted deduction, inverting resolution.

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

1. Machine Learning: An Algorithmic Perspective, Stephen Marshland, Taylor & Francis

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 improves 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
2. Android Application Development for Java Programmers, James C Sheusi, Cengage Learning, 2013

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 Excution 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 Isses.

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
3. Programming Ruby - The Pramatic Programmers guide, Dabve Thomas, 2nd Edition.

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.
5. Perl Power, J.P.Flynt, Cengage Learning.

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 data base 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

Transaction Concept, Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for serializability, Lock Based Protocols, Timestamp Based Protocols, Validation- Based Protocols, Multiple Granularity, Recovery and Atomicity, Log–Based Recovery, Recovery with Concurrent Transactions.

UNIT - V

Data on External Storage, File Organization and Indexing, Cluster Indexes, Primary and Secondary Indexes, Index data Structures, Hash Based Indexing, Tree base Indexing, Comparison of File Organizations, Indexes and Performance Tuning, Intuitions for tree Indexes, Indexed Sequential Access Methods (ISAM), B+ Trees: A Dynamic Index Structure.

Text Books

1. Database Management Systems, Raghurama Krishnan, Johannes Gehrke, Tata Mc Graw Hill 3rd Edition
2. Database System Concepts, Silberschatz, Korth, Mc Graw hill, V edition.

References

1. Database Systems design, Implementation, and Management, Peter Rob & Carlos Coronel, 7th Edition.
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.
4. Database Systems Using Oracle: A Simplified guide to SQL and PL/SQL,Shah,PHI.

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:
1. Physical Metallurgy and the Design of steels: F. B. Pickering, Applied Science publisher, London, 1978.
2. The physical Metallurgy of steels: W. C. Leslie by Hempisphere Publishers Corporation, 1981.

Reference Books:

1. Alloys Steels – Wilson.
2. Heat Treatment of steels – Rajan & Sharma.

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

Creep, Types of Creep, Testing methods, Creep data presentation, Creep Curve and stages of creep, Mechanisms of Creep and creep resistant steels.

UNIT-II

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

UNIT-III

Oxidation, Kinetics of oxidation, Factors controlling oxidation, Hot Corrosion, Testing methods, Mechanisms of hot corrosion, erosion, Hot corrosion properties of carbon steels and stainless steels.

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:

1. Evans, R.W and Wilshire, B. Creep of metals and alloys, Institute of metals, 1985, London.
2. J.R. Davis, ASM Specialty Handbook: Heat- resistant materials, ASM, 1997.

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)
2. The Super-alloys: Fundamentals and Applications, Roger C. Reed, Cambridge University Press; 1 edition (July 31, 2008)
3. High Temperature Coatings, Sudhansu Bose, Butterworth-Heinemann; 1 edition (February 6, 2007)
4. Polyimides and Other High Temperature Polymers: Synthesis, Characterization and Applications, K. L. Mittal, Brill Academic Publications, 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
Material hazards1: Introduction Hazardous substances-categories, Toxicity, Radiation, Flammability, Ignition, Fires and explosions.

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:
1. Chemical process industry safety by K S N Raju, Mc-Graw Hill education (India) Pvt.Ltd,2014
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.

UNITV

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
2. Fuels and Combustion, 3rd ed., Samir Sarkar, Universities Press, 2009.

REFERENCE BOOKS:

1. Non-conventional Energy Resources, G.D.Rai, Khanna Publishers.
2. Fuel and Energy, Harker and Backhurst, Academic press London 1981.
3. Fuel Science- Harker and Allen, Oliver and Boyd, 1972.

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-I: Introduction: Introduction to Project management –Project Characteristics- Project Life cycle – Project Identification, Formulation and Implementation- Project management in different sectors: Construction, Services Sector, Public sector and Government Projects. Systems approach to project management.

UNIT-II: Project Planning and Appraisal: Project Planning – Project Appraisal- Feasibility study- Technical, Commercial, Economic, Financial, Management, Social Cost Benefit Analysis- Project Risk Analysis.

UNIT-III: Project Finance : Project Cost Estimation, Project Financing- Investment Criteria, Project Evaluation Techniques- Pay Back Period, Accounting rate of return, Net present value, Internal Rate of return, Profitability Index, Cash Flows Estimation for new and replacement projects- Cost of Capital, Risk Analysis.

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.
- Prasanna Chandra, Projects, Planning, Analysis, Selection, Financing, Implementation and review, 6e, Tata Mc Graw Hill2008.
- K.Nagrajan, Project Management, New Age International Publishers, 7e 2015.
- Jack Gido, Jim Clements Rose Baker, Successful Project Management, Cengage Learning, 7e 2015.

R.Paneerselvam, P.Senthil Kumar, Project Management, PHI, 2009.

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 Hermit Equation 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 Frobenies method to find series solutions of ODE.
- Obtain solution of Bessel and Hermit equations.
- Study properties of $J_n(x)$, $P_n(x)$, $H_n(x)$

Text Books

1. B S Grewal (2012), *Higher Engineering Mathematics*, 42nd Edition, New Delhi, Khanna Publishers.
2. B V Ramana (2010), *Engineering Mathematics*, New Delhi, Tata McGraw Hill Publishing Co. Ltd
3. H K Dass, ErRajnishVarma (2012), *Higher Engineering Mathematics*, Second Revised Edition,

New Delhi, S.Chand& Co. Ltd.

References

1. M D Raisinghania, Ordinary and Partial Differential Equations, 6th Edition, New Delhi, S.Chand& Co. Ltd.
2. Ervin Kreyszig, Advanced Engineering Mathematics, 10thEdition, New Jersy, JohnWiley& Sons