**K L E F**

**DEPARTMENT OF MECHANICAL ENGINEERING**

**M.TECH IN MACHINE DESIGN-2019 ADMITTED BATCH**

**COURSE STRUCTURE & SYLLABUS**

**2019-20 admitted batch Course Structure**

**First Year (First Semester):**

| S. No. | Course Code | Course Title | Periods | | | Contact Hours | Credits |
|---|---|---|---|---|---|---|---|
| | | | L | T | P | | |
| 1 | 18 ME 5117 | Design Methods | 4 | 0 | 0 | 4 | 4 |
| 2 | 18 ME 5118 | Design with Advanced materials | 3 | 0 | 0 | 3 | 3 |
| 3 | 18 ME 5119 | Theory of Elasticity and Plasticity | 3 | 1 | 0 | 4 | 4 |
| 4 | 18 ME 5120 | Modeling & Analysis-1 (CAD) | 4 | 0 | 2 | 6 | 5 |
| 5 | | Elective-1 | 3 | 0 | 0 | 3 | 3 |
| 6 | | Elective-2 | 3 | 0 | 0 | 3 | 3 |
| 7 | 18 IE 5149 | Seminar | 0 | 0 | 4 | 4 | 2 |
| | | **Total** | **20** | **1** | **6** | **27** | **24** |

**First Year (Second Semester):**

| S. No. | Course Code | Course Title | Periods | | | Contact Hours | Credits |
|---|---|---|---|---|---|---|---|
| | | | L | T | P | | |
| 1 | 18 ME 5221 | Mechanical Vibrations | 3 | 0 | 0 | 3 | 3 |
| 2 | 18 ME 5222 | Design for Optimization | 3 | 1 | 0 | 4 | 4 |
| 3 | 18 ME 5223 | Advanced strength of materials | 3 | 1 | 0 | 4 | 4 |
| 4 | 18 ME 5224 | Modeling & Analysis-2 (FEM) | 4 | 0 | 2 | 6 | 5 |
| 5 | | Elective-3 | 3 | 0 | 0 | 3 | 3 |
| 6 | | Elective-4 | 3 | 0 | 0 | 3 | 3 |
| 7 | 18 IE 5250 | Term Paper | 0 | 0 | 4 | 4 | 2 |
| | | **Total** | **19** | **2** | **6** | **27** | **24** |

**Second Year (Third Semester & Fourth Semester)**

| S.NO. | Course Code | Course Title | Periods | | | Contact Hours | Credits |
|---|---|---|---|---|---|---|---|
| | | | L | T | P | | |
| 1. | 21IE6150/21IE6250 | Major Project | 0 | 0 | 36 | - | 36 |
| | | **Total Credits** | 0 | 0 | 36 | - | **36** |

**ELECTIVE COURSES:**

| **Elective – 1** | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 18 ME 51I1 | Precision and Quality Engineering | 3 | 0 | 0 | 3 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2 | 18 ME 51I2 | Advanced Mechanisms | 3 | 0 | 0 | 3 |
| 3 | 18 ME 51I3 | Concurrent Engineering | 3 | 0 | 0 | 3 |
| **Elective – 2** | | | | | | |
| 1 | 18 ME 51J1 | Design of Pressure Vessels and Plates | 3 | 0 | 0 | 3 |
| 2 | 18 ME 51J2 | Tribological System Design | 3 | 0 | 0 | 3 |
| 3 | 18 ME 51J3 | Product Design and Development | 3 | 0 | 0 | 3 |
| **Elective – 3** | | | | | | |
| 1 | 18 ME 52K1 | Mechanics of Composite Materials | 3 | 0 | 0 | 3 |
| 2 | 18 ME 52K2 | Machine Tool Design | 3 | 0 | 0 | 3 |
| 3 | 18 ME 52K3 | Fracture Mechanics | 3 | 0 | 0 | 3 |
| **Elective – 4** | | | | | | |
| 1 | 18 ME 52L1 | Engineering Noise & Control | 3 | 0 | 0 | 3 |
| 2 | 18 ME 52L2 | Engineering Failure Analysis and prevention | 3 | 0 | 0 | 3 |
| 3 | 18 ME 52L3 | Design for Manufacturing, Assembly and Environment | 3 | 0 | 0 | 3 |

**18ME5117-DESIGN METHODS**

**L-T-P: 4-0-0** **Credits: 4** **Pre-requisite: NIL**

**Mapping of CO-PO table:**

| CO# | Course outcome | PO/PSO | BTL |
|---|---|---|---|
| CO1 | Understand Phases of design and associated requisites | PO2 | 2 |
| CO2 | Understand Types of design and modelling of the problems | PO1 | 3 |
| CO3 | Understand Material and manufacturing considerations | PO2 | 3 |
| CO4 | Understand Reliability of design and quality concepts | PO6 | 3 |

**Syllabus:**

**THE DESIGN PROCESS:** Morphology of design – Design Drawings – Computer Aided Engineering -Design of Standards – Concurrent Engineering – Product Life Cycle – Technological Forecasting – Market Identification – Competition bench marking – System engineering – Life Cycle Engineering – Human Factors in Design – Industrial Design**. DESIGN METHODS:** Creativity and Problem Solving – Product Design Specification – Conceptual Design – Decision Theory – Decision Tree – Embodiment Design – Detail Design – Mathematical Modeling – Simulation – Geometric Modeling – Fine Element Modeling – Optimization – Search Methods – Geometric Programming – Structural and shape Optimization. **MATERIAL SELECTION PROCESS AND DESIGN:** Material Selection Process – Economics – Cost Vs Performance – Weighted Property Index – Value Analysis – Role of Processing in Design – Classification of Manufacturing Process – Design of Manufacture – Design of Assembly – Design for Casting, Forging, Metal Forming, Machining and Welding – Residual Stresses – Fatigue, Fracture and Failure. **ENGINEERING STATISTICS AND RELIABLITY:** Probability – Distributions – Test of Hypothesis – Design of Experiments – Reliability Theory – Design for Reliability – Reliability Centered Maintenance. **LEGAL AND ETHICAL ISSUES IN DESIGN AND QUALITY ENGINEERING:** Introduction- the Origin of Laws – Contracts – Liability – Tort Law – Product Liability – Protecting Intellectual Property – Legal and Ethical Domains – Codes of Ethics – Solving EthicalConflicts – Case Study**.** Total Quality Concept – Quality Assurance – Statistics Processes Control – Taguchi Methods – Robust Design – Failure Model Effect Analysis.

**Text Books**


1. Dieter, George E, Engineering Design – "A Material and Processing Approach" McGrawHill, International Editions, Singapore, 2000.
2. Karl T. Ulrich and Steven D. Eppinger "Product Design and Development" McGraw HillEdition 2000.


**Reference books:**


1. Pahl, G, and Betiz, W., "Engineering Design", Springer – Verlag, NY 1984.
2. Ray, MS, "Elements of Engg. Design", Prentice Hall Inc. 1985.
3. Suh, N.P., "The Principles of Design", Oxford University Press, NY 1990.


**18ME5118-DESIGN WITH ADVANCED MATERIALS**

**L-T-P: 3-0-0** **Credits: 3** **Pre-requisite: NIL**

**Mapping of CO-PO table:**

| CO# | Course outcome | PO/PSO | BTL |
|---|---|---|---|
| CO1 | Understand the properties of Ferrous and Non ferrous materials for suitable applications. | PO1,PO5 | 2 |
| CO2 | Understand mechanical behavior of the polymer materials and ceramics for engineering applications. | PO1,PO5 | 2 |
| CO3 | Design composites, Functionally graded materials and smart materials for advanced applications. | PO1,PO5 | 5 |
| CO4 | Design with intermetallic, super alloys and Nano materials to develop a suitable product. | PO1,PO5 | 5 |

**Syllabus:**

**FERROUS MATERIALS AND ALLOYS:** Aluminum: Wrought and cast aluminum alloys- Properties**.** Copper: Propertied of wrought copper alloys and copper alloy casting. Selection andapplication of copper alloys. Zinc and Tin: Properties, selection and application. **PLASTICS:** General properties of plastic: Introduction, Polymeric materials to designer and selection ofPlastics. Plastic additives, Mechanical behavior of plastic. **COMPOSITES**: Introduction; conventional engineering materials, what are composites? Function of fiber andmatrix special features, drawbacks, procession, product fabrication, application**. INTERMETALLIC:** Properties and application of titanium aluminides, Nickel aluminides, Iron Luminides, Beryllides and silicides. **SUPER ALLOYS:** Properties, Selection and Engineering application of Nickel based super alloy, cobalt basedsuper alloy and iron based super alloy. **CERAMICS**: Oxides surfaces, Ceramic forming and metal ceramic interface.

**TEXT BOOK:**

1. Engineering materials, properties and selection- Ken Budinski and Michael K.Budinski, Prentice Hall.

**REFERENCE BOOK:**

1. Material selction in machine design- Michael Ash by Butterworth- Heinemann.
2. Material selection and application in Machanical Engineering – Dr. A. Raman, Industrial Press Inc.
3. Selection and use of Engineering Materials – F.A.A. Crane, J.A.Charles and JustinFurness, Butterworth – Heinemann.

**18ME5119-THEORY OF ELASTICITY AND PLASTICITY**

**L-T-P: 3-1-0** **Credits: 4** **Pre-requisite: NIL**

## Mapping of CO-PO table:

| CO# | Course outcome | PO/PSO | BTL |
|---|---|---|---|
| CO1 | Understand the significance of compatibility and equilibrium equations. Evaluation of factor of safety against yielding in multi-axial stress state. | PO1 | 4 |
| CO2 | Solve 2-D elasticity problems in Cartesian and Polar coordinate systems | PO2 | 4 |
| CO3 | Analyze the bending of cantilever beams having rectangular and circular cross-sections; Axisymmetric stress and deformation in a solid of revolution ; and simple 3-D stress analysis problems | PO1 | 4 |
| CO4 | Understand the plastic deformation and plastic yielding. Solving problems using the characteristic methods and engineering methods. | PO1 | 4 |

**Syllabus:**

**ELASTICITY:** Two dimensional stress analysis - Plane stress - Plane strain – Equations of compatibility - Stress function - Boundary conditions. **PROBLEM IN RECTANGULAR COORDINATES** - Solution by polynomials - Saint Venent'sprinciples - Determination of displacement - Simple beam problems. **PROBLEMS IN POLAR COORDINATES** - General equations in polar coordinates – Stressdistribution symmetrical about axis - Strain components in polar coordinates - Simple andsymmetric problems. **ANALYSIS OF STRESS AND STRAIN IN THREE DIMENSIONS**: Principle stresses -Homogeneous deformations - Strain spherical and deviatoric stress - Hydrostatic strain. **General theorems**: Differential equations of equilibrium and compatibility - Displacement - Uniqueness of solution - Reciprocal theorem. **BENDING OF PRISMATIC BARS:** Stress function - Bending of cantilever beam - Beam ofrectangular cross-section - Beams of circular cross-section. **PLASTICITY**: Plastic deformation of metals - Structure of metals - Deformation - Creep stressrelaxation of deformation - Strain rate condition of constant maximum shear stress - Condition ofconstant strain energy - Approximate equation of plasticity. **METHODS OF SOLVING PRACTICAL PROBLEMS:** The characteristic method – Engineeringmethod - Compression of metal under press - Theoretical and experimental data drawing.

**REFERENCE BOOKS:**


1. Theory of Elasticity/Timoshenko S.P. and Goodier J.N./Koakusha Publishers
2. An Engineering Theory of Plasticity/E.P. Unksov/Butterworths
3. Applied Elasticity/W.T. Wang/TMH
4. Theory of Plasticity for Engineers/Hoffman and Sacks/TMH
5. Theory of Elasticity and Plasticity/Sadhu Singh/ Khanna Publishers
6. Theory of Elasticity and Plasticity/Harold Malcolm Westergaard/Harvard UniversityPress


**18ME5120-MODELING AND ANLALYSIS – I (CAD)**

**L-T-P: 4-0-2** **Credits: 5** **Pre-requisite: NIL**

**Mapping of CO-PO table:**

| CO# | Course outcome | PO/PSO | BTL |
|---|---|---|---|
| CO1 | To understand various evaluation criteria's for CAD/CAM system and need of graphics standard. | PO4 | 3 |
| CO2 | To represent different curves and surfaces of geometric models mathematically. | PO1,PO2 | 3 |
| CO3 | To represent solid models using different solid represent schemes | PO1,PO2 | 3 |
| CO4 | To recognize and apply various data exchange formats in geometric modeling and also will be able to apply finite element modeling and mechanical assembly concepts in design applications | PO1,PO3 | 3 |
| CO5 | To apply concepts of geometric modeling in designing using CAD tools | PO4 | 4 |

**Syllabus:**

**CAD TOOLS**: Definition of CAD Tools, Types of System, CAD/CAM system evaluation criteria, brief treatment of input an output devices. Graphics standards, functional areas of CAD, Modeling and Viewing, Software documentation efficient use of CAD Software. **GEOMETRIC MODELING:** Types of Mathematical representation of curves, wire frame models, wire frame entities, parametric representation of synthetic curves hermit cubic splines, Bezier curves, B-Splines rational curves. **SURFACE MODELING:** Mathematical representation surfaces, surface model, surface entities, surface representation, parametric representation of surfaces, plane surface, rule surface, surface of revolution, tabular cylinder. **PARAMETRIC REPRESENTATION OF SYNTHETIC SURFACES:** Hermit Bi-Cubic surface, Bezier curve surface, B-Spline surface, COONs, Blending Surface, Sculptured surface, Surface Manipulation- Displaying, segmentation, trimming, intersection, Transformations (2D and 3D). **GEOMETRIC MODELING 3D**: Solid modeling, solid representation, Boundary Representation (B-Rep**)**, Constructive Solid Geometry**. CAD/CAM DATA EXCHANGE:** Evaluation of data – Exchange format, IGES Data representations and structure, STEPArchitecture, Implementation, ACIS and DXF. **DESIGN APPLICATIONS**: Finite Element Modeling and Analysis and Mechanical Assembly**. COLLABORATIVE ENGINEERING:** Collaborative Design, Principles, Approaches, tools, designs system.

**Reference books:**


1. CAD/CAM Theory and Practice/Ibrhim Zeid/Mc Graw Hill International.
2. MASTERING CAD/CAM / Ibrahim Zeid / Mc Graw Hill International.
3. CAD/CAM PN Rao / TMH.
4. CAD/CAM Principles, Practice and Manufacturing Management / Chris Mc. Mohan,Jimmie Browne / Pearson edu. (LPE)
5. Concurrent Engineering Fundamentals: Integrated Product Development/ Prasad /Prentice Hall.
6. Successful implementation of concurrent Product and Process/Sammy G Sinha/Wiley John and Sons Inc.

## 18M5221- MECHANICAL VIBRATIONS

**L-T-P: 3-0-0** **Credits: 3** **Pre-requisite: NIL**

### Mapping of CO-PO table:

| CO# | Course outcome | PO/PSO | BTL |
|---|---|---|---|
| CO1 | Analyze the behavior of single degree of freedom undamped and damped free vibrations using basic principles. | PO1,PO2 | 4 |
| CO2 | Analyze the behavior of single degree of freedom damped forced vibrations using basic principles | PO1,PO2 | 4 |
| CO3 | Analyze the behavior of two degree of freedom and multi-degree of freedom vibrations for frequencies and amplitudes. | PO1,PO2 | 4 |
| CO4 | Analyze the the shafts for critical speeds as well as analysis of transient vibrations based on laplace transform approach. | PO1,PO2 | 4 |

**Syllabus: Review of Mechanical Vibrations:** Basic concepts; Free vibration of single degree offreedom systems with and without damping, Forced vibration of single DOF-systems. Force and motion isolation. Two DOF-system: natural frequency. **Transient Vibration of single Degree-of freedom systems:** Impulse excitation, arbitrary excitation, Laplace transforms formulation, Pulse excitation and rise time, Shock response spectrum, Shock isolation, Finite difference numerical computation. **Non Linear Vibrations:** Introduction, Sources of nonlinearity, Qualitative analysis of nonlinear systems. Phase plane, Conservative systems, Stability of equilibrium, Method of isoclines, Perturbation method, Method of iteration, Self-excited oscillations. **Random Vibrations :** Random phenomena, Time averaging and expected value, Frequency response function, Probability distribution, Correlation, Power spectrum and power spectral density, Fourier transforms, FTs and response. **Continuous Systems :** Vibrating string, Longitudinal vibration of rods, Torsional vibration of rods, Suspension bridge as continuous system, Euler equation for beams, Vibration of membranes. **Vibration Control:** Introduction, Vibration isolation theory, Vibration isolation theory for harmonic excitation, practical aspects of vibration analysis, shock isolation, Dynamic vibration absorbers, and Vibration dampers. **Modal analysis & Condition Monitoring:** Dynamic Testing of machines and Structures, Experimental Modal analysis, Machine Condition monitoring and diagnosis.

**Text Books:**

1. Theory of Vibration with Application, - William T. Thomson, Marie Dillon Dahleh,Chandramouli Padmanabhan, 5th edition Pearson Education.
2. Fundamentals of Mechanical Vibration. - S. Graham Kelly. 2nd edition McGrawHill.
3. Mechanical Vibrations, - S. S. Rao., 4th edition Pearson Education.

**Reference Books:**

1. Mechanical Vibrations - S. Graham Kelly, Schaum's Outlines, Tata McGraw Hill,2007

## 18ME5222-DESIGN FOR OPTIMIZATION

**L-T-P: 3-1-0** **Credits: 4** **Pre-requisite: NIL**

### Mapping of CO-PO table:

| CO# | Course outcome | PO/PSO | BTL |
|---|---|---|---|
| CO1 | Understanding the basic principles of optimizations and applying various design constraints for solving optimization problems. | PO2 | 2 |
| CO2 | Applying various optimization techniques for solving real time applications through Matlab and Python programming. | PO3,PO4 | 3 |
| CO3 | Designing of various structural applications by considering static conditions. | PO3,PO5 | 5 |
| CO4 | Designing of various structural applications by considering dynamic conditions. | PO1 | 5 |

**Syllabus:** **INTRODUCTION**: General Characteristics of mechanical elements, adequate and optimum design, principles of optimization, formulation of objective function, design constraints- Classification of Optimization problem. **OPTIMIZATION TECHNIQUES**:Single variable and multivariable optimization, techniques of unconstrained minimization- Golden selection, Random, Patter and Gradient search methods- interpolation methods, Optimization with equality and inequality constraints. Single variable and multivariable optimization, techniques of unconstrained minimization- Golden selection, Random, Patter and Gradient search methods- interpolation methods, Optimization with equality and inequality constraints. **MULTI OBJECTIVE OPTIMIZATION**: Direct methods – Indirect methods using penalty functions, Lagrange multipliers, Geometric programming and stochastic programming, multi objective optimization, Genetic algorithms and stimulated Annealing techniques. **STATIC APPLICATION**: Structural applications – Design of simple truss members, Design applications – Design of simple axial, transvers loaded members for minimum cost, maximum weight- Design of shafts and torsion ally loaded members- Design of springs. **DYNAMIC APPLICATION** : Dynamic applications- Optimum design of single, two degree of freedom systems , vibration absorbers. Application in mechanisms – Optimum design of simple linkage mechanisms.

**Text Books:**

1. Sigeresus S.Rao "Engineering Optimization – Theory and Practice" New age Intl.Ltd., Published, 2000.

**Reference books:**

1. Johnson Ray. C., "Optimum Design of mechanical elements", Wiely, John &sons,1990.
2. Goldberg. D.E., "Genetic algorithms in search optimization and machines", Barnen,Addison Wesley, New York, 1989.
3. Kalyanamoy Deb, "Optimization for Engineering Design algorithm and Examples",Prentice Hall of India Pvt. 1995.

## 18ME5223-ADVANCED STRENGTH OF MATERIALS

**L-T-P: 3-1-0** **Credits: 4** **Pre-requisite: NIL**

**Mapping of CO-PO table:**

| CO# | Course outcome | PO/PSO | BTL |
|---|---|---|---|
| CO1 | Analyse the stresses and deflections in the beams under unsymmetrical bending and determination of shear centre. | PO2 | 4 |
| CO2 | Analyse the stresses induced in curved beams subjected to loading. | PO1,PO2 | 4 |
| CO3 | Analyse the torsional stresses in beams and determine the contact stresses. | PO1,PO2 | 4 |
| CO4 | Apply principles of elasticity to determine stresses in two-dimensional and three dimensional problems. | PO2 | 4 |

**Syllabus:**

**SHEAR CENTER:** Bending axis and shear center- shear center of axisymmetric and unsymmetrical sections**.** **UNSYMMETRICAL BENDING:** Bending stress in beams subjected to non-symmetrical bending, deflection of straight beams due to non symmetrical bending**. CURVED BEAM THEORY:** Winkler Bach formula for circumferential stress-limitation – correct factors- radial stress in curved beams – closed ring subjected to concentrated and uniform loads-stress in chain links. Torsion: Linear elastic solution, Pradtl elastic membrane (Soap-Film) Analogue, Narrow rectangular cross section, Hollow thin wall torsion members, multiply connected cross section. **CONTACT STRESS:** Introduction, problem of determining contact stresses, assumptions on which a solution for contact stresses is based, expression for principle stresses, method of computing contact stresses, deflections of bodies in point contact, stresses for tow bodies in contact over narrow rectangular area (Line of contact). Loads normal to area, stressed for two bodies in line contact normal and tangent to contacts area. **TWO DIMENSIONAL ELASTICITY PROBLEMS**: Plane stress and plain strain – problems in rectangular Coordinates bending of cantilever beam loaded at the end, bending of a beam by uniform load. **TWO DIMENSIONAL ELASTICITY PROBLEMS**: In polar coordinates, general equations in polar coordinates, stress distribution symmetrical about the axis, pure bending of curved bars, and displacements for symmetrical stress distributions, rotating discs. **INTRODUCTION TO THREE DIMENSIONAL PROBLEMS**: Uniform stress stretching of a prismatic bar by its own weight, twist o circular shafts of constant cross section, pure bending of plates.

**Reference books:**

1. Advanced Mechanics of materials by Boresi and Sidebottom- Wiely International.
2. Theory of Elasticity by Timoschenko S.P. and Goodier J.N Mc Grawhill Publishers.
3. Advanced strength of material by Den Hortog J.P..
4. Theory of plates- Timoshenko.
5. Strength of Materials and Theory of Structures (Vol I&II) by B.C Punmai.

## 18ME5224-MODELING AND ANALYSIS- 2 (ADVANCED FEM)

**L-T-P: 4-0-2** **Credits: 5** **Pre-requisite: NIL**

### Mapping of CO-PO table:

| CO# | Course outcome | PO/PSO | BTL |
|---|---|---|---|
| CO1 | Apply finite element method to solve problems in Bending of plates and shells and Conforming and Non- Conforming elements. | PO3 | 3 |
| CO2 | Formulate and solve the Non Linear problems in - Elasto Plasticity and Large displacement formulation. | PO3,PO4 | 3 |
| CO3 | Formulate the Dynamic Problems problems in free, transient and forced vibration. | PO3,PO5 | 4 |
| CO4 | Interpret and Evaluate the quality of fluid mechanics and heat transfer and error estimates and adaptive refinement. | PO1 | 4 |
| CO5 | Gain hands on experience in converting a given structure into desired shape and size by applying suitable ANSYS APDL software. | PO6 | 4 |

**Syllabus: BENDING OF PLATES AND SHELLS** :Review of Elasticity equation – Bending of plates and shells – Finite Element formulation of plates and shell elements – Conforming and Non-Conforming elements- $C_0$ and $C_1$ Continuity elements – application and examples. **NON-LINEAR PROBLEM**: Introduction- Iterative Techniques – Material Non-Linearity – Elasto Plasticity – Plasticity – Viscos Plasticity – Geometric Non linearity – Large displacement formulation – application in metal forming process and contact problems. **DYNAMIC PROBLEMS**: Direct formulation- free, transient and forced response – Solution procedures- Subspace iterative Techniques – Houbot, Wilson, Newmark – Methods – Examples. **FLUID MECHANICS AND HEAT TRANSFER**: Governing equations of fluid mechanics – in viscid and incompressible flow – Potential formulations – Slow Non- Newtonian Fluid Flow – Metal and Polymer forming – Navier stocks equation – Steady and Transient solution. **ERROR ESTIMATES AND ADAPTIVE REFINEMENT**: Error norms and convergence rates- N Refinement with adaptively – Adaptive refinement.

**Text Books:**

1. Zienkiewicz, O.C. and Taylor, R.L., "The Finite Element Method", Fourth Edition,Volume I and 2, McGraw Hill International Edition, Physics services, 1991.

**Reference books:**

1. Cook R.D., "Concept and Applications of Finite Element Analysis:, John Wiely andSons Inc., New York 1989.
2. Bathe K.J., "Finite Element Procedure in Engineering Analysis", Prentice Hall, 1990.

## 18ME51I1-PRECISION AND QUALITY ENGINEERING

**L-T-P: 3-0-0** **Credits: 3** **Pre-requisite: NIL**

### Mapping of CO-PO table:

| CO# | Course outcome | PO/PSO | BTL |
|---|---|---|---|
| CO1 | Understand and apply the measuring tools to machines and instruments. | PO3 | 3 |
| CO2 | Understand the different methods and solve the problems of Quality control. | PO3 | 3 |

| | | | |
|---|---|---|---|
| CO3 | Relate the Quality and Reliability and it's associated failure modes. | PO3 | 3 |
| CO4 | Understand and implement the ISO 9000 series of total quality management. | PO3 | 3 |

**Syllabus: INTRODUCTION**: Importance of Precision Engineering, Tolerance and Technology, Definition of Tolerance, Impact of specifying Tolerance. **MEASUREMENT OF PRECISION**: Application of displacement transducers to machines and instruments, introduction to Precision Machine Design, Principles of Precision of Machine Design, Principle of Accuracy,Repeatability and resolution. **INTRODUCTION TO QUALITY**: Quality of design, Quality of Conformance to Design, Quality of Performance, Growth of Quality Control, Process Monitoring, Acceptance Sampling, Quality of Performance Reliability, Management of Quality, Quality and Productivity. **FUNDAMENTAL OF STATISTICS AND PROBABILITY IN QUALITY CONTROL**: Events and Probability, Laws of Probability, Distribution and Frequency, Binomial Distribution, Normal Distribution, Poisson's Distribution, Exponential and Weibull and Distribution, Random Experiments, Probability, Random Variable, Distribution Functions, Discrete Distributions, Continuous Distribution, Uniform Distribution, Numerical Characteristics of Random Variables. **STATISTICAL QUALITY CONTROL**: Variability in Materials, Machines and people, Statistical Understanding of Variability, Basicform of control chart, use of Control charts, Development of a Control Chart, Control charts for Variable and attributes. **BASIC CONCEPT OF RELIABILITY**: Introduction, Reliability and Quality, Failures and Failure Modes, Causes of Failures and Un reliability, maintainability and Availability, History of Reliability, Reliability literature. **TOTAL QUALITY MANAGEMENT**: Objectives of TQM, Management in TQM, Implementation of TQM. I.S.O 9000 Series. Introduction Characteristics, Area covered in ISO 9000

## 18ME51I2-ADVANCED MECHANISMS

**L-T-P: 3-0-0** **Credits: 3** **Pre-requisite: NIL**

**Mapping of CO-PO table:**

| CO# | Course outcome | PO/PSO | BTL |
|---|---|---|---|
| CO1 | Develop the concepts of different types of mechanism with the mobility and motion parameters along with their Application in kinematic analysis | P02 | 4 |
| CO2 | Analyze the coupler motion of links by analytical and graphical method. | P03,P04 | 4 |
| CO3 | Apply different method to evaluate the path generation of four bar Mechanism. | P03,P04 | 3 |
| CO4 | Analyze the Kinematic mechanism using ADAMs and different application of R0B0T by D-H notation by contrast with forward and inverse kinematics | P03 | 4 |

**Syllabus: Introduction:** Elements of Mechanisms; Mobility Criterion for Planar mechanisms and manipulators; Mobility Criterion for spatial mechanisms and manipulators. Spherical mechanisms-spherical trigonometry.
**Advanced Kinematics of plane motion- I:** The Inflection circle ; Euler – Savary Equation; analytical and graphical determination of di ; Bobillier's Construction; collineastion axis ; Hartmann's Construction ;Inflection circle for the relative motion of two moving planes; Application of the Inflection circle to kinematic analysis**Advanced Kinematics of plane motion - II:** Polode curvature; Hall's Equation; Polode curvature in the four bar mechanism; coupler motion; relative motion of the output and input links; Determination of the output angular acceleration and its Rate of change; Freudenstein's collineation –axis theorem; Carter – Hall circle; The circling – point curve for the Coupler of of a four bar mechanism. **Introduction to Synthesis-Graphical Methods - I:** The Four bar linkage; Guiding a body through Two distinct positions; Guiding a body through Three distinct positions; TheRotocenter triangle; Guiding a body through Four distinct positions; Burmester's curve. **Introduction to Synthesis-Graphical Methods - II:** Function generation- Generaldiscussion; Function generation: Relative– Rotocenter method, Overlay's method, Function generation- Velocity – pole method; Path generation: Hrones's and Nelson's motion Atlas, Roberts's theorem. **Introduction to Synthesis - Analytical Methods:** Function Generation: Freudenstien's equation, Precision point approximation, Precision – derivative approximation; Path Generation: Synthesis of Fourbar Mechanisms for specified instantaneous condition; Method of components; Synthesis of Four-bar Mechanisms for prescribed extreme values of the angular velocity of driven link; Method of components. **Manipulator kinematics – I:** D-H

notation, D-H convention of assignment of co-ordinate frames and link parameters table; D-H transformation matrix; Direct and Inverse kinematic analysis of Serial manipulators: Articulated ,spherical & industrial robot manipulators- PUMA, SCARA,STANFORD ARM, MICROBOT. **Manipulator kinematics – II:** Differential kinematics Formulation of Jacobian for planarserial manipulators and spherical manipulator; Singularity analysis.

**Text Books:**


1. Jeremy Hirschhorn, Kinematics and Dynamics of plane mechanisms,McGraw-Hill,1962.
2. L.Sciavicco and B.Siciliano, Modelling and control of Robot manipulators,Secondedition, Springer - Verlag,London,2000.
3. Amitabh Ghosh and Ashok Kumar Mallik, Theory of Mechanisms and Machines.E.W.P.Publishers.


**Reference Books:**


1. Allen S.Hall Jr., Kinematics and Linkage Design, PHI,1964.
2. J.E Shigley and J.J . Uicker Jr., Theory of Machines and Mechanisms , McGraw-Hill,1995.
3. Mohsen Shahinpoor, A Robot Engineering Text book,Harper & Row Publishers, NewYork,1987.
4.


## 18ME51I3-CONCURRENT ENGINEERING

**L-T-P: 3-0-0** **Credits: 3** **Pre-requisite: NIL**

### Mapping of CO-PO table:

| CO# | Course outcome | PO/PSO | BTL |
|---|---|---|---|
| CO1 | Understand the benefits of Concurrent Engineering and solve the relevant problems. | PO3 | 3 |
| CO2 | Understand the concurrent engineering organization and its Philosophies. | PO3 | 2 |
| CO3 | Understand the System engineering and its Complexity | PO3 | 2 |
| CO4 | Understand the Conventional Design and Development Process. | PO3 | 2 |

**Syllabus: Concurrent Engineering Definitions:**Introduction. Basic Principles of CE. Components of CE. Concurrency and Simultaneity. Modes of Concurrency. Modes of Cooperation. Benefits of Concurrent Engineering. References. Test Problems: CE Definitions. **Cooperative Work Teams:**Introduction. Cooperative Concurrent Teams. Program Organization. Supplier Rationalization. Types of CE Organization. Management Styles or Philosophies. Workplace Organization and Visual Control. Employee Excellence Development (New Technologiesand Team Capabilities). References. Test Problems: Cooperative Work Teams. **System Engineering:** Introduction. An Automobile Manufacturing Process. System Engineering. Systems Thinking. Approaches to System Complexity. Sharing and Collaboration in CE 300. System Integration. Management and Reporting Structure. Agile Virtual Company. References. Test Problems: System Engineering. **Information Modeling- Introduction:** Information Modeling. Modeling Methodology. Foundation of Information Modeling. Concurrent Engineering Process Invariant. Enterprise Model-Class. Specification Model-Class. Product Model-Class. Process Model- Class. Cognitive Models. Merits and Demerits. Summary. References. Test Problems: Information Modeling. **The Whole System:** Introduction. Conventional Design and Development Process. A Transformation Model for a Manufacturing System. CE Enterprise System Taxonomy. Integrated Product and Process Development. Transformation System for Product Realization. Key Dimensions of a CE Specification Set. Artifact's Intent Definitions. References. Test Problems: The Whole System.

**REFERENCES:**


**1.** Biren Prasad – "Concurrent Engineering Fundamentals: Integrated Product andProcess Organization" Volume I - Prentice Hall, 1996.


## 18ME51J1-DESIGN OF PRESSURE VESSELS AND PLATES

**L-T-P: 3-0-0** **Credits: 3** **Pre-requisite: NIL**

### Mapping of CO-PO table:

| CO# | Course outcome | PO/PSO | BTL |
|---|---|---|---|

| | | | |
|---|---|---|---|
| CO1 | Analyze stresses in cylindrical shells and its components | P01 | 4 |
| CO2 | Design pressure vessel under various pressure loads | P01,P03 | 4 |
| CO3 | Formulate basic equations for bending of plate | P01,P05 | 4 |
| CO4 | Analyze bending of circular plate | P01,P03 | 4 |

**Syllabus: INTRODUCTION**: Methods for determining stresses – Terminology and Ligament Efficiency – Applications. **STRESSES IN PRESSURE VESSELS:** Introduction – Stresses in a circular ring, cylinder – Membrane stress Analysis of Vessel Shell components – Cylindrical shells, spherical Heads, conical heads – Thermal Stresses – Discontinuity stresses in pressure vessels. **DESIGN OF VESSELS:**Design of Tall cylindrical self supporting process columns – supports for short vertical vessels – stress concentration – at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement – pressure vessel Design. **BASIC EQUATIONS OF THIN PLATE THEORY**: Introduction-assumptions-slopes and curvatures of bent plate-strain curvature relations-moment curvature relations-equilibrium equations-rectangular plate, circular plate-boundary conditions-rectangular plate, circular plate-summery of basic equations-basic equations in Cartesian coordinate system-basic equations in polar co-ordinate system**. Bending of plates:** Introduction-pure bending and cylindrical bending of rectangular plates-navier solution for anall-round simply supported rectangular plate-levy solution for rectangular plates- Method of superposition for the analysis of rectangular plates with arbitrary boundary conditions. **BENDING OF CIRCULAR PLATES:** Circular plates subjected to an arbitrary load- Symmetric bending of circular plates, circular plate subjected to asymmetric load.

**TEXT BOOKS**


1. John F. Harvey, Theory and Design of Pressure Vessels, CBS Publishers andDistributors, 1987.
2. K Chandrashekara, "Theory of plates", University Press, 2001


**REFERENCES**


1. Henry H. Bedner, "Pressure Vessels, Design Hand Book, CBS publishers andDistributors, 1987.
2. Stanley, M. Wales, "Chemical process equipment, selection and Design. Butterworthseries in Chemical Engineering, 1988.
3. William. J., Bees, "Approximate Methods in the Design and Analysis of PressureVessels and Piping", Pre ASME Pressure Vessels and Piping Conference, 1997.
4. Timoshenko S.P. and Goodier J.N, "Theory of elasticity" McGraw-Hill Publishers
5. Timoshenko S, " Theory Of Plates And Shells" McGraw-Hill Publishers.


## 18ME51J2-TRIBOLOGICAL SYSTEM DESIGN

**L-T-P: 3-0-0** **Credits: 3** **Pre-requisite: NIL**

**Mapping of CO-PO table:**

| CO# | Course outcome | PO/PSO | BTL |
|---|---|---|---|
| CO1 | Understand the surface wear and its treatment. | PO3 | 2 |
| CO2 | Analyze the lubricant flow and delivery in different bearings. | PO3 | 4 |
| CO3 | Understand the rolling bearings and its failure criterion. | PO3 | 2 |
| CO4 | Understand the tools to measure the bearing performance. | PO3 | 2 |

**Syllabus: SURFACES, FRICTION AND WEAR**: Topography of Surfaces – Surface features – Surface interaction – Theory of Friction – Sliding and Rolling Friction, Friction properties of metallic and non-metallic materials – friction in extreme conditions – wear, types of wear – mechanism of wear – wear resistance materials – surface treatment – Surface modifications – surface coatings. **LUBRICATION THEORY**: Lubricants and their physical properties lubricants standards – Lubrication Regimes Hydrodynamic lubrication – Reynolds Equation, Thermal, inertia and turbulent effects – Elasto hydrodynamic and plasto hydrodynamic and magneto hydrodynamic lubrication – Hydro static lubrication – Gas lubrication. **DESIGN OF FLUID FILM BEARINGS**: Design and performance analysis of thrust and journal bearings – Full, partial, fixed and pivoted journal bearings design – lubricant flow and delivery – power loss, Heat and temperature rotating loads and dynamic loads in journal bearings – special bearings – Hydrostatic Bearing design. **ROLLING ELEMENT BEARINGS**: Geometry and kinematics – Materials and manufacturing processes – contact stresses –Hertzian stress equation – Load divisions – Stresses and deflection – Axial loads androtational effects, Bearing life capacity and variable loads – ISO standards – Oil films and their effects – Rolling Bearings Failures. **TRIBO MEASUREMENT INSTRUMENTATION**: Surface Topography measurements – Electron microscope and friction and wear measurements – Laser method – instrumentation - International standards – bearings performance measurements – bearing vibration measurement.

**REFERENCES:**


1. Cameron, A. "Basic Lubrication Theory", Ellis Herward Ltd., OK, 1981
2. Hulling, J. (Editor) – "Principles of Tribology ", Macmillian – 1984.
3. Williams J.A. " Engineering Tribology", Oxford Univ. Press, 1994.
4. Neale, M.J. "Tribology Hand Book", Butterworth Heinemann, 1995.


## 18ME51J3-PRODUCT DESIGN & DEVELOPMENT

**L-T-P: 3-0-0** **Credits: 3** **Pre-requisite: NIL**

**Mapping of CO-PO table:**

| CO# | Course outcome | PO/PSO | BTL |
|---|---|---|---|
| CO1 | Understand the Product lifecycle management. | PO3 | 2 |
| CO2 | Understand the product design and development. | PO3 | 2 |
| CO3 | Understand the customer needs to establish the engineering specifications. | PO3 | 2 |
| CO4 | Understand and apply the rapid prototyping technique. | PO3 | 3 |

**Syllabus: COLLABORATIVE PRODUCT DESIGN**: Productlifecycle management-concepts,benefits, value addition to customer. Lifecycle models-creation of projects and roles, usersand project management, system administration, access control and its use in life cycle.Product development process and functions. Data transfer. Variants of e-commerce. Multisystem information sharing. Workgroup collaboration. Development of standardclassification for components and suppliers. Model assembly process-link product andoperational information. Customization factors-creation of business objects, user interfaces, search facile ties as designed by the enterprise. Software-PDM/PLM and their comparison. **PRODUCT DEVELOPMENT**: Quality function deployment-quality project approach and the problem solving process. Design creativity-innovations in design alternatives. Concurrent engineering, industrial design principles. Product development versus design, types of designand redesign, modern production development process, reverse engineering and redesign product development process, examples of product development process, scoping product development – S-curve, new product development. **UNDERSTANDING CUSTOMER NEEDS**: Gathering customer needs, organizing and prioritizing customer needs, establishing product function, FAST method, establishing system functionality. **PRODUCT TEAR DOWN AND EXPERIMENTATION**: Tear down method, post teardown report, benchmarking and establishing engineering specifications, product portfolios. GENERATING CONCEPTS: Information gathering, brain ball, C-sketch/6-3-5 method, morphological analysis, concept selection, technical feasibility, ranking, measurement theory,DFMA, design for robustness. PHYSICAL PROTOTYPES: Types of prototypes, use of prototypes, rapid prototyping technique scale, dimensional analysis and similitude, physical model and experimentation- design of experiments, statistical analysis of experiments.

**REFERENCE BOOKS:**


1. John W Gosnay and Christine M Mears, Business Intelligence with Cold Fusion ,Prentice Hall India, New Delhi, 2000.
2. David S Linthicum, "B2B Application Integration", Addison Wesley, Boston, 2001.
3. Alexis Leon,Enterprise Resource Planning, Tata McGraw Hill, New Delhi, 2002.
4. David Ferry and Larry Whipple,Building and Intelligent e-business, PrimaPublishing, EEE

Edition, California, 2000.
5. David Bedworth, Mark Hederson and Phillip Wolfe, Computer Integrated Design andManufacturing, McGraw Hill Inc., New York, 1991.
6. Kevin Otto and Kristin Wood, Product Design – Techniques in Reverse Engineeringand New Product Development, Pearson Education, New Delhi.
7. Karl T Ulrich and Stephen D Eppinger, Product Design and Development, McGrawHill, New York, 1994.

## 18ME52K1-MECHANICS OF COMPOSITE MATERIALS

**L-T-P: 3-0-0** **Credits: 3** **Pre-requisite: NIL**

**Mapping of CO-PO table:**

| CO# | Course outcome | PO/PSO | BTL |
|---|---|---|---|
| CO1 | Understand the micromechanics of Composites. | PO3 | 2 |
| CO2 | Understand the mechanical properties of composites and its characterization. | PO3 | 2 |
| CO3 | Understand the Macro-mechanics of Composite lamina. | PO3 | 2 |
| CO4 | Understand the strength of Unidirectional lamina and apply the failure theories to determine the strength of composite lamina. | PO3 | 3 |

**Syllabus: Basic concepts and characteristics:** Geometric and Physical definitions, natural and man- made composites, Aerospace and structural applications, types and classification of composites, **Reinforcements:** Fibres- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites. **Micromechanics:** Unidirectional composites, constituent materials and properties, elastic properties of a lamina, properties of typical composite materials, laminate characteristics and configurations. **Characterization and Testing of Composite Materials** Characterization of Constituent Materials, Physical Characterization of composite materials, Determination of Tensile, Compressive and shear properties of Uni-dimensional lamina, InterLamina Fracture Toughness, Bi-Axial Testing, Characterization of Composites with Stress Concentration, Structural Testing. **Elastic Behavior of Composite Lamina- Macro mechanics:** Stress Strain Relations, Relations between Mathematical and Engineering constants, Stress- strain Relations for a thin Lamina (Two-Dimensional), Transformation of Stress and Strain (Two-Dimensional), Transformation of Elastic Parameters (Two-Dimensional), Transformations of stress-strain Relations in Terms of Engineering Constants (Two- Dimensional), **Strength of Uni Directional Lamina.** Introduction, Longitudinal tension- Failure Mechanisms and strength, Longitudinal Compression, Transverse Tension and compression, In-plane shear, Out-of-plane Loading, **Strength of Composite Lamina** Failure Theories, Maximum Stress theory, Max Strain theory, Tsai-Hill, Tsai-Wu, Hashin-Rotem Failure theories, Evaluation and Applicability of Lamina Failure Theories.

**Text Books:**

1. Isaac M Daniel and Ishai, “Engineering Mechanics of Composite Materials”, OxfordUniversity Press, 1994.
2. B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites,WileyInter-science, New York, 1980.

**Reference Books:**

1. R. M. Jones, Mechanics of Composite Materials, Mc Graw Hill Company, New York,1975.
2. L. R. Calcote, Analysis of Laminated Composite Structures, Van Nostrand Rainfold,New York, 1969.

## 18ME52K2-MACHINE TOOL DESIGN

**L-T-P: 3-0-0** **Credits: 3** **Pre-requisite: NIL**

**Mapping of CO-PO table:**

| CO# | Course outcome | PO/PSO | BTL |
|---|---|---|---|

| | | | |
|---|---|---|---|
| CO1 | Understand the design of machine tools and its manufacturing. | PO3 | 2 |
| CO2 | Design the machine tool structures and speed & feed rate regulation. | PO3 | 5 |
| CO3 | Design the machine tools beds and guide ways. | PO3 | 5 |
| CO4 | Understand numerical control of machine tools. | PO3 | 2 |

**Syllabus: FUNDAMENTALS OF MACHINE TOOL DESIGN**: Introduction, working motions in machine tools, machine tool drives: electric motor, transmission arrangement, Hydraulic transmission of elements: pumps, hydraulic cylinders, throttles. General requirements of machine tool design: Productivity, accuracy, simplicity of design, safety, low cost of manufacturing, engineering process applied to machine tools. **DESIGN OF SPEED & FEED RATES:** Aim of speed & feed rate regulation; various laws of stepped regulation of speed-Design of speed box, Design of feed box, classification of speed & feed boxes. Step less regulation of speed & feed rates for hydraulics. **DESIGN OF MACHINE TOOL STRUCTURES:** Functions of machine tool structures & their requirements, Design criteria for machine tool structures, Basic design procedure of machine tool structures. **DESIGN OF BEDS, TABLES, COLUMNS:** Various types of beds used in machine tools- their construction & design feature; Determination of forces acting on horizontal table,Column design of milling machine & maximum deflection error in milling machine. **DESIGN OF GUIDE WAYS & HOUSINGS:** Functions & types of guide ways, Design of guide way- shapes, materials. Design of guide ways for wear resistance, stiffness. Design of housings- solid. **DESIGN OF POWER SCREWS OF MACHINE TOOLS:** Types & classifications, Design of sliding friction power screws, Design of rolling friction power screws. **DESIGN OF SPINDLE UNITS IN MACHINE TOOLS:** Functions, requirements, materials for spindles, Design calculations of spindles: deflection of spindle axis due to bending, due to compliance of spindle supports. **NUMERICAL CONTROL OF MACHINE TOOLS:** Fundamentals, classification &structure of NC systems, Program readers, Decoder, Buffer storage, comparators. Extension of numerical control systems: Introduction to DNC, CNC, Machining centers.

**Text Books:**

1. NK Mehta," Machine Tool Design and Numerical Control', second Edition, TataMcGraw Hill book Company, (1997)
2. Gopal Chandra sen & Amitabha Bhattacharya,"Principles of Machine Tools", NewCentral Book agency, Calcutta,(1998)


**Reference Books :**

1. SK Basu, DK Pal," Design of Machine Tools", Oxford & IBH Publication Co PvtLtd, New Delhi (1995)
2. CMTI "Machine Tool design Course , Vol 4,5 & 6, Central Machine Tool Institute,Bangalore. (1997)


**18ME52K3-FRACTURE MECHANICS**

**L-T-P: 3-0-0** **Credits: 3** **Pre-requisite: NIL**

**Mapping of CO-PO table:**

| CO# | Course outcome | PO/PSO | BTL |
|---|---|---|---|
| CO1 | Understand Crack growth and fracture mechanics | P02 | 4 |
| CO2 | Development of stress field equations in fracture mechanics | P01 | 4 |
| CO3 | Know the various methods for evaluating stress intensity factors | P01 | 4 |
| CO4 | Understand how to perform fracture toughness testing and crack growth phenomenon | P02 | 4 |

**Syllabus: ELEMENTS OF SOLID MECHANICS**: The geometry of stress and strain, elastic deformation, plastic and elasto-plastic deformation -limit analysis. **STATIONARY CRACK UNDER STATIC LOADING**: Two dimensional elastic fields – Analytical solutions yielding near a crack front – Irwin's approximation - plastic zone size – Dugdale model – J integral and its relation to crack opening displacement. **ENERGY BALANCE AND CRACK GROWTH**: Griffith analysis – Linear Fracture Mechanics-Crack Opening displacement – Dynamic energy balance – crack arrest. **FATIGUE CRACK**

**GROWTH CURVE**: Empirical Relation describing crack growth by fatigue – Life calculations for a given load amplitude – effects of changing the load spectrum – Effects of Environment. **ELEMENTS OF APPLIED FRACTURE MECHANICS**: Examples of crack-growth Analysis for cyclic loading - leak before break – crack Initiation under large scale yielding – Thickness as a Design parameter – crack instability in Thermal or Residual – stress fields.

**REFERENCES:**


1. David Broek, "Elementary Engineering Fracture Mechanics", Fifthoff andNoerdhoff International Publisher, 1978.
2. Kare Hellan, "Introduction of Fracture Mechanics", McGraw-Hill BookCompany, 1985.
3. Preshant Kumar, "Elements of Fracture Mechanics", Wheeler Publishing, 1999.


## 18ME52L1-ENGINEERING NOISE AND CONTROL

**L-T-P: 3-0-0** **Credits: 3** **Pre-requisite: NIL**

**Mapping of CO-PO table:**

| CO# | Course outcome | PO/PSO | BTL |
|---|---|---|---|
| CO1 | Understand the Noise-Control Strategies. | PO3 | 2 |
| CO2 | Understand and apply the instruments for noise measurement and analysis. | PO3 | 2 |
| CO3 | Understand the harmful effects of Noise. | PO3 | 2 |
| CO4 | Understand and estimate the Noise of Noise associated devices and their control. | PO3 | 3 |

**Syllabus: FUNDAMENTALS AND BASIC TERMINOLOGY**: Introduction, Noise-Control Strategies, Acoustic Field Variables and the Wave Equation, Plane and Spherical Waves, Mean Square Quantities, Energy Density, Sound Intensity, Sound Power, Units, Spectra, Combining Sound Pressures, Impedance, Flow Resistance. **INSTRUMENTATION FOR NOISE MEASUREMENT AND ANALYSIS**: Microphones, Weighting Networks, Sound Level Meters, Grades of Sound Level Meter, Sound Level Meter Calibration, Noise Measurements Using Sound Level Meters, Time- Varying Sound, Noise Level Measurement, Statistical Analyzers, Noise Dosimeters, Tape Recording of Noise, Spectrum Analysers, Intensity Meters, Energy Density Sensors. **CRITERIA**:Introduction, Hearing Loss, Hearing Damage Risk, Hearing Damage Risk Criteria, Implementing a Hearing Conservation Program, Speech Interference Criteria, Psychological Effects of Noise, Ambient Noise Level Specification, Environmental Noise Level Criteria, Environmental Noise Surveys. **SOUND POWER AND SOUND PRESSURE LEVEL ESTIMATION PROCEDURES**: Introduction, Fan Noise, Air Compressors, Compressors for Refrigeration Units, Cooling Towers, Pumps, Jets, Control Valves, Pipe Flow, Boilers, Turbines, Diesel and Gas-Driven Engines, Furnace Noise, Electric Motors, Generators, Transformers, Gears, Transportation Noise. **ACTIVE NOISE CONTROL**: Introduction, Active Control of Sound Propagation in Ducts, Active Control of Sound Radiation From Vibrating Structures, Sound Transmission into Enclosed Spaces, ActiveVibration Isolation, Electronic Controller Design

**Text books:**


1. David A. Bies and Colin H. Hansen; "Engineering noise control: theory and practice"


## 18ME52L2-ENGINEERING FAILURE ANALYSIS AND PREVENTION

**L-T-P: 3-0-0** **Credits: 3** **Pre-requisite: NIL**

**Mapping of CO-PO table:**

| CO# | Course outcome | PO/PSO | BTL |
|---|---|---|---|
| CO1 | Familiarising with Failure causes and Analysis. | P02 | 2 |
| CO2 | Understanding Different types of failures. | P02 | 2 |

| | | | |
|---|---|---|---|
| CO3 | Exploring Failure problems during processing | P02 | 2 |
| CO4 | Reviewing Case studies. | P02 | 2 |

**Syllabus:** Common causes of failure. Principles of failure analysis. Fracture mechanics approach to failure problems. Techniques of failure analysis. Service failure mechanisms ductile and brittle fracture, fatigue fracture, wear failures, frettingfailures, environment induced failures, high temp. failure. Faulty heat treatment and design failures, processing failures (forging, casting, machiningetc.), failure problems in joints and weldments. Case studies for ferrous and non-ferrous metallic parts and parts made from polymers andceramic.

**Text Books:**

1. Metals Hand Book, Vol.10, "Failure Analysis and Prevention ", (10th Edition), 1994.
2. Failure Analysis of Engineering Structures: Methodology and Case Histories- V.Ramachandran
3. Practical Engineering Failure Analysis by Hani M. Tawancy, Anwar Ul-Hamid,Nureddin M. Abbas.

## 18ME52L3-DESIGN FOR MANUFACTURING, ASSEMBLY AND ENVIRONMENT

**L-T-P: 3-0-0** **Credits: 3** **Pre-requisite: NIL**

**Mapping of CO-PO table:**

| CO# | Course outcome | PO/PSO | BTL |
|---|---|---|---|
| CO1 | Understand the manufacturability and form design. | PO3 | 2 |
| CO2 | Design and assemble machined components. | PO3 | 5 |
| CO3 | Identify uneconomical design and redesign the cast components. | PO3 | 5 |
| CO4 | Understand different methods for design for the environment. | PO3 | 2 |

**Syllabus INTRODUCTION:** General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric tolerances - Assembly limits -Datum features - Tolerance stacks. **FACTORS INFLUENCING FORM DESIGN:** Working principle, Material, Manufacture, Design- Possible solutions - Materials choice - Influence of materials on form design - form design of welded members, forgings andcastings. **COMPONENT DESIGN - MACHINING CONSIDERATION**: Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation -simplification by amalgamation - Design for machinability - Design for economy - Designfor clamp ability - Design for accessibility - Design for assembly. **COMPONENT DESIGN - CASTING CONSIDERATION:** Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - Modifying the design - group technology - ComputerApplications for **DFMA DESIGN FOR THE ENVIRONMENT**: Introduction – Environmental objectives – Global issues – Regional and local issues – Basic DFE methods – Design guide lines – Example application – Lifecycle assessment – Basic method – AT&T's environmentally responsible product assessment - Weighted sum assessment method – Lifecycle assessment method – Techniques to reduce environmental impact – Design to minimize material usage – Design for disassembly – Design for recyclability – Design for remanufacture – Design for energy efficiency – Design to regulations and standards.

**REFERENCE BOOKS:**

1. Boothroyd, G, 1980 Design for Assembly Automation and Product Design. NewYork, Marcel Dekker.
2. Bralla, Design for Manufacture handbook, McGraw hill, 1999.
3. Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel Dekker,1994.
4. Dickson, John. R, and Corroda Poly, Engineering Design and Design for Manufactureand Structural Approach, Field Stone Publisher, USA, 1995.
5. Fixel, J. Design for the Environment McGraw hill., 1996.
6. Graedel T. Allen By. B, Design for the Environment Angle Wood Cliff, Prentice Hall.Reason Pub., 1996. Kevien Otto and Kristin Wood, Product Design. Pearson Publication, 200