UG OPEN ELECTIVES		
Internal	External	Total
40	60	100

NOTE: MORE COURSES MAY BE ADDED IN THIS LIST LATER ON

UG OPEN ELECTIVES		
COURSE CODE	**COURSE**	**NOT APPLICABLE FOR PROGRAMMES**
Open Electives offered by department of Mechanical Engg.		
BMECO1-001	Power Plant Engineering	B. Tech. Mechanical Engg.
BMECO1-002	Thermal and Fluid Engineering	
BMECO1-003	Strength of Materials	
BMECO1-004	Fluid Machinery	
BMECO1-005	Automobile Engineering	
BMECO1-006	Modern Manufacturing Process	
Open Electives offered by department of CSE		
BCSEO1-001	Data Structures & Algorithms	B. Tech. CSE
BCSEO1-002	MATLAB Programming	
BCSEO1-003	Database Management Systems	
BCSEO1-004	Artificial Intelligence	
BCSEO1-005	Image Processing	
BCSEO1-006	Soft Computing	
BCSEO1-007	Big Data Analytics	
BCSEO1-008	Data Mining	
BCSEO1-009	Software Engineering	
BCSEO1-010	Computer Networks	
BCSEO1-011	Machine Learning	
BCSEO1-012	Internet of Things	
BCSEO1-013	Operating Systems	
BCSEO1-014	Object Oriented Programming	
BCSEO1-015	Information Technology in Engineering	
Open Electives offered by department of ECE		
BECEO1-001	Fundamentals of Electronic Communication Systems	B. Tech. ECE
BECEO1-002	Cellular and Mobile Communication	
BECEO1-003	Fundamentals of Wireless Communication	
BECEO1-004	Industrial Automation	
BECEO1-005	Bio-Medical Electronics & Instrumentation	
BECEO1-006	Android based Operating Systems	
BECEO1-007	Neural Network & Fuzzy Logic	

POWER PLANT ENGINEERING

Subject code: BMECO1-001 **L T P C** **Duration: 45 Hrs.**

3 0 0 3

Course Objectives:

1. Basic knowledge of Different types of Power Plants, site selection criteria of each one of them.
2. Understanding of Thermal Power Plant Operation, turbine governing, different types of high pressure boilers including supercritical and supercharged boilers, Fluidized bed combustion systems.
3. Design of chimney in thermal power plants, knowledge of cooling tower operation, numerical on surface condenser design.
4. Basic knowledge of Different types of Nuclear power plants including Pressurized water reactor, Boiling water reactor, gas cooled reactor, liquid metal fast breeder reactor.
5. Understanding of Power Plant Economics, Energy Storage including compressed air energy and pumped hydro etc.
6. Discussing environmental and safety aspects of power plant operation

UNIT-I

Generators, Boilers, Turbines and Condensers: Classification of steam generators, Types of Boilers: Babcock Wilcox, Cochran boilers, Types of condensers, effect of air in condensers, Dalton's law of partial pressure, cooling water calculations, steam nozzles, types of steam turbines, efficiencies, compounding, governing and control. Draught system and its types Combined Power Cycles– Comparison and Selection, Load Duration Curves. Fluidized Bed combustion system. Energy conservation and management. **05 Hrs.**

UNIT-II

Thermal Power Plant: Layout and working of Modern Thermal Power Plant, Fuel characteristics and storage, Coal benefication, blending and desulphurization, Liquid and Gaseous fuels, Slurry or Emulsation type fuels, Coal handling, Storage, Preparation and Feeding, Ash handling and Dust collection, Scrubber technology, selection of site, Description of Rankin cycle, Regenerative cycle, Reheat-Regenerative Cycle, Binary Vapour Cycle, High Pressure and Super Critical Boilers. Different systems of thermal power plant: fuel, air and flue gas systems, pulverizes, Condensate and feed water treatment system, Construction and functioning of

condenser, de-aerator and closed feed water heaters, HP - LP By-pass systems, Auxiliary Steam System, Turbine gland steam system. Cooling water system, Cooling Ponds and Cooling Towers—principle of operation and types, Advantages and Disadvantages of Thermal Power Plants. **12 Hrs.**

UNIT- III

Hydro-Electric Power Plants: Layout of Hydro Power Plant, selection of site, classification of Hydro power plants, Design, Construction and Operation of Different components of Hydro-Electric Power stations, Hydrology, Hydraulic Turbines, Governing of Turbines-Micro Hydel developments, Calculation of available Hydro Power, Combined operation of Hydro and Thermal Power Plants, Advantages and Disadvantages of Hydro Power Plants.

Nuclear Power Plants: Energy– Fission, Fusion Reaction, Radioactivity, Nuclear reactions, Components of Nuclear Power Plant, selection of site, Layout of Nuclear Power Plant, Types and classification of Reactors, General problems of Reactor operation, Pressurized Water Reactor (PWR), Boiling Water Reactor (BWR),CANDU type reactor, Gas cooled reactors, Liquid Metal-cooled reactors, Organic moderated and cooled reactors, Breeder reactors Waste Disposal and safety, Advantages and Disadvantages of Nuclear Power Plants. Comparison of Nuclear and Thermal power plants. **14 Hrs.**

UNIT-IV

Diesel and Gas Turbine Power Plant: Diesel power plant- Layout, Selection of site, Types of Diesel Plants, Components, Diesel Cycle, Engine Types and different systems of diesel power plant. Performance and advantages and disadvantages over thermal plants

Gas Power Plant- Layout, Gas Turbine cycle, Fundamental concept of gas turbine control and monitoring system, Applications of Gas Turbine Power Plant–Fuels- Gas Turbine Material–Open, Closed Cycles and Combined Cycle, Efficiency, Components of gas turbine plants, Gas and steam turbine combined cycles, Waste heat recovery system, Advantages and Disadvantages of diesel and gas turbine power plant.

Non-Conventional Power Generation: Power from Renewables(Solar, wind,Biomass and small Hydro),Geothermal power plant,Tidal power plants, Wind power plants, Solar power plants, Direct Energy conversion system, Magneto Hydrodynamic System(MHD). Combined Operation of Different Power Plants. **14 Hrs.**

Course Outcomes:

Students successfully completing this module will be able to:

1. Describe sources of energy and types of power plants.
2. Analyze different types of steam cycles and it's efficiencies in a steam power plant,
3. Describe basic working principles of gas turbine and diesel engine power plants.
4. Define the performance characteristics and components of such power plants.
5. List the principal components and types of nuclear reactors.
6. List types, principles of operations, components and applications of steam turbines, Steam generators, condensers, feed water and circulating water systems.
7. Estimate different efficiencies associated with power plant systems.

Recommended Books:

1. EI-Wakil M.M., 'Power Plant Technology', McGraw Hill,**1984**.
2. S.C. Arora, 'A course in Power Plant Engineering',Dhanpat Rai & Sons.
3. P.K. Nag, 'Power Plant Engineering', Tata McGraw Hill, **1998.**
4. G.R. Nagpal,'Power Plant Engineering', Hanna Publishers, **1998.**
5. K.K.Ramalingam, 'Power Plant Engineering', Scitech Publications, **2002.**
6. G.D.Rai,'Introduction to Power Plant Technology', Khanna Publishers, **1995.**
7. R.K. Rajput, 'Power Plant Engineering', Laxmi Publications, **1995.**

THERMAL & FLUID ENGNEERING

Subject code: BMECO1-002 **L T P C** **Duration: 45 Hrs.**

3 0 0 3

Course Objectives:

1. To make conceptual understanding of fluids and their properties.
2. To learn about the application of mass and momentum conservation laws for fluid flows.
3. To recognize basic components of turbo machines and understand related fundamental laws/ principles. To know about constructional, working and design aspects various turbines and pumps.
4. To learn the about reciprocating compressors with and without intercooling.
5. To give an overview of Internal Combustion Engines, their classification, applications, operation and processes.
6. To provide a fundamentals of refrigeration and air conditioning.

UNIT-I

Introduction & Fluid Properties

Fundamentals of Fluid Mechanics: Introduction; Applications; Concept of fluid; Difference between solids, liquids and gases, Newton's law of Viscosity, classification of fluid: Newtonian & Non- Newtonian fluids, Ideal & Real fluids, Fluid properties: viscosity, compressibility, cohesion, adhesion, surface tension, capillarity, vapour pressure, cavitations.

Static's of Fluid- Pressure head, Pascal's law, continuity equation , total pressure, total Pressure on an immersed surface, Bernoulli's equation, applications of Bernoulli's equation, orifice meter, venturi meter, Pitot tube. Classification of fluids and fluid flows;

Measurements of fluid pressure; piezometer tubes, manometers, mechanical gauges, bourdon's tube, diaphragm pressure gauge, dead weight pressure gauge. **10 Hrs.**

UNIT-II

Fluid Machinery:

Impulse momentum principle; Basic components of a turbo machine and its classification on the basis of purpose; fluid dynamic action; operating principle; geometrical features; path followed by the fluid. Euler's equation for energy transfer in a turbo machine Construction, working and applications of hydraulic turbines, Construction, working and applications of centrifugal pumps and reciprocating pumps. Construction; operation and utility of simple and differential accumulator. **10 Hrs.**

Steam generators:

Introduction, formation of a steam at a constant pressure, temperature Versus total heat graph during steam formation, steam properties, boiler performance, boiler efficiency, equivalent of evaporation and energy balance, measurement of dryness fraction of steam by throttling calorimeter. Construction and working of Lancashire boiler, Babcock Wilcox boiler.

05 Hrs.

UNIT-III

I.C. Engines.

Thermodynamics : System & Control volume; Property, State & Process; Exact & Inexact differentials; Work-Thermodynamic definition of work; electrical, magnetic, gravitational, spring and shaft work. Zeroth, first and second law of thermodynamics, thermodynamic system and processes. Classification of I.C. Engines, construction and working of two stroke, four stroke, S.I. and C.I. Engines, terms used in air cycles, thermodynamic air cycles-Otto, Diesel and Dual combustion cycles, Cooling and lubrication systems of I.C. engines., applications of I.C. Engines. **10 Hrs.**

UNIT-IV

Air Compressors: A. Introduction, Classifications, working of single stage reciprocating air compressors, work done by a single stage reciprocating air compressors with and without clearance, multistage compression, two stage reciprocating air compressors with intercooler, intercooling of air in a two stage reciprocating air compressors, work done by a two stage reciprocating air compressors Applications of Compressed air Construction and working of centrifugal compressor and axial Flow air compressors.

Refrigeration and Air conditioning: Air refrigeration working on Bell Coleman Cycle, Simple Vapour Compression Cycle, Vapour absorption cycle, types and properties of refrigerants, p-h and T-s diagram, window, central, and Industrial Air conditioning Systems. Introduction to heat transfer-conduction, convection, radiation. **10 Hrs.**

Course Outcomes:

The student will be able to

1. Understand basic concepts of thermodynamic, fluids and classification of flows.
2. Analyze air standard cycles and various types of air compressor
3. Differentiate impulse and reaction turbines.

4. Discuss fundamental refrigeration and air conditioning principles.
5. Understand use of steam for power generation and process heating.

Recommended Books :

1. Fluid Mechanics and Hydraulic Machines, Bansal R.K., Laxmi Publication, 1990, 9th ed**.,** ISBN 81-7008-311-7.
2. Fluid Mechanics and Hydraulic Machines, S.C. Gupta, Pearson Education
3. Fluid Mechanics including Hydraulic Machines, Jain A.K**.,** Khanna Publishers, 1990,
4. Thermal Engineering, Kumar A., Narosa Publishing House, ISBN 97-88-1731-95281.

Reference Books :

1. A course in Thermodynamics and heat engines Thermal engineering with solar energy,
1. Kothanaraman C. P., Khajuria P. P., Arora S. and Domkundawars ,Dhanpat Rai & Sons, 1989.
2. Hydraulics and Fluid Mechanics, Modi P. N. and Seth S. M, Standard Book House, New Delhi, 1987.
3. Hydraulics Machinery Textbook of Fluid Machinery, Deshpande V. M., Everest Publication, 1998.
4. Textbook of Refrigeration and Air Conditioning, Khurmi R. S. and Gupta J. K., S. Chand and Co.1989.

STRENGTH OF MATERIALS

Subject code: BMECO1-003 **L T P C** **Duration: 45 Hrs.**

3 0 0 3

Course Objective:

1. The course is designed to understand the basic concepts of stress, strain and their variations due to different type of loading.
2. The concept of mechanical properties, Poisson's ratio, bulk modulus, elastic modulus, modulus of rigidity, combined stress and strain, principal stress, principal plane, bending moment and shear force in beams under various loading conditions, understanding of torsional shear stress in solid and hollow shaft; principal and maximum shear stress in a circular shaft subjected to combined stresses, forces and reactions in frames, stresses in struts and columns subjected to axial load; bending stress, slope and deflection under different loading and supporting conditions.

UNIT-I

Stresses and Strains: Basic definitions: Stress and strain and their types, fatigue, creep, ductility, brittleness, hardness, toughness, impact strength, stress concentration, Elasticity, Plasticity. Hook's law, longitudinal and lateral strain, Poisson's ratio, stress-strain diagram for ductile and brittle materials, extension of a bar with or without self-weight, bar of uniform strength and of varying cross section, elastic constants and their significance, Young's modulus of elasticity, modulus of rigidity and bulk modulus, thermal stress and strain in single and compound bars.

11 Hrs.

UNIT-II

Bending Moment (B.M) and Shear Force (S.F.) Diagrams: S.F and B.M definitions; relation between load, shear force and bending moment; B.M and S.F diagrams for cantilevers, simply supported beams with or without overhangs, and calculation of maximum B.M and S.F and the point of contra flexure under the following loads:

a) Concentrated loads

b) Uniformly distributed loads over the whole span or part of span

c) Combination of concentrated and uniformly distributed load

d) Uniformly Varying load (optional)

e) Application of moments **12 Hrs**.

UNIT–III

Slope and Deflection: Relationship between moment, slope and deflection; double integration method, Macaulay's method and use of these methods to calculate slope and deflection for:

a) Cantilevers

b) Simply supported beams with or without overhang

c) beams under concentrated loads, uniformly distributed loads and their combination.

Columns and Struts: Introduction of columns and struts, end conditions, failure of columns, Euler's formula, empirical formulas to find buckling load. **10 Hrs.**

UNIT–IV

Torsion: Derivation of torsion equation and its application to the hollow and solid circular shafts. Torsional rigidity, Angle of twist, combined torsion and bending of circular shafts; Frames: Introduction of frames, types of frames, assumptions made in finding out the forces in frame, reactions of the supports of a frame, analysis of frames: method of joints, method of sections, graphical method and its applications. **12 Hrs.**

Course Outcomes:

After studying the course, the student will be able to analyze different stresses, strains and deflection for designing a simple mechanical element e.g. beams, shafts, columns and frames under various loading conditions.

Recommended Books

1. Sadhu Singh, 'Strength of Materials', Khanna Publishers.
2. Kirpal Singh, 'Mechanics of Materials', Standard Publishers.
3. G.H. Ryder, 'Strength of Materials', Macmillan India Ltd.
4. S.S. Rattan, 'Strength of Materials', Tata McGraw Hills.
5. Timoshenko and Gere, 'Mechanics of Materials', CBS Publishers.
6. E.P. Popov, 'Mechanics of Materials', Pearson Education.
7. R. K. Bansal, 'Strength of Materials', Laxmi Publication P) Ltd

FLUID MACHINERY

Subject code: BMECO1-004 **L T P C** **Duration: 45 Hrs.**

3 0 0 3

Course Objectives:

1. To expose the students to the basic fundamentals of Momentum Equation, Euler's equation for energy transfer, Impact of jets, turbines and pumps.

UNIT-I

General Concepts: Impulse momentum principle; jet impingement on stationary and moving flat plates, and on stationary or moving vanes with jet striking at the center and tangentially at one end of the vane; calculations for force exerted, work done and efficiency of jet.

Basic components of a turbo machine and its classification on the basis of purpose, fluid dynamic action, operating principle, geometrical features, path followed by the fluid and the type of fluid etc. Euler's equation for energy transfer in a turbo machine and specifying the energy transfer in terms of fluid and rotor kinetic energy changes. Viscous Flow: Momentum Equation, Navier Stokes Equation and its derivation, aerofoil theory, lift and drag**.** **12 Hrs.**

UNIT-II

Pelton Turbine: Component parts and operation; velocity triangles for different runners, work output; Effective head, available power and efficiency; design aspects such as mean diameter of wheel, jet ratio, number of jets, number of buckets with working proportions Francis and Kaplan Turbines: Component parts and operation velocity triangles and work output; working proportions and design parameters for the runner; Degree of reaction; Draft tubes - its function and types. Function and brief description of commonly used surge tanks, Electro Mechanical governing of turbines **11 Hrs.**

UNIT-III

Centrifugal Pumps: Layout and installation; Main elements and their functions; Various types and classification; Pressure changes in a pump - suction, delivery and manometric heads; vane shape and its effect on head-capacity relationships; Departure from Euler's theory and losses; pump output and efficiency; Minimum starting speed and impeller diameters at the inner and outer periphery; Priming and priming devices, Multistage pumps - series and parallel arrangement; submersible pumps. Construction and operation; Axial and mixed flow pumps; Trouble shooting - field problems, causes and remedies.

Similarity Relations and Performance Characteristics: Unit quantities, specific speed and model relationships, scale effect; cavitation and Thomas cavitation number; Concept of Net Positive Suction Head (NPSH) and its application **12 Hrs.**

UNIT-IV

Reciprocating Pumps: Components parts and working; pressure variations due to piston acceleration; acceleration effects in suction and delivery pipes; work done against friction; maximum permissible vacuum during suction stroke; Air vessels.

Hydraulic Devices and Systems: Construction, operation and utility of simple and differential accumulator, intensifier, fluid coupling and torque converter, Air lift and jet pumps; gear, vane and piston pumps, Hydraulic Rams. **10 Hrs.**

Course Outcomes:

The students will be able to:

1. Understand the working principle of the hydropower plant, selection of design parameters, size calculations of the hydro turbine component.
2. Understand the governing, similarity relations and unit quantities for pump and turbine.
3. Understand the basic working principle of pumps, centrifugal and reciprocating pumps, their design parameters.

Recommended Books

1. R.L. Daughaty, Hydraulic Turbines, McGraw Hill.
2. Jagdish Lal, 'Hydraulic Machines', Metropolitan Book Co.
3. D.S. Kumar, 'Fluid Mechanics and Fluid Power Engineering', S.K. Kataria and Sons.
4. K. Subramaniam, 'Hydraulic Machines', Tata McGraw Hill.
5. S.S. Rattan, 'Fluid Machines and Hydraulic Machines', Khanna Publishers, New Delhi, 2004.
6. J.F. Douglas, J.M. Gasiorek and J.A. Swaffield, 'Fluid Mechanics', Addison-Wesley. Longman Inc., Edinburgh, U.K., 1995.
7. R.L. Panton, 'Incompressible Fluid Flow', John Wiley & Sons, New Jersey, 2005.
8. F.M. White, 'Viscous Fluid Flow', McGraw Hill, New York, 2006.
9. T. Wright, 'Fluid Machinery', CRC Press, USA, 2009.

AUTOMOBILE ENGINEERING

Subject code: BMECO1-005 **L T P C** **Duration: 45 Hrs.**

3 0 0 3

Course Objectives.

1. Understand the constructional, working principle of various sub system of an automobile with various controlling systems and Trouble shootings in automobile.
2. To identify the different parts of the automobile. Emissions, ignition, controls, electrical systems and ventilation.
3. To understand functioning of different systems of automobile and command over automotive system and the recent development in the area.
4. To provide the knowledge of design procedure of various components and factors affecting operation of vehicle on road.
5. At the end of this course, the student will be able to Command over automotive engines and the recent development in the area of engines.

UNIT-I

Introduction: Basic structure, general layout and type of automotive vehicles, Frameless and unitary construction; position of power unit; Components of the Automobile; Functions of Major Components of an Automobile.

Power Unit: Power requirements - motion resistance and power loss, tractive effort and vehicle performance curves; selection of power unit and engine performance characteristics; pollution due to vehicle emission and exhaust emission control system, silencers, types of pistons and rings.

Fuel Supply System: Air cleaner and fuel pumps; Air fuel requirements and carburation; constructional details of carburetor and fuel injection systems; MPFI (Petrol), Diesel Engine fuel supply system - cleaning, injection pump, injector and nozzles, Individual Pump and Common Rail fuel supply systems. **12 Hrs.**

UNIT-II

Lubrication and Cooling Systems: Necessity of lubrication; Desirable properties of lubricants; various types of lubricants and oil additives; different systems of lubrication - oil filters, oil pumps and oil pressure indicator; crank case ventilation and dilution. Purpose of cooling, air and water cooling systems; radiator, thermostat, pump and fan.

Chassis and Suspension: Loads on the frame, considerations of strength and stiffness, engine mounting, independent suspension systems (Mac Pherson, Trailing Links, Wishbone), shock absorbers and stabilizers; wheels and tyres, tyre wear types, constructional details of plies

11 Hrs.

UNIT-III

Transmission System: Basic requirements and standard transmission systems; constructional features of automobile clutch, gear box, differential, front and rear axles; overdrives, propeller shaft, universal joint and torque tube drive; Rear wheel vs front wheel drive, principle of automatic transmission

Steering System: Requirement and steering geometry; castor action, camber and king pin angle, toe-in of front wheels, steering linkages and steering gears; wheel alignment; power steering, Ball re-circulating mechanism

Braking System: General braking requirements; Mechanical, hydraulic, vacuum power and servo brakes; Weight transfer during braking and stopping distances, Anti-Braking systems.

10 Hrs.

UNIT-IV

Starting System: Principle, starting torque, engine resistance torque, and power required for starting of engine. Starter motor and its circuit. Types of drive mechanisms: Bendix drive, pinion type, axial sliding armature starter. Slipping and overrunning of clutches, automatic switches for starting, cold starting devices: Glow plug & choke.

Electrical and electronic Systems: Classification, Introduction to Conventional and transistorized ignition systems; Charging, capacity ratings and battery testing; voltage and current regulation, wiring, fuse system, circuit breakers, Relays, Switches. Layout and Wiring diagram of vehicles, automotive accessories and safety features in automobile.

Latest Trends in automobile sector: Introduction of Gas, Electrical and Hybrid, solar powered vehicles.

Maintenance: Preventive maintenance, trouble shooting and rectification in different systems; engine tuning and servicing, major tools used for maintenance of automobiles. **12 Hrs.**

Course Outcomes:

Students successfully completing this course will be able to do the following -

1. An ability to identify the different parts of the automobile.
2. Anunder standing of location and importance of each part of an automobile.

3. An understand functioning of different systems of automobile.
4. An ability design various components and factors affecting operation of vehicle on road.
5. Knowledge of future developments in the automobile industry.

Recommended Books

1. Kamaraju Ramakrishna, 'Automobile Engineering', PHI Course, New Delhi, 2012.
2. Jain &Asthana, 'Automobile Engineering', Tata McGraw-Hill, New Delhi, 2002.
3. W.H. Crouse, 'Automotive Mechanics', McGraw Hill.
4. J. Heitner, 'Automotive Mechanics', East West Press.
5. Kirpal Singh, 'Automobile Engineering', Vol. I and II, Standard Publishers.
6. P.S Gill, 'Automobile Engineering', S.K. Kataria.

MODERN MANUFACTURING PROCESSES.

Subject code: BMECO1-006 **L T P C** **Duration: 45 Hrs.**

3 0 0 3

Course objectives:

1. To expose the students to the principles of different manufacturing techniques and learn advanced operations of machining.
2. To acquire knowledge of various advanced casting processes, casting simulation and analysis.
3. Understand different aspects of powder metallurgy and surface coating
4. Understand rapid prototyping and generative manufacturing processes.
5. Understand various micro-manufacturing and additive manufacturing.

UNIT- I

Advances in Casting Process: evaporative casting, V-process, flask less molding, Investment casting. Shellmould casting, Recent developments in pattern and casting designing, Use of CAD/CAM in foundries, Casting simulation and analysis.

Special Forming Processes Principle, Machines, Process variables, characteristics, advantages, limitations and application of High Energy Rate Forming process (HERF), High Velocity Forming (HVF), Explosive forming, Magnetic pulse forming, Electro hydraulic forming, Metal spinning, Flow forming, Stretch forming Micro forming, Micro coining, Micro extrusion, Micro bending/laser bending, fine blanking. **12 Hrs.**

UNIT- II

Advanced Welding Processes: Laser beam welding, Cryogenic welding, Friction stir welding, Electron Beam welding, Ultrasonic welding, Under water welding, , Thermal spray coatings, Welding of plastics and composites, Explosive joining, Adhesive bonding.

Powder metallurgy and surface coating: Powder Metallurgy: process, different methods of producing powders, different techniques to form the shape viz. pressing, extruding, sintering, and hot pressing, advantages, disadvantages. **13 Hrs.**

UNIT- III

Non-conventional Machining Techniques Introduction to hybrid processes, Abrasive flow finishing, Magnetic abrasive finishing, Abrasive water-jet machining, Wire electric discharge

machining, Electrochemical grinding (ECG),Electrochemical Deburring (ECD), Shaped tube electrolytic machining (STEM) Electrochemical discharge Machining (ECDM), Laser surface treatments.

Micro Manufacturing techniques, Introduction, need of micro Manufacturing, Machine/setup, Process parameters, Mechanism of material removal, Applications. **10 Hrs.**

UNIT- IV

Additive Manufacturing Processes Classification of additive manufacturing processes and its principle, process steps and materials; Introduction and principle of the additive manufacturing process; Post-processing of parts manufactured by Additive Manufacturing (AM) processes, Applications of Additive Manufacturing in Medical and Aerospace technologies. Rapid Prototyping: Product development cycle and importance of prototyping, type's prototypes, principles and advantages, different types of generative manufacturing process, viz. streolithography, FDM. **10 Hrs.**

Course outcomes:

Students After completing the course, students will be able to:

1. Understand and possess the knowledge of different advanced manufacturing technique
2. Identify different micro-machining processes and devices used for AMT
3. Evaluate different aspects of micro-machining
4. Understand about powder metallurgy and surface coating
5. Identify rapid prototyping and types of generative manufacturing processes

Recommended Books:

1. V. K. Jain, "Advanced Machining Processes", Allied Publishers Pvt. Ltd.
2. M. P Groover., Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, 6th Edition, Wiley 2015.
3. 3 Benjamin W. Niebel, Allen B Draper, Richard A. Wysk, "Modern Manufacturing process engineering" by McGraw Hill International Editions.
4. Garry F. Benedict- Marcel Dekker Inc "Non Traditional Manufacturing Processes" by CRC Press New York.
5. A. Ghosh, A. K. Mallik, Manufacturing Science, Affiliated East-West Press Pvt. Ltd., New Delhi.
6. B.H. Amsteal, Philip F. Ostwald & Myron L. Begeman "Manufacturing process", By Joh Wiley & Sons, Eighth edition.

References :

1. ASM: Metal Handbook, Volume 6, “Welding, Brazing and Soldering”, Metal Park, Ohio.

2. ASM: Metal Handbook, Volume 14, “Forming”, Metal Park, Ohio.

3. V. K. Jain, Micro manufacturing Processes, CRC Press ISBN-13: 978-1138076426 ISBN.

4. H.M.T , “Production Technology Hand Book”,TMH.

DATA STRUCTURES AND ALGORITHMS

Subject Code- BCSEO1-001 **L T P C** **Duration – 45 Hrs**

3 0 0 3

COURSE OBJECTIVE:

1. To impart the basic concepts of data structures and algorithms
2. To understand concepts about searching and sorting techniques.
3. To understand basic concepts about stacks, queues, lists, trees and graphs

COURSE OUTCOMES

CO1: For a given algorithm student will able to analyze the algorithms and justify the correctness.
CO2: To learn basics of stacks and queues.
CO3: To learn linked list concepts.
CO4: To learn different sorting algorithms.

COURSE CONTENTS

UNIT-I (12hrs)

Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc. Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques.

UNIT-II (09hrs)

Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks, Queues and its types.

UNIT-III (12hrs)

Linked Lists: Introduction to Linked Lists and its types, Representation of single linked list in memory, operations: Traversing, Searching, Insertion into, Deletion from linked list; Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Binary Search trees

UNIT-IV (12hrs)

Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Performance and comparison among all the methods, Hashing. Graph: Basic Terminologies and Representations.

RECOMMENDED BOOKS:

1. Fundamentals of Data Structures‖, Illustrated Edition by Ellis Horowitz, SartajSahni, Computer Science Press.
2. Algorithms, Data Structures, and Problem Solving with C++‖, Illustrated Edition byMark Allen Weiss, Addison-Wesley Publishing Company
3. ―How to Solve it by Computer‖, 2nd Impression by R.G. Dromey, Pearson Education.

MATLAB Programming

Subject Code- BCSEO1-002 **L T P C** **Duration- 45 Hrs**
3 0 0 3

COURSE OBJECTIVE:

1. To learn the MATLAB environment and its programming fundamentals
2. Ability to write Programs using commands and functions

COURSE OUTCOMES:

CO1: Student will able to use MATLAB environment for writing, debugging and executing programs.
CO2: To be able to learn different operators used in MATLAB.
CO3: To learn how to use data types.
CO4: To learn 1D and 2D plotting.

COURSE CONTENTS

UNIT I (12 Hrs)

Introduction to MATLAB Software: MATLAB window, Command window, Workspace, Command history, Setting directory, working with the MATLAB user interface, Basic commands, Writing Script file, Executing script files The MATLAB Editor, Saving m files.

UNIT-II (12 Hrs)

Assigning variable, operation with variables. BODMAS Rules, Arithmetic operations, Operators and special characters, Mathematical and logical operators, Solving arithmetic equations

UNIT III (09 Hrs)

Data files and Data types: Character and string, Arrays and vectors, Column vectors and Row vectors
Creating rows and columns Matrix, Matrix operations, finding transpose, determinant and Solving matrices

UNIT IV (12 Hrs)

1D and 2D Ploting: Plotting vector and matrix data, Plot labelling, curve labelling and editing, 2D plots: Basic Plotting Functions, Creating a Plot, Plotting Multiple Data Sets in One Graph Specifying Line Styles and Colors Graphing, Displaying Multiple Plots in One Figure, Controlling the Axes.

RECOMMENDED BOOKS

1. “MATLAB and its applications in Engineering”, by R.K. Bansal, A.K. Goel and M.K Sharma, PEARSON
2. “MATLAB: Easy way of Learning”by S. Swapna Kumar and Lenina S. V. B.

DATABASE MANAGEMENT SYSTEMS

Subject Code- BCSEO1-003 **L T P C** **Duration – 45 Hrs**
3 0 0 3

COURSE OBJECTIVE:

1. To understand the different issues involved in the design and implementation of a database system.
2. To develop an understanding of DBMS concepts such as: database security, integrity, and concurrency.

COURSE OUTCOMES

1. To be able to learn different DBMS languages and data models.
2. To be able to learn different database languages.
3. For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.
4. Implement database security.

COURSE CONTENTS

UNIT I (11 Hrs)

Database system architecture: introduction, Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML).
Data models: Entity-relationship model, network model, relational model, integrity constraints.

UNIT II (11 Hrs)

Relational query languages: Relational algebra, Tuple and domain relational calculus, DDL and DML constructs.
Relational database design: Domain and data dependency, Normal forms, Dependency preservation.

UNIT III (12 Hrs)

Query processing and optimization: Evaluation of relational algebra expressions, Join strategies.
Transaction processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers.

UNIT IV (11 Hrs)

Database recovery: Introduction, log based recovery, shadow page recovery.
Database Security: Introduction to Authentication, Authorization and access control, introduction to SQL injection.

RECOMMENDED BOOKS

1. "Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F.Korth, S. Sudarshan, McGraw-Hill.
2. "Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer Science Press.
3. "Fundamentals of Database Systems", 5th Edition by R. Elmasri and S. Navathe, Pearson Education
4. "Foundations of Databases", Reprint by Serge Abiteboul, Richard Hull, Victor Vianu, Addison-Wesley

ARTIFICIAL INTELLIGENCE

Subject Code- BCSEO1-004 **L T P C** **Duration – 45 hrs.**
3 0 0 3

COURSE OBJECTIVE:

1. Introduce the basic principles in artificial intelligence.
2. Cover simple representation schemes, problem solving paradigms, constraint propagation, and search strategies.

COURSE OUTCOMES:

1. Understand the concept of Artificial intelligence, problem solving and various types of search strategies.
2. Understand the concept of Knowledge base, knowledge representation, AI languages.
3. Identify uncertainty and understand fuzzy logic concept.
4. Understand the COURSE of AI agents and various COURSE methods.

COURSE CONTENTS:

UNIT-I (12 Hrs)

Introduction: History of AI - Intelligent agents – AI and Applications - Problem spaces and search - Heuristic Search techniques – Best-first search – Informal search strategies-A* algorithm. Game Playing: Minimax search procedure.

UNIT-II (12 Hrs)

Knowledge Representation: Approaches and issues in knowledge representation Knowledge - Based Agent- Propositional Logic – Predicate logic –Reasoning, AI languages Prolog.

UNIT-III (12 Hrs)

Reasoning under uncertainty: Implementation- Basic probability notation - Bayes rule – Certainty factors and rule based systems, Fuzzy Logic.

UNIT IV (09 Hrs)

Planning and COURSE: Basic representation of plans - conditional planning - Multi-Agent planning. Forms of COURSE.

RECOMMENDED BOOKS:

1. Elaine Rich, Kevin Knight and Shivashankar B.Nair, ‘Artificial Intelligence’, 3rd Edn., Tata McGraw-Hill, **2009**.

2. Stuart J. Russell and Peter Norvig, ‘Artificial Intelligence: A Modern Approach’, Pearson Education Asia, 2nd Edn., **2003**.

3. N.P. Padhy, ‘Artificial Intelligence and Intelligent System’, Oxford University Press, 2nd Edn., **2005**.

4. Rajendra Akerkar, ‘Introduction to Artificial Intelligence’, Prentice-Hall of India, **2005**.

5. Patrick Henry Winston, ‘Artificial Intelligence’, Pearson Education Inc., 3rd Edn., **2001**.

6. Eugene Charniak and Drew Mc Dermott, ‘Introduction to Artificial Intelligence’, Addison-Wesley, ISE Reprint, **1998**.

7. Nils J. Nilsson, ‘Artificial Intelligence - A New Synthesis’, Harcourt Asia Pvt. Ltd., Morgan Kaufmann, **1988**.

IMAGE PROCESSING

Subject Code- BCSEO1-005 **L T P C** **Duration – 45 hrs.**
3 0 0 3

COURSE OBJECTIVE:
This course will help to understand the different techniques used for image processing.

COURSE OUTCOMES:
1. To give introduction of image processing.
2. To understand image enhancement.
3. To have knowledge of image Compression.
4. To have knowledge of Image Segmentation.

Unit-I (13 Hrs)

Digital Image Fundamentals: Simple image model, sampling and quantization, imaging geometry, digital geometry, different types of digital images, image formation, Elements of Storage, Relationships between pixels-neighbours of pixel, application of image Processing.
Bilevel Image Processing: Digital distance, distance transform, medial axis transform, component labelling, thinning.

Unit-II (12 Hrs)

Image Enhancement: Point processing, spatial filtering, frequency domain methods, multi-spectral image enhancement, image restoration.
Color Image Processing: Color representation, laws of color matching, chromaticity diagram, color image segmentation, color edge detection.

Unit-III (10 Hrs)

Image Compression Redundancy models, error free compression, Lossy compression, Image compression standards.

Unit-IV (10 Hrs)

Image Segmentation Detection of Discontinuity, Edge detection, Boundary detection, Thresholding, Regional oriented segmentation, use of motion in segmentation.

RECOMMENDED BOOKS:
1. Digital Image Processing - by Rafact Gonzalez and Richard E. Woods, Pearson Education Society.
2. Digital Image Processing - by Keenneth R Castleman, Pearson Education Society.
3. A. K. Jain, ―Fundamental of Digital Image Processing‖, PHI

SOFT COMPUTING

Subject Code- BCSEO1-006 **L T P C** **Duration – 45Hrs.**
3 0 0 3

COURSE OBJECTIVE:
1. To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.
2. To implement soft computing based solutions for real-world problems.

COURSE OUTCOMES:
CO1: Identify and describe soft computing techniques and their roles in building intelligent machines
CO2: To learn neural networks- I.
CO3: To learn the concept of neural networks-II.
CO4: To learn the concept of Genetic Algorithms.

COURSE CONTENTS:

UNIT-I (12 Hrs)

Introduction to Soft Computing and Neural Networks: Introduction to soft computing, soft computing constituents, difference between soft computing and hard computing, Applications of Soft Computing.
Fuzzy Logic: Basic Concepts, Fuzzy Sets and Operations, Properties of Fuzzy Sets, Fuzzy Relations, Defuzzification methods, Industrial applications.

UNIT-II (12 Hrs)

Neural Networks-I: (Introduction & Architecture): Biological Neuron, Machine Learning Using Neural Network, Artificial Neuron and its model, activation functions, Supervised, unsupervised and reinforcement Learning.

UNIT-III (12 Hrs)

Neural Networks-II: Supervised learning- Perceptron learning, single layer/multilayer perceptron, linear separability, hidden layers, back propagation algorithm, Unsupervised learning - Kohonen, SOM, k-means clustering, Application of neural networks.

UNIT-IV (09 Hrs)

Genetic Algorithms: Concept of Introduction to Genetic Algorithms (GA),Simple GA (SGA), other types of GA, Applications of GA .

Recommended Books:
1. Jyh: Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, ‘Neuro: Fuzzy and Soft Computing17’, Prentice-Hall of India, 2003.
2. George J. Klir and Bo Yuan, ‘Fuzzy Sets and Fuzzy Logic: Theory and Applications17’, Prentice Hall, 1995. 3. MATLAB Toolkit Manual.

BIG DATA ANALYTICS

Subject Code-BCSEO1-007 **L T P C** **Duration – 45 hrs.**
3 0 0 3

COURSE OBJECTIVE:
To learn various concepts used in Big data.

COURSE OUTCOMES:

1. To understand the competitive advantages of big data analytics
2. To understand the big data frameworks
3. To learn data analysis methods
4. To gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics

COURSE CONTENTS:

UNIT I (06 Hrs)

INTRODUCTION: Introduction to Big Data, Need, Importance, Applications of Big Data, RoleofV's in Big Data.

UNIT II (14 Hrs)

HADOOP: Introduction, Hadoop Architecture, Compare Hadoop Ecosystem and Traditional Ecosystem, Introduction to YARN, Importing and Exporting data in Hadoop.

HIVE: Hello to Apache Hive, Why Apache Hive, Hive Architecture and Hive Shel, Features and limitations of Apache Hive, HQLV/SSQL

UNIT III (14 Hrs)

EXPLORING PIG AND NO SQL: Introduction to PIG, Features of PIG, PIG Architecture and applications, Introduction to NOSQL, Advantages and disadvantages of NO SQL, PIGV/SSQL; APACHEPIGV/SHIVE; APACHEPIG V/S Map Reduce.

DATABASE AND DATA WAREHOUSES: Introduction to database and data warehouses, database V/S data warehouses, Optimization of database and data warehouses, Applications.

UNIT IV (11 Hrs)

Understanding Big Data Technology Foundation: Data source Layer, Ingestion layer, Source Layer, Security Layer, Visualization layer.

SECURITY AND PRIVACY CHALLENGES: Big Data Acquisation, Big Data Storage, Big Data Analytics, Big Data Security Solutions.

RECOMMENDED BOOKS:

1. Chris Eaton, Dirk deroos et al., 'Understanding Big data', 1st Edn., McGraw Hill, **2015**.
2. Tom White, 'HADOOP: The definitive Guide', 4th Edn., O Reilly, **2015**.
3. Gautam Shroff, 'Enterprise Cloud Computing Technology Architecture Applications', 1st Edn., Cambridge University Press, **2010**.
4. Toby Velte, Anthony Velte, Robert Elsenpeter, 'Cloud Computing, A Practical Approach', 1st Edn., McGraw Hill Education, **2009**.
5. Thomas Erl, ' Big Data Fundamentals', 1st Edn., Pearson Education, **2016**
6. Srinivasan, ' Cloud Computing', 1st Edn,, Pearson Education, **2016.**

DATA MINING

Subject Code- BCSEO1-008 **L T P C** **Duration – 45 hrs.**
3 0 0 3

COURSE OBJECTIVE:
To be able to extract data from databases using different data mining techniques.

COURSE OUTCOMES:
1. To introduce the basic concepts of Data Mining techniques.
2. To apply various classification techniques on trees.
3. To learn concept of search engines.
4. To understand the concept of web mining.

COURSE CONTENTS:

UNIT-I (12 Hrs)

Data Mining: Introduction to data mining, introduction to data warehousing, architecture of data warehouse, association rules in mining, Naive algorithm, Mining frequent pattern without candidate generation, performance evaluation of algorithms.

UNIT-II (12 Hrs)

Classification: Introduction, decision tree, tree induction algorithms – split algorithm based on information theory, estimating predictive accuracy of classification method

UNIT-III (12 Hrs)

Cluster Analysis: Introduction, partitional methods, hierarchical methods, density based methods, dealing with large databases, Search engines: Characteristics of Search engines, Search Engine Functionality, Search Engine Architecture, Ranking of web pages, The search engine history.

UNIT IV (09 Hrs)

Web Data Mining: Web Terminology and Characteristics, Locality and Hierarchy in the web, Web Content Mining, Web Usage Mining, Web Structure Mining, Web mining Software.

RECOMMENDED BOOKS:

1. Carlo Vercellis, 'Business Intelligence: Data Mining and Optimization for Decision Making', 1st Edn., WILEY, **2009**.
2. J. Han, M. Kamber and J. Pei, 'Data Mining Concepts and Techniques', 3rd Edn., Morgan Kaufmann Publishers, **2011**.
3. V. Pudi, P.R. Krishana, 'Data Mining', 1st Edn., Oxford University Press, **2009**.
4. P. Adriaans, D. Zantinge, 'Data Mining', 1st Edn., Pearson Education Press, **1996**.
5. P. Pooniah, 'Data Warehousing Fundamentals', 1st Edn., Willey Interscience Publication, **2001**.

SOFTWARE ENGINEERING

Subject Code- BCSEO1-009 **L T P C** **Duration – 45 hrs.**
3 0 0 3

COURSE OBJECTIVE:
To enable the students to learn the principles and methodologies followed to develop software.

COURSE OUTCOMES:
1. To study how software engineering principles evolve and to analyze the various software models that can be followed to develop software.
2. To understand how to make plan for software development.
3. To study coding, testing and reliability of a software.
4. To highlight the various management activities.

COURSE CONTENTS:

UNIT-I (11 Hrs)

Introduction: Evolution and impact of Software engineering, Software crisis, Principles of Software Engineering, Feasibility study

Software Life Cycle Models: Waterfall, prototyping, Evolutionary, and Spiral models, Comparison of software models.

UNIT-II (11 Hrs)

Scheduling and Planning: Management Activities, Project planning and control, cost estimation, project scheduling using PERT and GANTT charts.

Requirement Analysis: Functional and Non-functional requirements, Requirements gathering, Requirements analysis and specification.

UNIT-III (12 Hrs)

Software Design: Basic principles of software design, modularity, cohesion, coupling and layering, function-oriented software design: DFD and Structure chart, Design specifications, Design metrics, Verification and validation.

Coding: Coding standards and Code review techniques.

Software Testing: Fundamentals of testing, Types of software testing, White-box, and black-box testing, test case design techniques.

UNIT-IV (11 Hrs)

Reliability: Software reliability metrics, reliability growth modelling.

Software Quality Management: Risk Management, Quality management, ISO and SEI CMMI, Six Sigma, Software maintenance, Software Configuration Management, Component-based software developments

RECOMMENDED BOOKS:

1. Pressman, 'Software Engineering: A Practitioner's Approach', 3rd Edn., TMH, **2004**
2. Flecher and Hunt, 'Software Engineering and CASE: Bridging and Culture Gap', **2000**.
3. Shepperd, 'Software Engineering, Metrics', Vol.-1 (EN), McMillan, **1999.**
4. Robert S. Arnold, 'Software Re–engineering', IEEE Computer Society, **1994**.
5. Pankaj Jalote, 'An Integrated Approach to Software Engineering', 3rd Edn., Narosa Publishers, **2006**.
6. Ghezzi, Cario, 'Fundamentals of Software Engineering', 2nd Edn., PHI, **2002**.

COMPUTER NETWORKS

Subject Code- BCSEO1-010 **L T P C** **Duration – 45 hrs.**
3 0 0 3

COURSE OBJECTIVE:

1. To develop an understanding of modern network architectures from a design and performance perspective.
2. To provide an opportunity to do network programming.

COURSE OUTCOMES:

1. Explain the functions of the different layer of the OSI Protocol.
2. To learn to send data error free.
3. For a given problem related TCP/IP protocol developed the network programming.
4. Configure DNS, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, using open source available software and tools.

COURSE CONTENTS:

UNIT I (12 Hrs)

Data communication Components: Representation of data and its flow Networks, Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division.

UNIT II (12 Hrs)

Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC.

UNIT III (12 Hrs)

Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping –ARP, RARP, Forwarding and Unicast Routing protocols.

Transport Layer: Process to Process Communication, User Datagram Protocol(UDP), Transmission Control Protocol (TCP), Quality of Service.

UNIT IV (09 Hrs)

Application Layer: introduction toDomain Name Space (DNS), EMAIL, File Transfer Protocol (FTP), WWW, HTTP.

RECOMMENDED BOOKS

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw-Hill.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson PrenticeHall India.
3. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New InternationalEdition.
4.Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.
5. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, UnitedStates of America.

MACHINE LEARNING

Subject Code- BCSEO1-011 **L T P C** **Duration – 45 hrs.**
3 0 0 3

COURSE OBJECTIVE:

1. To learn applications of machine learning.
2. To learn different learning algorithms.

COURSE OUTCOMES:

1. To learn the concept of learning algorithm.
2. To learn representation of decision trees.
3. To learn unsupervised learning.
4. To learn SVM.

COURSE CONTENTS:

UNIT-I (12 Hrs)

Introduction: Introduction to machine learning, use of machine learning, type of machine learning: supervised, unsupervised and reinforcement learning, Main challenges in machine learning

Preparation of Model: Introduction to Statistical Learning, Significance of Mean, Mode, Median, variance, standard deviation, Basic types of data in machine learning, Exploring structure of data, Data quality and remediation, Data pre-processing.

Modelling and evaluation: Model Selection, Training, Model representation and interpretability, evaluating performance of a model.

UNIT-II (12 Hrs)

Supervised Learning (Regression/Classification):

Basic methods: Distance-based methods, Decision Trees.

Linear models: Simple Linear Regression, Multiple linear regression.

UNIT-III (12 Hrs)

Unsupervised Learning (Clustering): Different types of clustering techniques, K-medoids, Hierarchical clustering

Dimensionality Reduction: Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA), Introduction to Matrix Factorization and Matrix Completion

UNIT-IV (09 Hrs)

Support Vector Machines (SVM): Linear learning machines and Kernel space, Making Kernels and working in feature space, SVM for classification and regression problems.

RECOMMENDED BOOKS:

1. SaikatDutt ,Subramanian Chandramouli and Amit Kumar Das, 'Machine Learning', Pearson, 2019.
2. Oliver Theobald, 'Machine Learning For Absolute Beginners: A Plain English Introduction (Second Edition).

INTERNET OF THINGS

Subject Code- BCSEO1-012 **L T P C** **Duration – 45 hrs.**
3 0 0 3

COURSE OBJECTIVE:
The purpose of this course is to impart knowledge on IoT Architecture and various protocols, study their implementations

COURSE OUTCOMES:
1. To Understand the Architectural Overview of IoT
2. To Understand Raspberry.
3. To Understand the various IoT Protocols (Data link, Network)
4. To understand sensor applications.

COURSE CONTENTS:

UNIT I –12 hours

OVERVIEW: Introduction to IOT, how does it work? Difference between Embedded device and IoT device, Properties of IoT device, IoT Ecosystem, IoT Decision Framework, IoT Solution Architecture Models, Major IoT Boards in Market, Privacy issues in IOT

UNIT II –09 hours

Setting Up Raspberry Pi/Arduino to Create Solutions Explore Raspberry Pi, setting up Raspberry Pi, showing working of Raspberry Pi using Secure Shell (SSH) Client and Team Viewer.

UNIT III –12 hours

IOT DATA LINK LAYER & NETWORK LAYER PROTOCOLS: Communication Protocols used in IoT Types of wireless communication, Major wireless Short-range communication devices, properties, Major wireless Long-range communication devices, properties.

UNIT IV –12 hours

Sensors Applications of various sensors: Google Maps, Ola Positioning sensors: encoders and accelerometers, Image sensors: cameras Global positioning sensors: Global Positioning System (GPS).

RECOMMENDED BOOKS:
1. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-onApproach)”, 1 st Edition, VPT, 2014.
2. Peter Waher, “Learning Internet of Things”, PACKT publishing, BIRMINGHAM – MUMBAI
3. Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”, ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer
4. Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, ISBN: 978-1-118-47347-4, Willy Publications

OPERATING SYSTEMS

Subject Code- BCSEO1-013 **L T P C** **Duration – 45 hrs.**
3 0 0 3

COURSE OBJECTIVE

1. To learn the mechanisms of OS to handle processes and threads and their communication
2. To know the components and management aspects of concurrency management
3. To learn to implement simple OS mechanisms

COURSE OUTCOMES

At the end of this course, students will demonstrate the ability to
CO1 To learn the meaning of OS and its types.
CO2 To understand the concept of executing a process.
CO3 To have efficient management of memory using various techniques.
CO4 To implement file handling techniques.

COURSE CONTENT

UNIT-I (09hrs)

Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, Structure of an OS-Layered.

UNIT-II (12hrs)

Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Multiprocessor scheduling: Real Time scheduling.

UNIT-III (12 hrs)

Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker‘s algorithm, Deadlock detection and Recovery.
Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition
Virtual Memory: Basics of Virtual Memory – Hardware and control structures.

UNIT-IV (12 hrs)

File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability.

RECOMMENDED BOOKS

1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.

OBJECT ORIENTED PROGRAMMING

Subject Code- BCSEO1-014 **L T P C** **Duration – 45 hrs.**
3 0 0 3

COURSE OBJECTIVE

To introduce the principles and paradigms of Object Oriented Programming Language for design and implement the Object Oriented System

COURSE OUTCOMES

CO1 To introduce the basic concepts of object oriented programming language and its representation
CO2 To understand the concept of memory allocation.
CO3 To introduce polymorphism and overloading of operator.
CO4 To learn the concept of text streams.

COURSE CONTENT

UNIT-I (12hrs)

Introduction to C++, C++ Standard Library, Illustrative Simple C++ Programs. Header Files, Namespaces, Application of object oriented programming. Object Oriented Concepts, Introduction to Objects and Object Oriented Programming, Encapsulation, Polymorphism, Overloading, Inheritance, Abstract Classes, Access specifier (public/ protected/ private), Class Scope.

UNIT-II (12hrs)

This Pointer, Dynamic Memory Allocation and De-allocation (New and Delete), Static Class Members, Constructors, parameter Constructors and Copy Constructors, Destructors, Introduction of inheritance, Types of Inheritance

UNIT-III (12hrs)

Polymorphism and its types, Fundamentals of Operator Overloading, Rules for Operators Overloading, Implementation of Overloading Unary Operators, Binary Operators.

UNIT-IV (09hrs)

Text Streams and binary stream, Sequential and Random Access File, Stream Input/ Output Classes, Stream Manipulators.

RECOMMENDED BOOKS:

1. Robert Lafore, _Object Oriented Programming in Turbo C++‘,2nd Ed., The WAITE Group Press, 1994.
2. Herbert shield, _The complete reference C ++‘, 4th Ed., Tata McGraw Hill, 2003.
3. Shukla, _Object Oriented Programming in C++‘, Wiley India, 2008.
4. H M Deitel and P J Deitel, _C++ How to Program‘,2nd Ed., Prentice Hall, 1998.
5. D Ravichandran, _Programming with C++‘, 3 rd Ed., Tata McGraw Hill, 2003.
6. Bjarne Stroustrup, _The C++ Programming Language‘,4th Ed.,Addison Wesley,2013.
7. R. S. Salaria, _Mastering Object-Oriented Programming with C++‘, Salaria Publishing House, 2016.

INFORMATION TECHNOLOGY IN ENGINEERING

Subject Code- BCSEO1-015 **L T P C** **Duration – 45 hrs.**
3 0 0 3

COURSE OBJECTIVE

The students should be able to understand the concepts of Data structures, Algorithms, Operating systems and Object-oriented programming concepts.

COURSE OUTCOMES

1. Choose the data structures that efficiently model the information in a problem.
2. Understand concepts of Operating System.
3. Understand real world problem and identify objects in given problem.

COURSE CONTENTS

UNIT-I (12 Hrs)

Data structures & Algorithm:
Introduction to data structures and algorithm, recursion, time and space complexity of algorithms, Big-O notation, stacks, queues, evaluation of expressions, linked lists, application of stacks, queues and linked lists, binary trees, binary tree traversal, representation of binary trees, application of binary trees, graph representation, graph traversals, Dijkstra algorithm for shortest path, minimum spanning tree, hashing and indexing, application of data structure in real time application environment
Searching: linear search, binary search; Sorting: insertion, selection sort

UNIT-II (12 Hrs)

Operating Systems: Introduction, computer system architecture and organization, structure, open source operating systems, services, user and interface, system calls, system programs, debugging, example scenario of these process in window and Linux.

UNIT-III (11 Hrs)

Linux: Linux basics/fundamentals, operations on files, data manipulation using filters, introduction to Bash shell programming, Linux utilities, introduction to vi.

UNIT-IV (10 Hrs)

Object Oriented Programming:
Introduction to various programming paradigms, functions, classes & objects, constructors, destructors, polymorphism, inheritance

RECOMMENDED BOOKS:

1. Data Structures and Program Design in C By Robert L. Kruse,C.L.Tondo, Bruce Leung, Pearson Education
2. Fundamentals of Data Structures, By Ellis Horowitz and Sartaj Sahni, Computer Science Press.
3. Operating system, Galvin &Silberschatz, 7th Edition, John Willey
4. Operating Systems-A Concept Based Approach ByDhamdhare, TMH
5. Object Oriented Programming in C++, Robert Lafore, 4th Edition, SAMS
6. Object Oriented Programming with C++, Balaguruswamy, Tata Mc Graw Hill

FUNDAMENTALS OF ELECTRONIC COMMUNICATION

Subject Code: BECEO1-001 | **L T P C** 3 0 0 3 | **Duration: 45 Hrs.**

Course Objectives:

1. To understand the basic concept of communication and amplitude modulation.
2. To understand the concept of angle modulation.
3. To understand theory of digital modulation.
4. To understand working of radio receivers.

Course Outcomes:

At the end of the Course the student shall be able to:

1. Understand the fundamentals of communication systems and to perform amplitude and angle modulation and demodulation of analog signals
2. Perform and analyze PAM, PCM and PWM
3. Analyze FDM and TDM systems.
4. Design and conduct experiments, using modern communication tools necessary for various engineering applications.

UNIT-I (12 Hrs.)

Introduction: Basic elements of communications. Noise Modulation and frequency translation Need for modulation.

Amplitude Modulation (AM): Expression for AM, modulation index for AM, amplitude waveform and bandwidth of amplitude modulated signal, power distribution in amplitude modulated signal. Double sideband suppressed carrier (DSB-SC), single sideband (SSB), and vestigial sideband (VSB) AMs.

AM Modulators: Introduction. Circuit diagrams and operational principles of square law modulator, switching modulator, balanced modulator, ring modulator.

AM Demodulators: Introduction. Circuit diagrams and explanations of envelope detector and square law detector.

UNIT-II (12 Hrs.)

Angle Modulation: Introduction to Phase modulation (PM) and frequency modulation (FM). Relationship between PM and FM. Phase and frequency deviation. Power distribution in angle modulated signal. Spectral characteristics of angle modulated signals. Effect of noise on angle modulation, role of limiter, pre-emphasis and de-emphasis in FM. Comparison of FM with AM in communication systems.

UNIT-III (11 Hrs.)

Introduction to Digital Signals: Comparison of Analog and Digital Signals; Advantages and disadvantages of Digital Communications, Elements of Digital Communication Systems. Pulse Amplitude Modulation, Pulse Code Modulation (PCM); Quantization Noise, Commanding Sampling Theorem, Concept of aliasing & flat top sampling, PCM bandwidth, Differential PCM, Delta Modulation(DM), Pulse width Modulation(PWM), Adaptive Delta Modulation(ADM).

UNIT-IV (10 Hrs.)

Line Coding Schemes: Introduction, properties, general methods for derivation of power spectral density of a broad class of line coding scheme: ON-OFF signaling, polar signaling, bipolar and comparison among them. Pulse shaping, introduction to equalizer and eye diagram.

Recommended Text Books / Reference Books:

1. Taub and Schilling, ‘Principles of Communication Systems’, McGraw Hill.
2. G. Kennedy, ‘Electronic Communication System’, PHI.
3. Roddy and Coolen, ‘Electronic Communications’, PHI
4. ThiagrajanVishwanathan, ‘Communication Switching Systems and Networks’, PHI Pub.
5. Proakis, ‘Communication System Engineering’, Pearson.

CELLULAR & MOBILE COMMUNICATION

Subject Code: BECEO1-002 | **L T P C** 3 0 0 3 | **Duration: 45 Hrs.**

Course Objectives:

The student should be made to:

1. Know the characteristic of cellular mobile systems
2. Learn the various elements of cellular radio systems design and interference.
3. Understand the difference between different wireless generations.
4. Understand the various handoff techniques.

Course Outcomes:

At the end of the Course, the student should be able to

1. Understand cellular wireless communication systems.
2. Learn about elements of cellular radio systems.
3. Compare various cellular mobile generations and analyze their performance.
4. Describe about hand offs and call drops.

UNIT-I (12 Hrs.)

Introduction to Cellular Mobile Systems Its Generations: A basic cellular system, performance criteria, Uniqueness of mobile radio environment, operation of cellular systems, planning a cellular system, analog & digital cellular systems. Introduction to different generations of cellular mobile systems:- first generation, second generation, third generation, fourth generation and fifth generation cellular systems.

UNIT-II (11 Hrs.)

Hand Off & Dropped Calls: Introduction to concept of handoff, need of handoff, , types of handoff and their characteristics, dropped call rates & their evaluation. Introduction to Operational Techniques: Parameters, coverage hole filler, leaky feeders, cell splitting and small cells, narrow beam concept.

UNIT-III (10 Hrs.)

Elements of Cellular Radio Systems Design: General description of the problem, concept of frequency reuse channels, co-channel interference, cell splitting, consideration of the components of cellular systems.

UNIT-IV (12 Hrs.)

Cell Coverage for Signal & Traffic: General introduction, obtaining the mobile point to point mode, Introduction to the concepts of :- propagation over water or flat open area, foliage loss, propagation near in distance, long distance propagation, point to point prediction model, cell site, antenna heights and signal coverage cells, mobile to mobile propagation.

Recommended Text Books / Reference Books:

1. C.Y. Lee William,'Mobile Cellular Telecommunications', McGraw Hill.
2. KamiloFeher, 'Wireless and Digital Communications', PHI.
3. T.S. Rappaport, 'Wireless Communication, Principles & Practice', PHI.

FUNDAMENTALS OF WIRELESS COMMUNICATION

Subject Code: BECEO1-003 | **L T P C** 3 0 0 3 | **Duration: 45 Hrs.**

Course Objectives:

1. To make aware the students about wireless communication system and evolution of different wireless communication generations.
2. To impart the knowledge of different wireless generations.
3. To provide the students about the concept of multiple access techniques for Wireless Communication.

Course Outcomes:

At the end of the course the students will be able to

1. Understand the functioning of different wireless generations.
2. Understand the concept of wireless networks and its latest technologies.
3. To compare different wireless technologies.

UNIT-I (11 Hrs.)

Introduction to wireless communication system, history of wireless communication system, Difference between wireless and fixed telephone networks, types of common wireless systems, examples of wireless communication systems: paging systems, cordless telephone systems, cellular telephone systems.

UNIT-II (10 Hrs.)

Generations of wireless communication systems, Introduction to first generation, second generation, third generation, fourth generation and fifth generation wireless networks. comparison of different wireless generations, Introduction to VoLTE.

UNIT-III (12 Hrs.)

Introduction to multiple access techniques in wireless communication systems, introduction to Frequency Division Multiple Access (FDMA) Technique, Time Division Multiple Access (TDMA) Technique, Spread Spectrum Multiple Access (SSMA) Technique, Space Division Multiple Access (SDMA) Technique.

UNIT-IV (12 Hrs.)

Introduction to wireless in local loop, wireless local area networks, Introduction to Wi-Fi, WiMAX, ZigBee, Blue tooth and Personal Area networks. Introduction to Adhoc Wireless networks.

Recommended Text Books / Reference Books:

1. Wireless Communication, Theodore S. Rappaport, Prentice hall
2. Wireless and Digital Communications; Dr.KamiloFeher (PHI)
3. Mobile Communications Engineering, William C. Y. Lee, Mc Graw Hill Publications
4. Mobile and personal Communication system and services by Rajpandya, IEEE press (PHI).
5. Wireless Communications-T.L.Singh-TMH
6. Wireless Communications, Andrea Goldsmith, Cambridge University Press, 2005.

INDUSTRIAL AUTOMATION

Subject Code: BECEO1-004 | **L T P C** 3 0 0 3 | **Duration: 45 Hrs.**

Course Objectives:

1. To make the students familiar about the industrial automation.
2. To provide understanding of computer aided measurement and control.
3. To provide the knowledge of detailed concepts of PLC and its applications.
4. To give awareness about the industrial automation using robots.

Course Outcomes:

At the end of the course the students will be able to:

1. Understand various industrial automation components and control systems.
2. Explain architecture of industrial automation system.
3. Use Internet of Things for industrial automation.
4. Understand Programmable logic controllers, PLC programming, Advantage of using PLC for Industrial purposes.
5. Describe the overview of Industrial automation using robots.

UNIT-I (11 Hrs.)

Introduction: Introduction: Automation overview, Requirement of automation systems, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA). Industrial bus systems: modbus & profibus.

Automation components: Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, Introduction of DC and AC servo drives for motion control.

UNIT-II (12 Hrs.)

Computer aided measurement and control systems: Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, computer based data acquisition system, Internet of things (IoT) for plant automation.

UNIT-III (12 Hrs.)

Programmable logic controllers: Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.

UNIT-IV (10 Hrs.)

Distributed Control System: Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

Overview of Industrial automation using robots: Basic construction and configuration of robot Pick and place robot, Welding robot.

Recommended Text Books / Reference Books:

1. Industrial Instrumentation and Control, By. S.K. Singh, Tata McGraw Hill.
2. Process Control Instrumentation Technology By. C.D. Johnson, PHI.
3. Industrial control handbook, Parr, Industrial Press.
4. Programmable logic controller, Dunning , Delmar.

BIOMEDICAL ELECTRONICS AND INSTRUMENTATION

Subject Code: BECEO1-005 | **L T P C** 3 0 0 3 | **Duration: 45 Hrs.**

Course Objectives:

This Course introduces general biological concepts

1. It helps students to understand importance of biological concepts in engineering fields.
2. To understand application of engineering concepts in medical instrumentation.

Course Outcomes:

Upon successful completion of the Course, students will be able to

1. Use bioinstrumentation, required in cellular or molecular biology investigations.
2. Apply the concepts of engineering in different streams of biomedical field.

UNIT-I (10 Hrs.)

Biomedical Signals: Origins of Bioelectric Signals, Human body, Heart and Circulatory System, Electrodes, Transducers, ECG, EMG.

UNIT-II (12 Hrs.)

Recording & Monitoring Instruments: Recording Electrodes, Physiological Transducers, Biomedical Recorders, Biomedical Recorders, Heart rate measurement, Temperature measurement, Foetal Monitoring System, Foetal Monitoring System, Foetal Monitoring System, Foetal Monitoring System, Biomedical Telemetry.

UNIT-III (11 Hrs.)

Imaging System: Working with X-Rays, CT scanner, NMR, NMR, Ultrasonic System, Ultrasonic System, Ultrasonic System.

UNIT-IV (12 Hrs.)

Therapeutic &Physiotherapy Equipment's: Cardiac Pacemakers, Cardiac defibrillator, SW Diathermy & MW Diathermy.

Patient Safety: Electric Shock Hazards, Test Instruments, Biomedical Equipment's, Biomedical Equipment's.

Recommended Text Books / Reference Books:

1. R.S. Khandpur, 'Handbook of Biomedical Instrumentation'.
2. Leslie Cromwell, 'Biomedical Instrumentation and Measurements', PHI.
3. T.K. Attuwood, 'Introduction to bioinformatics', Pearson Education.
4. Joseph J. Carr& John M Brown, 'Introduction to biomedical equipment Technology', Pearson Education.

ANDROID BASED OPERATING SYSTEMS

Subject Code: BECEO1-006 | **L T P C** 3 0 0 3 | **Duration: 45 Hrs.**

Course Objectives:

This course is meant to provide fundamental knowledge to students for understanding android based operating systems.

1. To make aware the students about the concept android operating system.
2. To impart knowledge of android operating architecture.
3. To provide the students concepts of android interfacing.
4. To design basic android services.

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

1. Design an android app for a given application
2. Understand the concepts of android operating system.
3. Understand android user interface.

UNIT-I (11 Hrs)

Computer System Overview-Basic Elements, Instruction Execution, Interrupts, Memory Hierarchy, Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization. Operating system overview-objectives and functions, Evolution of Operating Systems- Computer System Organization Operating System Structure and Operations- System Calls, System Programs, OS Generation and System Boot.

UNIT-II (11 Hrs)

Android, Android Versions, Features of Android, Architecture of Android Obtaining the Required Tools, Android SDK, Installing the Android SDK Tools Configuring the Android SDK Manager – Eclipse, Android Development Tools (ADT), Creating Android Virtual Devices (AVDs), Creating Your First Android Application – Types of Android Application, Anatomy of an Android Application.

UNIT-III (13 Hrs)

Android User Interface Understanding the Components of a Screen , Adapting to Display Orientation Managing Changes to Screen Orientation, Utilizing the Action Bar, Creating the User Interface Programmatically, Listening for UI Notifications, Designing Your User Interface With Views, Using Basic Views, Using Picker Views, Using List Views to Display Long Lists, Understanding Specialized Fragments – Displaying Pictures and Menus With Views, Using Image Views to Display Pictures – Using Menus with Views, Additional Views.

UNIT-IV (10 Hrs)

Location Based Services, Networking and Android Services Location Based Services, Displaying Maps, Getting Location Data, Monitoring a Location, Project- Building a Location Tracker, Networking, Consuming Web Services Using HTTP, Consuming JSON Services, Sockets Programming Developing.

Recommended Text Books / Reference Books:

1. Mark L Murphy, “Beginning Android”, Wiley India Pvt Ltd (2009)
2. Sayed Y Hashimi and Satya Komatineni, “Pro Android”, Wiley India Pvt Ltd (2009)
3. Wei - Meng Lee, “Beginning Android 4 Application Development” , John Wiley & Sons, Inc.
4. Reto Meier, “Professional Android 4 Application Development” , John Wiley & Sons, Inc.
5. ZigurdMednieks, Laird Dornin, Blake Meike G, and Masumi Nakamura, “Programming Android”, O’Reilly.

NEURAL NETWORK & FUZZY LOGIC

Subject Code: BECEO1-007 | **L T P C** 3 0 0 3 | **Duration:45 Hrs.**

Course Objectives:

1. To introduce the fundamentals of Artificial Neural Networks.
2. To Learn and apply ANN architectures, learning laws to different applications
3. To understand Fuzzy logic and design fuzzy inference systems.
4. To apply fuzzy logic and neural nets to real world problems.

Course Outcomes:

At the end of the course the students will demonstrate the ability to:

1. To design different types of ANNs for variety of applications.
2. To apply ANN to various real world applications.
3. To learn Fuzzy Algebra and design fuzzy inference systems.
4. To design and apply Neuro-fuzzy and genetic algorithms for different applications.

UNIT-I (11 Hrs.)

Introduction to Neural Networks: Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential, Applications of ANN.

Types of Learning: Supervised, Unsupervised learning, Basic Learning laws, Hebb's rule, Delta rule, Widrow and Hoff LMS learning rule, Correlation learning rule instar and ouster learning rules, Competitive Learning, Reinforcement Learning.

UNIT-II (12 Hrs.)

Multilayer Perceptron: Perceptron, Feedforward Neural Network, Multilayer Perceptron, Error Backpropagation Learning Algorithm, MLP design issues and implementation in various applications.

Other ANNs: K-means clustering algorithm, Kohonen's feature maps. ART networks, Radial Basis Function Nets- recurrent networks, Hopfield Neural Nets, Associative and Hetro-associative memories, Applications of ANN in pattern recognition, optimization, control etc

UNIT-III (12 Hrs.)

Fuzzy Algebra: Fuzzy algebra fundamental concepts, Classical sets, Fuzzy sets, Fuzzy relations, Fuzzification, Defuzzification,

Fuzzy Logic Systems: Membership functions, Fuzzy rules and Knowledge base, Fuzzy Inference System, applications of Fuzzy logic in real world problems, Fuzzy logic control and its comparison with PID control.

UNIT-IV (10 Hrs.)

Neuro-fuzzy network, Genetic Algorithms, and their applications.

Recommended Text Books / Reference Books:

1. Berkin Riza C and Trubatch, "Fuzzy System design principles- Building Fuzzy IF-THEN rule bases", IEEE Press.
2. Yegna Narayanan, "Artificial Neural Networks". 8th Printing. PHI(2003)
3. Patterson Dan W, "Introduction to artificial Intelligence and Expert systems", 3rd Ed., PHI
4. Simon Haykin, "Neural Networks" Pearson Education.
5. Yen and Langari, "Fuzzy Logic: Intelligence, Control and Information", Pearson Education.
6. Jacek M Zaurada, "Introduction to artificial neural Networks, Jaico Publishing Home, Fouth Impression.