Name of program- **B.Tech** Semester: **VIII**
Subject: **Finite element methods** Code: **BT810**
Branch: **Mechanical Engineering**

Unit-I Formulation of Finite Element Equation

Formulation of Finite Element Equation starting from governing differential equation, Domain residual and minimization, Weighted residual method, Weak form of weighted residual method, solution of weak form using trial function, piecewise continuous trial function solution, formulation of one dimensional bar element using weak form of weighted residual element Minimization of potential energy, Rayleigh-Ritz method, Piece-wise continuous trail function, finite element form of Rayleigh-Ritz method, finite element formulation derived from a functional, formulation of bar element and heat transfer element using Rayleigh-Ritz method

Unit-II One dimensional finite element analysis

One dimensional finite element analysis, generic form of total potential for one dimensional case, determination of shape functions for linear bar finite element and quadratic bar finite element, stiffness matrix, one dimensional problems of structure mechanics and heat conduction

Unit-III shape functions and element matrices

Stiffness matrix formulation for beam and frame element, Determination of shape functions and element matrices, Application problems

Unit-IV Two dimensional finite element analysis

Two dimensional finite element analysis, simple three node triangular elements, four node rectangular element, six node triangular element, natural coordinates, coordinate transformation, simple two dimensional problems, Gauss Quadrature Technique

Unit-V Application of Finite element analysis

Finite element analysis for plane stress and plane strain problem, Strain displacement matrix for 2-D elements, two-dimensional integrals. Application problems, Scalar field problems including heat conduction and flow problems.

TEXT BOOKS

1. Textbook of Finite Element Analysis – Seshu P – Prentice Hall of India. 2. Fundamentals of Finite Element Analysis - David Hutton – TMH, Delhi

REFERENCE BOOKS

1. Finite Element Method: Basic concepts & Applications- Alavala – PHI, Delhi
2. Finite Element in Engineering - T.R. Chandrupatla and Belegundu, Pearson,Singapore
3. Concepts and Applications of Finite element analysis - Cook, Robert – John Wiley
4. The Finite Element Method, A Practical Course - Liu and Quek. – McGraw Hill
5. The Finite Element Method in Engineering - S.S. Rao.
6. An Introduction to the Finite Element Method – J.N. Reddy – TMH, Delhi
7. Finite Element Method – Zienkiewicz. O C - TMH, Delhi
8. Finite Element Analysis: Theory And Programming – Krishnamoorthy C.S.- TMH, Delhi
9. Finite Element Procedure – K.J.Bathe – Prentice Hall of India 10. A First Course in The Finite Element Method – Logan – Cenegage Learning

Name of program- **B.Tech** Semester: **VIII**
Subject: **Nuclear Engineering** Code: **BT8111**
Branch: **Mechanical Engineering**

Unit-1 BASIC CONCEPTS IN NUCLEAR PHYSICS

Nuclear constituents – charge, mass, shape, and size of nucleus, Binding energy, packing fraction, nuclear magnetic moment, saturation and short range nuclear forces, Radioactivity – Laws of radioactive decay, half life, mean life, specific activity, Nuclear models – single particle shell model, evidence and limitations of shell model, liquid drop model : Introduction, assumptions, semi-empirical mass formula.

Unit-2 MECHANISMS OF NUCLEAR DECAY

Law of radioactive decay, half life, mean life, specific activity, partial radioactive decay, successive disintegration, α decay: Barrier penetration, β decay: Fermi theory, selection rules, parity non-conservation, γ decay of excited states.

Unit-3 DETECTION AND MEASUREMENT OF RADIOACTIVITY

Ionization chamber, Geiger- Muller,proportional, scintillation counters, Wilson cloud chamber, Health physics instrumentation-Film badges, Pocket ion chambers, portable counters and survey meters, Accelerators: Van de Graff and cyclotron.

Unit-4 NUCLEAR DETECTORS AND ACCELERATORS

Types of detectors, Geiger-Mueller counter, Scintillation counter, classification of accelerators, Cyclotron, Betatron.

Unit-5 NUCLEAR ENGINEERING & NUCLEAR REACTORS

Theories of Nuclear reactions, Conservation laws, Q-value equation, Nuclear fission, explanation on the basis of liquid drop model, energy available from fission, Nuclear chain reaction, Nuclear fusion.

Nuclear Reactor – Basic principle, classification, constituent parts, Heterogeneous reactor, Swimming pool reactor, Breeder reactor, Heavy water cooled and moderated CANDU type reactors, Gas cooled reactors

TEXT BOOK

D.C.Tayal, Nuclear Physics, Himalayan Publication house, Bombay ,1980.

REFERENCE BOOKS

1. Irving Kaplan, “Nuclear Physics”, Narosa Book Distributors, 2002.

2. R.D. Evans, “The atomc Nucleus”, McGraw-Hill,1955.

3. D.C.Tayal, Nuclear Physics, Himalayan Publication house, Bombay ,1980.

4. J.H.Horlock ,"Combined Power Plants" ,Pergamon Press, 1992.

Name of program- **B.Tech** Semester: **VIII**
Subject: **Fatigue and Fracture Mechanics** Code: **BT8112**

Branch: **Mechanical Engineering**

UNIT-I FATIGUE OF STRUCTURES

S.N. curves - Endurance limits - Effect of mean stress, Goodman, Gerber and Soderberg relations and diagrams - Notches and stress concentrations - Neuber's stress concentration factors - Plastic stress concentration factors - Notched S.N. curves.

UNIT-II STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR

Low cycle and high cycle fatigue - Coffin - Manson's relation - Transition life – cyclic strain hardening and softening - Analysis of load histories - Cycle counting techniques -Cumulative damage - Miner's theory - Other theories.

UNIT-III PHYSICAL ASPECTS OF FATIGUE

Phase in fatigue life - Crack initiation - Crack growth - Final Fracture - Dislocations -fatigue fracture surfaces.

UNIT-IV FRACTURE MECHANICS

Strength of cracked bodies - Potential energy and surface energy - Griffith's theory -Irwin - Orwin extension of Griffith's theory to ductile materials - stress analysis of cracked bodies - Effect of thickness on fracture toughness - stress intensity factors for typical geometries.

UNIT-V FATIGUE DESIGN ANDTESTINIG

Safe life and Fail-safe design philosophies - Importance of Fracture Mechanics in Turbo machineries- Application to composite materials and structures.

TEXT BOOKS

1. Prasanth Kumar – "Elements of fracture mechanics" – Wheeter publication, 1999.

2. Barrois W, Ripely, E.L., "Fatigue of aircraft structure", Pegamon press. Oxford, 1983.

REFERENCES

1. Sin, C.G., "Mechanics of fracture" Vol. I, Sijthoff and w Noordhoff International Publishing Co., Netherlands, 1989.

2. Knott, J.F., "Fundamentals of Fracture Mechanics", Buterworth & Co., Ltd., London, 1983.

Name of program- **B.Tech** Semester: **VIII**
Subject: **Design and Optimization** Code: **BT8113**
Branch: **Mechanical Engineering**

UNIT – I Optimization Technique

Optimization Technique Classification of optimization, problems, single variable and multivariable optimization with equality constraints and Inequality constraints. Convex programming problem.

UNIT – II Linear Programming

Linear Programming - II Duality in Linear programming, dual simplex method, decomposition principle, sensitivity analysis, quadratic programming, changes in cost coefficient, golden section method.

UNIT – III Non-Linear Programming

Non-Linear Programming – I Rate of convergence, Design variables, Random search methods, Chrivariate methods, Powell's method, Newton's method, Marquard Method, Test function.

UNIT – IV Geometric Programming

Geometric Programming Unconstrained minimization problem, primal dual relationship, geometric programming with mixed Erie quality, application and complementary function.

UNIT- V Dynamic Programming

Dynamic Programming Multistage Decision processes. principles of optimality, continuous dynamic programming.

TEXT BOOKS

1. Optimization Techniques – C.S. Rao – Dhanpat Rai & Sons, New Delhi
2. Optimization methods for Engineering Design – R.L. Fox - Addison Wesley

REFERENCE BOOKS

1. Engineering Optimization Theory and Practice – S.S. Rao – New Age Publishers.
2. Introduction to optimum Design – J.S. Arora – Mc. Grawhill publishers
3. Optimization Methods for Engineering – Raju – PHI,Delhi
4. Foundation of Mathematical optimization – Pallaschke – Kluwer Academic Publishers

5. Optimization Methods in Operations Research and System Analysis–K V Mittal–Wiley,Delhi

6. Engineering Optimization: Theory And Practice - Singiresu S Rao – New Age

7. Optimization For Engineering Design- Deb, Kalyanmoy-Prentice Hall

8. Optimization Methods – Mohan & Deep- New Age, Delhi

9. An Introduction to Optimization- Chang, Edwin& Zak Stanislaw -John Wiley, New York

10. Optimization Concepts And Applications In Engineering – Belegundu & Chandrupatla-Pearson,Singapore

Name of program- **B.Tech** Semester: **VIII**
Subject: **Machinery Fault Diagnostics and Signal Processing** Code: **BT8114**
Branch: **Mechanical Engineering**

Unit 1: Failure and failure analysis-Failures and failure analysis. Fault detection sensors. Data processing and signal analysis. Condition based maintenance principles. Fault analysis planning and system availability.

Unit 2: Failure concepts and characteristics-Reliability/failure concepts. Application of diagnostic maintenance to specific industrial machinery and plants.

Unit 3: Failure analysis-FMECA, Basics of Machine Vibration. Computer aided data acquisition, Time Domain Signal Analysis, Frequency Domain Signal Analysis.

Unit 4: Fault Detection Transducers and Monitoring, Vibration Monitoring. Field Balancing of Rotors. Condition Monitoring of Rotating Machines. Noise Monitoring, Wear & Debris Analysis.

Unit 5: Condition Monitoring - Electric Motor Current Signature Analysis Ultra-sonics in Condition Monitoring, NDT Techniques in Condition Monitoring, Case studies.

Text/Reference Books:

1. E. S. Tehrani and K. Khorasani,Fault diagnostics of a nonlinear system using a hybrid approach ,Springer.
2. Paresh Girdhar, Cornelius Scheffer ,Practical machinery vibration analysis and predictive maintenance, Elsevier
3. Rolf Isermann, B. Freyermuth, Fault Detection, Supervision and Safety for Technical Processes, Pergamon Press.

Name of program- **B.Tech** Semester: **VIII**
Subject: **Cryogenics** Code: **BT8115**
Branch: **Mechanical Engineering**

UNIT-I

Introduction to Cryogenic Systems, Properties of materials at low temperature, Properties of Cryogenic Fluids.Air and Gas Liquefaction Systems: Thermodynamically ideal system, Production of low temperatures Liquefaction systems for gases other than Neon, Hydrogen and Helium, liquefaction systems for Neon, Hydrogen and Helium. Cryogenic Refrigeration System

UNIT – II

Gas Separation and Gas Purification Systems The thermodynamically ideal separation system properties of mixtures, Principles of gas separation, air separation systems, Hydrogen, Argon, Helium air separation systems, Gas purification methods.

UNIT – III

Vacuum Techniques, System for production of high vacuum such as mechanical, diffusion, ion and cryopumps.Cryogenics measurement systems,Temperature pressure, flow rate, liquid level measurement, Introduction to Cryocoolers.

UNIT – IV

Cryogenic Fluid Storage Systems,Introduction, Basic Storage vessels, inner vessel, outer vessel design, piping, access manways, safety device. Cryogenic insulations,Vacuum insulation, gas filled powders and fibrous materials, solid foam, selection and comparison of insulations. Cryogenic fluid transfer systems. Transfer through uninsulated lines, vacuum insulated lines, porous insulated lines etc.

UNIT – V

Advances in Cryogenics Vortex tube and applications, Pulse tube refrigerator, Cryogenic Engine for space vehicles.Cryogenic Applications in gas industry, cryogenic fluids, space research, Cryobiology, food processing, electronics, nuclear and high energy physics, chemical processing, metal manufacturing, cryogenic power generation, medicine, analytical physics and chemistry.

TEXT BOOKS

1. Cryogenic Systems – R.F. Barron

2. Cryogenic Engineering – R.B. Scott – D.Van Nostrand Company, 1959

REFERENCE BOOKS

1. Cryogenic Process Engineering – K.D. Timmerhaus and T.M. Flynn, Plenum Press, New York,1989
2. High Vacuum Technology – A. Guthree – New Age International Publicat

Name of program- **B.Tech** Semester: **VIII**
Subject: **Engineering System Analysis and Design** Code: **BT8121**
Branch: **Mechanical Engineering**

Unit 1: INTRODUCTION- Systems, Elements of a system, Types of systems, Subsystems, Super systems, Need for system analysis and design, CASE tools for analysis and its limitations.

Unit 2: System Analysis-Methods of system analysis, system development life cycle, structured approach, development tools, data base and networking techniques.

Unit 3: System design- Design technologies, Design principles, Design tools and methodologies, feasibility survey, conversion and testing tools, design management and maintenance tools .

Unit 4: Object oriented analysis and design- Introduction, Object modeling, Dynamic modeling, functional modelling, UML diagrams and tools.

Unit 5: Case studies- Developing prototypes for systems like, online exam management, Computer gaming and online website management.

Text Books:

1. Perry Edwards, “System analysis and design”, McGraw Hill international edition, 1993.
2. Len Fertuck, “System analysis and design with CASE tools”, Wm C. Brown Publishers, 1992.

Reference Books:

1. Er. V.K. Jain, “System analysis and design “, Dreamtech Press.
2. Kenneth E.Kendall and Julie E.Kendall, “System analysis and design”, Prentice Hall, India, 2007.

Name of program- **B.Tech** Semester: **VIII**
Subject: **Engineering System Design Optimization** Code: **BT8122**
Branch: **Mechanical Engineering**

Unit 1: Introduction- Optimization problem formulation, optimization algorithms, applications and examples, different optimization methods available.

Unit 2: Single Variable optimization-Optimization criteria, bracketing methods – Exhaustive search method, bound phase method; Region Elimination methods – Fibonacci search method, Golden search method; Gradient based methods – Newton Raphson method, Bisection method; Root finding using optimization technique.

Unit 3: Multi objective optimization- Optimization criteria, Different search methods, Unidirectional search, Direct search method – Evolutionary optimization method, Powell‟s conjugate direction method; Gradient based methods – Newton‟s method and Variable metric method.

Unit 4: Specialized Methods- Integer programming, Geometric programming, simulated annealing, Global optimization using - steep descent method, simulated annealing.

Unit 5: Genetic algorithms and evolutionary approaches-Differences and similarities between genetic algorithms and traditional techniques, operators of GA‟s, Computer program for simulated annealing, Newton Raphson method, Evolutionary optimization method.

Text Books:

1. Kalyanmoy Deb, “Optimization for Engineering design”, Prentice Hall, India, 2005.
2. Kalyanmoy Deb, “Multi objective optimization using Evolutionary algorithms”, John Wiley, 2001.

Reference Books:

1. Taha, Operations Research, TMH 2010

Name of program- **B.Tech** Semester: **VIII**
Subject: **Engineering System Modeling and Simulation** Code: **BT8123**
Branch: **Mechanical Engineering**

Unit 1: Introduction-Systems, System types, System Modeling, Types of system modelling, Classification and comparison of simulation models, attributes of modelling, Comparison of physical and computer experiments, Application areas and Examples

Unit 2: Mathematical and Statistical Models- Probability concepts, Queuing Models, Methods for generating random variables and Validation of random numbers.

Unit 3: Language-System modelling, programming languages, comparison of languages, Identifying and selection of programming language, feasibility study of programming language for the given application.

Unit 4: Experiments-Simulation of different systems, Analysis, validation and verification of input and output simulated data, study of alternate techniques.

Unit 5: Case study-Developing simulation model for information centers, inventory systems and analysis of maintenance systems.

Text Books:

1. Geoffrey Gordon, "System Simulation", Second edition, Prentice Hall, India, 2002.

2. Jerry Banks and John S.Carson, Barry L.Nelson, David M.Nicol, "Discrete Event System Simulation", Third edition, Prentice Hall, India, 2002.

Reference Books:

1. Robert E. Shannon, "System Simulation The art and science", , Prentice Hall, New Jersey, 1995.
2. D.S. Hira, "System Simulation", S.Chand and company Ltd, New Delhi, 2001.

Name of program- **B.Tech** Semester: **VIII**
Subject: **Game Theory with Engineering Applications** Code: **BT8124**
Branch: **Mechanical Engineering**

Unit-1 Introduction-What is Game Theory? Definition of Games. Actions, Strategies, Preferences, Payoffs. Examples. Strategic form games and examples: Prisoner's Dilemma, Bach or Stravinsky, Matching Pennies. Notion of Nash Equilibrium. Examples of Nash Equilibrium. Best Response Functions. Dominated Actions. Symmetric Games and Symmetric Equilibria. Case Studies of Nash Equilibrium in popular games

Unit-2 Mixed Strategy Nash Equilibrium- Randomization of Actions, Mixed strategy Nash equilibrium, Dominated actions, Pure strategy equilibria in the presence of randomization, Illustrations: (1) expert diagnosis (2) reporting a crime. Finding all mixed strategy Nash equilibria of some representative games.

Unit-3 Extensive games with Perfect Information- Extensive games, Strategies and outcomes, Nash equilibrium, Subgame perfect equilibrium, finding subgame perfect equilibria using backward induction. Allowing for simultaneous moves in extensive games with perfect information. Example of committee decision making. Two Player Zerosum Games: Maxminimization and Nash Equilibrium. Strictly competitive games. Nash equilibrium in strictly competitive games. Minimax theorem. Solution via linear programming. Examples.

Unit-4: Bayesian and Repeated Games- Motivational Examples. Definition of a Bayesian Game and Bayesian Nash Equilibrium and examples. Auctions: Independent private values, Nash equilibrium of first price auction and second price auction, common valuations, revenue equivalence of auctions. Idea of repeated games. Finitely repeated prisoner's dilemma, infinitely repeated prisoner's dilemma, strategies in a repeated prisoner's dilemma, Nash equilibria and equilibria payoffs in infinitely repeated prisoner's dilemma, sub-game perfect equilibria and equilibria payoffs in infintely repeated prisoner's dilemma.

Unit-5: Coalitional Games- Coaltional games. The Core. Illustrations: (1) Ownership and distribution of wealth (2) exchanging homogeneous items (3) exchanging heterogeneous items (4) voting (5) matching. Shapley value and examples.

Text Books:

1. Martin Osborne. An Introduction to Game Theory. Oxford University Press, 2003.
2. Philip D. Straffin, Jr. Game Theory and Strategy. The Mathematical Association of America, January 1993.

Reference Books:

1. Ken Binmore, Fun and Games : A Text On Game Theory, D. C. Heath & Company, 1992.
Y. Narahari. Essentials of Game Theory and Mechanism Design. IISc Press, 2011

Name of program- **B.Tech** Semester: **VIII**
Subject: **Supply Chain Management-Planning** Code: **BT8125**
Branch: **Mechanical Engineering**

UNIT I- FUNDAMENTALS OF SUPPLY CHAIN MANAGEMENT

Supply chain networks, Integrated supply chain planning, Decision phases in s supply chain, process view of a supply chain, supply chain flows, Overview of supply chain models and modeling systems, Supply chain planning: Strategic, operational and tactical, Understanding supply chain through process mapping and process flow chart.

UNIT II- SCM STRATEGIES, PERFORMANCE

Supply chain strategies, achieving strategic fit, value chain, Supply chain drivers and obstacles, Strategic Alliances and Outsourcing, purchasing aspects of supply chain, Supply chain performance measurement: The balanced score card approach, Performance Metrics. Planning demand and supply: Demand forecasting in supply chain, Aggregate planning in supply chain, Predictable variability.

UNIT III- PLANNING AND MANAGING INVENTORIES

Introduction to Supply Chain Inventory Management. Inventory theory models: Economic Order Quantity Models, Reorder Point Models and Multiechelon Inventory Systems, Relevant deterministic and stochastic inventory models and Vendor managed inventory models.

UNIT IV- DISTRIBUTION MANAGEMENT

Role of transportation in a supply chain - direct shipment, warehousing, cross-docking; push vs. pull systems; transportation decisions (mode selection, fleet size), market channel structure, vehicle routing problem. Facilities decisions in a supply chain. Mathematical foundations of distribution management, Supply chain facility layout and capacity planning,

UNIT V- STRATEGIC COST MANAGEMENT IN SUPPLY CHAIN

The financial impacts, Volume leveraging and cross docking, global logistics and material positioning, global supplier development, target pricing, cost management enablers, Measuring service levels in supply chains, Customer Satisfaction/Value/Profitability/Differential Advantage.

REFERENCES

1. David Simchi-Levi, Philip Kaminsky, and Edith Simchi-Levi Designing and Managing the Supply Chain: Concepts, Strategies, and Case Studies, Second Edition, , McGraw-Hill/Irwin, New York, 2003. 31
2. Sunil Chopra and Peter Meindel. Supply Chain Management: Strategy, Planning, and Operation, Prentice Hall of India, 2002.
3. Sunil Chopra & Peter Meindl, Supply Chain Management , Prentice Hall Publisher, 2001
4. Robert Handfield & Ernest Nichols, Introduction to Supply Chain Management, Prentice hall Publishers, 1999.

Name of program- **B.Tech** Semester: **VIII**
Subject: **Finite Element Methods lab** Code: **BT813**
Branch: **Mechanical Engineering**

Minimum eight assignments are to be completed on following area using appropriate Software.
1. Structural Analysis
2. Thermal Analysis
3. Fluid Flow Analysis
4. Coupled Field Analysis
5. Modal Analysis

Minimum four problems shall be solved with Manual calculations in any of area specified above.