

Curriculum Structure of ME -Industrial Design

1st Semester

S. No.	Course Code	Course Name	L	T	P	Credits
1	ID 501	Creative Engineering Design	4	0	0	4
2.	MA 503	Advanced Mathematics	4	0	0	4
3.	ID 502	Product Form and Aesthetics	4	0	0	4
4		Elective I	4	0	0	4
5	ID 503	Product in Usage and Beyond (Seminar)	-	-	-	2

2nd Semester

S. No.	Course Code	Course Name	L	T	P	Credits
1	ID504	Product Design and Development	4	0	0	4
2.	MA 505	Design of Experiments and Research Methodology	4	0	0	4
3.	ID 505	Applied Ergonomics	4	0	0	4
4		Elective II	4	0	0	4
5	ID 506	Invited faculty seminar	-	-	-	2

3rd Semester

S. No.	Course Code	Course Name	L	T	P	Credits
1	ID 698	Thesis	-	-	-	16

4th Semester

S. No.	Course Code	Course Name	L	T	P	Credits
1	ID 699	Thesis	-	-	-	16

Electives

S. No	Course Code	Course Name
1	ID 511	Material Manufacturing and Design
2	ID512	CAE in Product Design
3	ID 513	Mechatronics System Design
4	ID 514	Design Management
5	ID 515	Quality and Reliability Engineering
6	ID 516	Modeling and Simulation
7	ID 517	Value Engineering
8	ID 518	Design and Manufacture of Mechanical Assemblies
9	ID 519	Mechanism Design
10	ID 520	Advanced Manufacturing Processes

Course Name : **CREATIVE ENGINEERING DESIGN**
Course Code : **ID 501**
Credits : **4**
L T P : **4 0 0**

Lecture wise breakup **No. of Lectures**

Creative Product & System Design **(6)**

Creative design, Innovation versus invention, Globalisation, Team work, Project scheduling and management.

Creative Mind **(4)**

Whole Brain thinking, Creativity, What makes an individual creative?

Reclaiming Creativity **(6)**

Mental Barriers, Types of mental Barriers, False assumptions and nonexistent limitations, Associating thinking, misunderstandings, inability to communicate properly, emotions, culture and environment related barriers, improper method of solution

Creative Problems solving Techniques **(7)**

Brain storming, 6-3-5 method, Morphological attitude list, list of alternative actions, analogy (Case based reasoning) method, random attributes, Scamper method

Imagination, vsualisation, graphical representation and communication **(8)**

Imagination, drawings, engineering drawings, realistic drawings, Perspectives and location of objects, determining depth in perspective: scale factors, drawing perspective, sketching, put-in-the-box scheme

Design Consideration and Decisions **(8)**

Cost, size, weight, material selection, method of fabrication, Physical and structural standards, Function standards and expectations, performance, efficiency, reliability, Company image and mission, quality, service ability, Styling shape, aesthetics and packaging, Safety, human factors, Environmental effects, Disposability, sustainability, Assembly-Disassembly, life expectancy, ethical issue, Patent and other intellectual property rights, Legal matters.

ECONOMICS OF DESIGN **(8)**

Value of a Product or System, Global Economics Models ,Costs, Revenues and Profits, Cost Breakdown of Products and Systems, Product Life Span, Engineering Economy,

DESIGN AND PRODUCT LIABILITY **(8)**

Product Liability History and Background, Major Administrative Law Related to Product Liability, Basic Theories of Product Liability Law, reducing Product Liability Risk, Failure Mode and Effect Analysis (FMEA), Code of Ethics for Engineers, Standards and Codes,

Books:

1 Saeed Benjamin Niku, Creative Design Of Products And Systems

Course Name : **ADVANCED MATHEMATICS
(Optimization Techniques)**
Course Code : **MA 503**
Credits : **4**
L T P : **4 0 0**

Lecture wise breakup	No. of Lectures
Linear programming problem, Simplex method	(5)
Artificial variables and dual phase method	(4)
Non-linear programming problems, unconstrained extremal problems, Necessary and sufficient conditions for extrema, Fibonacci and Golden search methods	(6)
Gradient methods	(6)
Direct search methods	(4)
Constrained extremal problems, Equality constraints, Jacobian and Lagrangean methods	(4)
Inequality constraints, extension of Lagrangean method, the Kuhn -Tucker conditions	(5)
Direct search methods	(3)
Separable, Quadratic, Geometric programming and Linear combination method	(8)

Book:

Operations Research, Taha, 7th ed, 2002, Prentice Hall.

REFERENCES:

1. Phillips and Solberg, Operations Research, Ravindran, 2nd edition 2000, John Wiley & Sons.
2. Chapra and Canale, Numerical Methods for Engineers, 4th edition, 2005, Tata Mc Graw Hill.
3. S.S.Rao, Engineering Optimization, 3rd edition, 2000, New Age

Course Name : **PRODUCT FORM AND AESTHETICS**
Course Code : **ID 502**
Credits : **4**
L T P : **4 0 0**

Lecture wise breakup **No. of Lectures**

Elements and Principles of Design

History of design, Design in everyday life, Art, design & Society **(4)**

Elements of design : space, form, line, texture, etc. **(4)**

Principles of Design: Scale, Balance, Proportion, Rhythm, etc **(4)**

Objectives of Design: Truth, Beauty, Order, Efficiency and Economy **(4)**

Theory of colours, Colour symbolism **(4)**

Design Theory and Visual Design

Art movements and design: Principles of style in art, product design, architecture and graphic design **(4)**

Art and perception : Methodology of criticism and appreciation **(4)**

Types of 2D and 3D Visual Media, Visual Grammar, Application in Visual Design **(4)**

Visual Perception and Analysis, Visual Forms & Concepts **(4)**

Design and Development of Form **(4)**

Communication through Visual Modes of Application. **(4)**

Creative Visualization

Studies in form and style, conceptualization, exploration, and development of form and style in both product design and Visual communication. **(4)**

Bases for creative visualization: Fantasy. Metaphors, Cultural connotations and Bionics in the context of form-making. **(4)**

Study of evolution of forms in products : 2D and 3D space analysis Dominant - sub dominant - subordinate relationships **(4)**

Books:

1. Noel Riley, The Elements of design, Mitchell Beazley Publ.
2. Robin Baker, Designing the Future, Thames & Hudson

References:

- 1 John Chris Jones, Design Methods, Van Nostrand Reinhold
- 2 Richard Morris, The Fundamentals of Product Design.

Course Name : **PRODUCT DESIGN AND DEVELOPMENT**
Course Code : **ID 504**
Credits : **4**
L T P : **4 0 0**

Lecture wise breakup **No. of Lectures**

UNDERSTANDING DESIGN **(8)**

Nature of design, Design activities, Design problems, Problems structures, Design ability, What Designers say, How Designers think, Learning to Design, Design process - Descriptive models, Prescriptive models, An integrative model

DESIGN PROCESS **(18)**

Systematic design procedures, Design methods, Creative methods, Rational methods, Identifying opportunities-the user scenarios method, Establishing functions-the function analysis method, Setting requirements-the performance specification method, Determining characteristics-the quality function deployment method, Generating alternatives-the morphological chart method, Evaluating alternatives-the weighted objective method, Improving details-the value Engineering method.

Reclaiming Creativity **(18)**

Mental Barriers, Types of mental Barriers, False assumptions and nonexistent limitations, Associating thinking, misunderstandings, inability to communicate properly, emotions culture and environment related barriers, improper method of solution

COMPUTER AIDED DESIGN **(4)**

Geometric Modeling Approaches, Wireframe Modeling, Surface Modeling, NURBS, Solid Modeling, Features, Parametric and Variational Design, Computer-Aided Engineering Analysis, CAD/CAM Data Exchange, Rapid Prototyping

MANAGING DESIGN **(4)**

Design strategies, Frameworks for action, Strategy control, Setting strategies and choosing tactics

PRODUCT DEVELOPMENT **(8)**

Product Design, Product planning , Product innovation

Books:

1. N. Cross, Engineering Design Methods-Strategies for Product Design, John Wiley & Sons
2. N. Singh, Systems Approach to Computer Integrated Design and Manufacturing, John Wiley & Sons

REFERENCES

1. K. T. Ulrich and S.D. Eppinger, Product Design and Development, TMH
2. Ibrahim Zeid, Mastering CAD/CAM, TMH

Course Name : **DESIGN OF EXPERIMENTS AND RESEARCH METHODOLOGY**
Course Code : **MA 505**
Credits : **4**
L T P : **4 0 0**

Lecture wise breakup	No. of Lectures
Basic principles of design of experiment, Error analysis in experiments.	(10)
Classification of experimental designs, Design and analysis of one factor experiments -Completely randomized and randomized complete block designs, Analysis of variance.	(8)
Estimation of parameters, Residual analysis and model checking, Sample size problem.	(5)
Design with two blocking variables, Latin squares, Analysis of data from a Latin square.	(2)
Experiment with two factors- Introduction, Main effects and interactions, Two-factor analysis of variance, Graphic analysis, Choice of sample size.	(6)
Design of Experiments with the help of orthogonal arrays, Taguchi's Robust parameter design, Analysis, Noise factors, Tolerance on control factors.	(5)
Research Methodology – Nature and objective of research, Research topic, Literature review, Formulation of problem, Research design, Sampling techniques, Data collection, Statistical and sensitive analysis of data, Interpretation of result and report writing.	(10)

Book:

1. Walpole, Myers, Myers and Ye, Probability and Statistics for Engineers and scientists, 7th ed, 2002, Pearson Education.

REFERENCES:

1. Bernard Ostle & Richard N.Mensing, Statistics in Research, 3rd ed, 1975, Oxford & IBH Pub Co.
2. Hines, Montgomery, Goldsman and Borror, Probability and Statistics in Engineering, 4th ed, 2003, John Wiley & Sons.
3. Federer, Experimental Design, Theory & application, 1955, Oxford & IBH pub Co

Course Name : **APPLIED ERGONOMICS**
Course Code : **ID 505**
Credits : **4**
L T P : **4 0 0**

Lecture wise breakup **No. of Lectures**

INTRODUCTION **(5)**

Human Factors and Systems. Human Factors Research Methodologies

INFORMATION INPUT **(15)**

Information Input and Processing, Text, Graphics, Symbols and Code, Visual Display of Dynamic Information, Auditory, Tactual and Olfactory Displays, Speech Communications

HUMAN OUTPUT AND CONTROL **(10)**

Physical Work and Manual Materials Handling Motor Skills, Human Control of systems, Controls and Data Entry devices, Hand tools and devices,

WORKPLACE DESIGN **(8)**

Applied Anthropometry, Work-space design and Seating, Arrangement of Components within a Physical Space, Interpersonal Aspects of Workplace Design

ENVIRONMENTAL CONDITIONS **(8)**

Illumination, Climate, Noise, Motion

HUMAN FACTORS APPLICATIONS **(10)**

Human Error, Accidents and Safety, Human Factors and the Automobile. Human Factors in Systems design

Book:

1. Mark Sanders, Ernest McCormick, Human Factors In Engineering and Design, 7th edition, McGraw-Hill International Editions

Course Name : **MATERIAL MANUFACTURING AND DESIGN**
Course Code : **ID 511**
Credits : **4**
L T P : **4 0 0**

Lecture wise breakup **No. of Lectures**

INTRODUCTION **(7)**

Materials Structure, nucleation & growth, phase diagrams application of phase diagram

ENGINEERING MATERIALS **(8)**

Metals and their properties, ferrous and non-ferrous metals, uses, production, forming and joining of metals.

CERAMICS AND GLASSES **(8)**

Structures of ceramics and glasses, design properties, ceramics uses, production, forming and joining of ceramics.

POLYMERS AND COMPOSITES **(10)**

Structure of polymers and composites, properties, production, forming and joining of polymers, composites types, properties, uses.

MATERIAL SELECTION **(10)**

Sources of information on materials properties, methods, of materials selection.

DESIGN PROCESS **(10)**

Materials in design, design for brittle fracture, design for fatigue failure, design for corrosion resistance, design with plastic.

Book:

1. Ashby M.F., Engineering Materials, Pergamon Press

Reference:

- 1 Dieter, GE, Engineering Design, A materials and processing approach, Mc Graw Hill.

Course Name : CAE IN PRODUCT DESIGN
Course Code : ID 512
Credits : 4
L T P : 4 0 0

Lecture wise breakup **No. of Lectures**
Product development driven by concurrent engineering; role of CAE (Computer-Aided Engineering) in Product design; mathematical abstractions of product for functionality verification (4)

Introduction to FEM (5)
The Finite Element Method, Elements and Nodes, Modeling the problem and Checking Results, Discretization and other Approximations, Responsibility of the user, Elementary Matrix Algebra.

Bars and Beams (5)
Linear Static Analysis: Stiffness Matrix Formulation: Bar Element, Stiffness Matrix Formulation: Beam Element, properties of stiffness matrices – Avoiding Singularity, Mechanical Loads and Stresses, Thermal Loads and Stresses

Plane Problems (7)
Constant Strain Triangle (CST),s Linear Strain Triangle (LST), Bilinear Quadrilateral (Q4), Quadratic Quadrilateral (Q8), Improved Bilinear Quadrilateral (Q6), Elements with “Drilling” dof, Elements of more General Shape, Loads, Stress Calculation.

Isoparametric Elements and Solution Techniques (7)
Node Numbering and Matrix Sparsity, Equation solving, Transformations, Isoparametric Elements Formulation, Gauss Quadrature and Isoparametric Elements, Choice of Quadrature Rule and Instabilities, Stress Calculation and Gauss Points, Nature of Finite Element Solution, Convergence Requirements – Patch Test, Infinite Media and Infinite Elements, Substructures, Symmetry, Constraints.

Modeling, Errors and Accuracy in Linear Analysis (7)
Modeling in General, Structure Behavior and Element Behavior, Element Tests and Element Shapes, Test Cases and Pilot Studies, Material Properties, Loads, Connections, Boundary Conditions, Planning the Analysis, Numerical Error : Sources and Detection, Common Mistakes, Checking the Model, Critique of FE Results, Stress Concentrations – Submodeling, Convergence with Mesh Refinement, Error Measures and Adaptivity.

Solids and Solids of Revolution (7)
Elements of 3D Solids, 3D Application, Axisymmetric Solid Elements, An Axisymmetric Application, Nonaxisymmetric Loads.

Thermal Analysis (7)
Some Basic Equations, Finite Elements in Thermal Analysis, Radiation and Other Nonlinearities, Thermal Transients, Modeling Considerations.

Vibration and Dynamics (6)
Basic equations – Vibration, Mass matrices, Undamped Free Vibration, Damping, Reduction, Modeling Equations.

Books:

1. Cook R D, Finite Element Modeling for stress Analysis, John Wiley and Sons, Inc.

References:

- 1 Rao.S.S. 'Finite Element Methods in Engineering', Pregamon Press,1989.
- 2 Chandrupatla & Belegundu, 'Finite Elements in Engineering', Prentice Hall of India Pvt. Ltd., 1997.
- 3 Reddy .J.N , 'An Introduction to Finite Element Method', McGraw Hill International Editions,1993.

Course Name : MECHATRONICS SYSTEM DESIGN
Course Code : ID 513
Credits : 4
L T P : 4 0 0

Lecture wise breakup **No. of Lectures**

INTRODUCTION **(4)**

Introduction; Integrated design issues in Mechatronics; Mechatronics key elements; Mechatronics Design Process; Approaches in Mechatronics.

MODELING & SIMULATION OF PHYSICAL SYSTEM **(10)**

Simulation in Block Diagrams; Analogies and impedance Diagrams; Electrical System; Mechanical Systems; Electromechanical coupling, Fluid System.

SENSORS AND TRANSDUCERS **(10)**

Sensors for motion and position measurement; Force, Torque and tactile sensors: flow sensors; temperature sensing devices; Ultrasonic Sensors; Rain Sensors: Active Vibration Control using magnetostrictive Transducers; Fiber optic devices in Mechatronics.

ACTUATING DEVICES **(8)**

DC Motors; PM Stepper Motors; Fluid Power Actuation; Fluid Power Design Elements; Piezoelectric Actuators.

HARDWARE COMPONENTS FOR MECHATRONICS **(8)**

Binary Logic; Karnaugh Map minimisation : Transducer Signal Conditioning and devices for data conversion: Programmable controller.

SIGNAL SYSTEMS AND CONTROLS SYSTEMS & CONTROLS **(10)**

System representation; Linearization of Non-Linear Systems; Measures of System Performance, Root Locus; Bode Plots.

REAL TIME INTERFACING **(6)**

Elements of Data Acquisition & Control System; Overview of the I/O Process

Book:

1. D.Shetty R. Kolk, Mechatronics System Design,PWS Publishing Co.

REFERENCES:

1. S.Necsulescu, Mechatronics by Pearson Education Asia.

Course Name : **DESIGN MANAGEMENT**

Course Code : **ID 514**

Credits : **4**

L T P : **4 0 0**

Lecture wise breakup **No. of Lectures**

Design Management (4)

What is Design Management? Why is Design Management Important? The Design Management Timeline, Managing the Design Strategy

Understanding Design (7)

Identifying Opportunities for Design, Understanding the Audience and Market, Interpreting Client and Customer Needs, Auditing the Use of Design

Design Strategies (8)

Establishing the Design Strategy, Promoting and Selling the Design Strategy, Planning for Long-term Growth, Practice, Case Studies

Managing Client Relations (8)

Key Skills, Managing Client Relations, Guiding Design Decisions, Developing Good Working Relationships, Verbal Communication, Managing the Design Process

Business Strategies (10)

Giving Form to Business Strategy, Increasing Awareness with Design, Expressing the Brand Through Design, Initiating Design Projects, Design Methods, Design Processes, Competitive Advantage Through Design, Practice, Case Studies

Managing Designing Teams (10)

Key Skills, Managing Creative Teams, Facilitating the Design Process, Developing Collaborative Cultures, Visual Communication, Managing the Design Implementation

The Project Management Process (10)

The Project Management Process, Project Management in Practice, Social and Environmental Responsibilities, Design Policies, Procedures and Guidelines, Translating Global Design into Local Design, Measuring the Success of Design, Reviewing and Revising the Design Strategy, Case Studies

Book:

1. Kathryn Best: 2007, Design Management: Managing Design Strategy, Process and Implementation, AVA publishing

Course Name : **QUALITY AND RELIABILITY ENGINEERING**
Course Code : **ID 515**
Credits : **4**
L T P : **4 0 0**

Lecture wise breakup **No. of Lectures**

Quality Engineering

Introduction, Quality basics and history , Quality improvement , Quality Improvement Techniques; Pareto Diagrams, Cause-Effect Diagrams, Scatter Diagrams, Run Charts, Cause and Effect Diagrams. **(6)**

Modern Quality Philosophies, Statistics Fundamentals for Quality Engineering, Introduction to Control charts: X bar, R and S Control Charts, Attribute Control Charts **(6)**

Process Capability Studies, Six sigma Concept **(4)**

Acceptance Sampling, OC Curve **(3)**

Total Quality Management **(2)**

Deming, Juran, Crosby ,Quality Management . **(3)**

Reliability Engineering

Definition of reliability, types of failures, definition and factors influencing system effectiveness, various parameters of system effectiveness. **(3)**

Definition of probability, laws of probability, conditional probability, Bay's theorem; various distributions; data collection, recovery of data, data analysis Procedures, empirical reliability calculations. **(4)**

Types of system- series, parallel, series parallel, stand by and complex; development of logic diagram, methods of reliability evaluation; cut set and tieset methods, matrix methods event trees and fault trees methods, reliability evaluation using probability distributions, Markov method, frequency and duration method. **(6)**

Methods of reliability improvement, component redundancy, system redundancy, types of redundancies-series, parallel, series – parallel, stand by and hybrid, effect of maintenance. **(4)**

Life testing, requirements, methods, test planning, data reporting system, data reduction and analysis, reliability test standards. **(3)**

Book:

1. Elsayed and Hsiang, Quality Engineering in Production Systems by Taguchi, McGraw Hill Publication

REFERENCES:

1. Norbert Lloyd Emick, Quality Reliability and Process Improvement, Industrial Press Inc.
2. Richard Barrett Clements, Handbook of Statistical Methods in Manufacturing, Prentice Hall Publication.
3. John Bieda, Practical Product Assurance Management, ASQ Quality Press

Course Name : **MODELING AND SIMULATION**
Course Code : **ID 516**
Credits : **4**
L T P : **4 0 0**

Lecture wise breakup **No. of Lectures**

Introduction to modeling **(6)**

Concept of system, continuous and discrete systems, types of models, time and advance mechanisms, components and organizations of a discrete event simulation models, step in simulation study.

Statistical Model in Simulation **(9)**

Discrete, Continuous, Poisson and empirical distributions; Output data analysis for a single system-types of simulation with regard to output analysis, statistical analysis for terminating simulations comparing alternative system configurations, statistical procedures for comparing real world observations with simulation output data, generation of arriving processes.

Verification and Validation of Simulation Models **(5)**

Introduction, Guidelines of determining the level of model details, Verification of simulation computer programs, techniques of increasing model validity and credibility.

Monte Carlo Simulation **(8)**

Introduction to Monte Carlo Simulation, random number generators, and inventory control simulations- Fixed period and Fixed quantity systems, simulation of queuing problems, applications in queuing models and inventory models.

Simulation of Manufacturing and Material Handling systems **(8)**

Introduction, objective of simulation in manufacturing, modeling system randomness, sources of randomness, machine down times, calendar time and busy time approach, models of material handling systems.

Case Studies **(6)**

Use of simulation package problems related to simulation of queuing systems, simulation of material handling and manufacturing systems.

Books:

- 1 Jerry Banks, Discrete event system simulation,

Course Name : VALUE ENGINEERING
Course Code : ID 517
Credits : 4
L T P : 4 0 0

Lecture wise breakup	No. of Lectures
Concepts and Approaches of Value Analysis and Engineering	(4)
Concept of value, Maximum value, normal degree of value, importance of value, value oriented work, use of value resources, value work expands market and jobs, approach to prepare the mind for the value analysis techniques	
Clasification of functions	(4)
Use and aesthetic functions, Identification, clarification and naming functions, quantifying functions, unifying the function and its specifications, Analysis of Aesthetic functions, Classification of functions	
Evaluation of functions	(8)
Evaluation of Function, Evaluation of Functions by Comparison, Case Studies on evaluation of a single function, three functions, interactive Functions, Evaluation of all functions by comparison	
Problem setting system	(4)
Identify Functions, Seperate Functions, Group Functions, Case study on Problem Setting, overlap of problem setting and problem solving .	
Problem Solving Syatem	(7)
The Value Analysis Job Plan: Information step, Analysis step , Creativity step, Judgment step, Development planning step, Case study.	
Setting and solving Management-Decision-type Problems	(6)
Types of Management problems, Setting the precise problem , Case Study -Should a company build manufacturing facilities for an important purchased assembly.	
Using the System	(7)
Three Basic Steps, Example of procedure, Basic Step I: identify the function, Basic Step-II: Evaluate the Function, Basic Step-III: cause value alternatives to be developed, interrelation of Basic Steps, Job Plan steps, and results- accelerating techniques	
Effect on other work in the business	(3)
Accounting, Appearance design, Cost reduction activities, Cost reductions versus value analysis.	
Effective Organisation for value work	(6)
Smallest and smaller business, One man Set Up , Two man Set Up, Three man Set Up, Four or more consultant, structuring the company, Decision Cretiria-Performance and time, Decision Cretiria-Performance , time, and Cost, Understanding the research and development problem.	
Advance Techniques	(7)
Function Analysis System Technique (FAST), How to use FAST Diagram, FAST diagram cost allocation, Case Study, Quantitative evaluation of ideas. FAST for Product services and other processes, Value optimization, Cohesive Theory, Structure Frame Work, Flow charting, Step by Step Techneques. Developing a Template for Life cycle, Cost, Customer, FAST to conduct value study.	

Books

1. Lawrence D. Miles, Techniques of Value Analysis & Engineering, 1990

References

- 1 Jerry Kaoufman, Value Analysis's Tear Down- A New Process for Product Development and innovation, Yashihiko Sato Industrial Press 2004
- 2 Aurther E Mudge, VE- A systematic approach , Part I, Lawvene D Miles Foundation.
- 3 Charles Bytheway, FAST Creativity and Innovation: Rapidly Improving Processes, Product Development and Solving Complex Problems, *J. Ross Publishing*

Course Name : **DESIGN AND MANUFACTURE OF MECHANICAL ASSEMBLIES**
Course Code : **ID 518**
Credits : **4**
L T P : **4 0 0**

Lecture wise breakup **No. of Lectures**

PRODUCT REQUIREMENTS AND TOP-DOWN DESIGN **(4)**

Chain of delivery of quality, Key characteristics, Variation risk management, Examples, Key characteristics conflict, Assembly in the context of product development, Assembling a product, Present status of assembly

MATHEMATICAL AND FEATURE MODELS OF ASSEMBLIES **(10)**

Types of assemblies: Distributive systems, Mechanism and structures, Types of assembly models, Matrix transformations: Nominal location transforms, Variation transforms, Assembly features and feature-based design, Mathematical models of assemblies, Examples of assembly models

CONSTRAINT IN ASSEMBLY **(10)**

Kinematic design, Features as carriers of constraints, Use of screw theory to represent and analyze constraints, Design and analysis of assembly features using screw theory, Constraint analysis

DIMENSIONING AND TOLERANCING PARTS AND ASSEMBLIES **(8)**

Dimensional accuracy in manufacturing, KCs and tolerance flowdown from assemblies to parts, Geometrical dimensioning and tolerance, Statistical and worst-case tolerancing, Modelling and managing variation buildup in assemblies

ASSEMBLY SEQUENCE ANALYSIS **(8)**

Assembly sequence design process, Bourjault method of generating feasible sequences, Cutset method, Checking stability of sub-assemblies

DATUM FLOW CHAIN **(8)**

DFC definition, Mates and contacts, KC conflict and its relation to assembly sequence and KC priorities, Assembly precedence constraints, DFCs, tolerances and constraints, Design procedure for assemblies

CONCURRENT ENGINEERING **(8)**

Sequential versus concurrent engineering, understanding interactions between design and manufacturing, benefits of concurrent engineering, concurrent engineering techniques, design for assembly, design for manufacturing

Books:

1. D.E. Whitney, Mechanical assemblies: Their design, manufacture and role in product development, Oxford University Press

REFERENCES:

1. I Zeid, CAD/CAM Theory and Practice, TMH
2. Nanua Singh, Systems Approach to Computer Integrated Design and Manufacturing, John Wiley & sons

Course Name : **MECHANISM DESIGN**
Course Code : **ID 519**
Credits : **4**
L T P : **4 0 0**

Lecture wise breakup **No. of Lectures**

Introduction **(5)**

Introduction to Kinematics and Mechanisms - motion, mobility, degree of freedom, analysis vs synthesis, etc.

Kinematic Analysis **(12)**

Kinematic analysis of simple mechanism using Relative Velocity and Instant Center Method, Relative Acceleration, Coriolis Acceleration, Mechanisms with Curved Slots, Mechanical Advantage

Static and Dynamic Force Analysis **(12)**

Introduction To Statics and Dynamics Force Analysis of Mechanisms - Inertia Forces in Linkages, Kinetostatic Analysis of Mechanisms, the superposition Method (Graphical & Analytical), the Matrix Method.

Coupler Curves **(8)**

Application of coupler curves for Dwell Mechanisms, Two and Three position rigid body guidance.

Cams Design **(8)**

Cam & Follower, Displacement Diagrams (Graphical and Analytical), Advanced Cam Profile Techniques, Graphical and Analytical Cam profile Synthesis.

Gear and Gear Trains **(12)**

Gear Tooth Nomenclature, Forming of Gear Teeth, Cycloidal and Involute, Contact Ratio, Bevel, Helical, Worm gearing, Analysis of Gear Trains, Planetary Gear Trains (Formula, Tabular, and Instant Center , Methods), Tooth Loads and Power Flow.

Books:

1. George N, Sandor and Arthur, Advanced Mechanism Design, Volumes I & II; Prentice Hall of India Limited, New Delhi.

References:

- 1 Ivan I. Artobolevsky, Mechanism in Modern Engineering Design, Vol I to IV; Mir Publishers, Moscow.
- 2 Hamilton E, Mabie and Fred W. Ocvirk, Mechanisms and Dynamics of Machinery; John Wiley and Sons, New York.

Course Name : **Advanced Manufacturing Processes**

Course Code : **ID 520**

Credits : **4**

L T P : **4 0 0**

Lecture wise breakup **No. of Lectures**

INTRODUCTION (5)

Need for new technology, classification of new technology, historical background of new technology process Definition and application of various processes, comparative analysis of various new technological processes Mechanical processes.

ABRASIVE JET MACHINING AND ABRASIVE FLOW MACHINING (6)

Fundamental Principles, application possibilities, process parameters, schematic lay out of machine and operational characteristics, conclusion

ULTRASONIC MACHINING (6)

Introduction, range and application of possibilities of ultrasonic machining, fundamental principles, processes parameter, purpose of slurry and selection of abrasive, tool design, tool feeding mechanism, transducer megnetostriktion, megnetostriktive material, analysis for metal removal rate, design of horn (velocity transformer), analysis of process parameters, conclusion, exercises

CHEMICAL MACHINING (5)

Introduction, fundamental principle, process parameter, classification and selection of etch ant resistant material, selection of etchant.

ELECTROCHEMICAL MACHINING (ECM) (7)

Background of ECM process ,classification of ECM processes, fundamental principles of ECM, determination of metal removal rate, evaluation of metal removal rate of an alloy, electrochemisty of ECM, dynamics of ECM process, hydrodynamics of ECM process, optimisation analysis of ECM parameters, choice of electrolytes, conclusion, problems. Such as explosive forming, electro–hydraulic forming, Electro-Magnetic forming, high speed hot forging

ELECTROCHEMICAL GRINDING (ECG) (3)

Introduction, fundamental principle, electrochemistry of ECG, basic scheme of the process, classification of ECG, process of parameter ECG, conclusion.

ELECTRICAL DISCHARGE MACHINING (8)

Introduction, mechanism of metal removal, basic EDM circuitry and their principle of operation, analysis of relaxation and RLC type of circuits, evaluation of metal removal rate, evaluation machining accuracy, optimisation analysis of metal removal rate in EDM process, selection of tool materials, choice of dielectric fluid.

LASER BEAM MACHINING (6)

Introduction, background of laser action, production of photon cascade in a solid optical laser, machining application of laser, other application of laser in workshop technology, conclusion.

ELECTRON BEAM MACHINING (5)

Introduction, background of electron beam action, a dimensionless analysis to establish correlation between EBM parameters generation of electron beam, advantage and

limitation.

PLASMA ARC MACHINING (4)

Introduction, plasma, non thermal generation of plasma, metal removal, process parameter, operation data, quality of cut, metallurgical effects, work environment, equipment, other application of plasma jet.

FORMING OF METALS (HVFM) (7)

High Velocity Explosive forming:, Introduction, scheme of explosion forming process, Development of velocity forming processes, comparison of conventional and high velocity forming methods, stress waves and deformation in solids, explosive fabrication, electro hydraulic forming, magnetic pulse forming, pneumatic mechanical high velocity forming, criteria of formability, applications and energy requirements for high velocity forming process.

STUDY OF RECENT DEVELOPMENTS (6)

AJM, AFM, USM, CM, ECM, ECG, EDM, LBM, PAM, EBM, HVFM, E-HF, E-MF, HSH Forgings, & HS Extrusions through journals & e-journals

Books:

1. P.C.Pandey & H.S.Shah 'Modern Machining Process' Tata McGraw-Hill. New Delhi 2002

REFERENCES:

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