

ADVANCE MATHEMATICS
MID-101

Unit 1 : Partial Differential Equation

Solution of Partial Differential Equation (PDE) by separation of variable method, Numerical solution of PDE (Laplace, Poisson's, Parabola) using finite difference Methods.

Unit 2 : Matrices And Linear System Of Equations

Solution of linear simultaneous equations by Gaussian elimination and its modification, Crout's triangularization method, Iterative methods-Jacobins method, Gauss-Seidal method, Determination of Eigen values by iteration.

Unit 5 : Calculus Of Variations

Euler-Lagrange's differential equation, The Brachistochrone problems and other applications. Isoperi-metric problem, Hamilton's Principle and Lagrange's Equation, Rayleigh-Ritz method, Galerkin method.

Unit 4 : Fuzzy Logic

Operations of fuzzy sets, fuzzy arithmetic & relations, fuzzy relation equations, fuzzy logics. MATLAB introduction, programming in MATLAB scripts, functions and their application.

Unit 5 : Reliability

Introduction and definition of reliability, derivation of reliability functions, Failure rate, Hazard rate, mean time t future & their relations, concepts of fault tolerant analysis.

Reference Books:

1. Higher Engineering Mathematics - by Dr. B.S. Grewal; Khanna Publishers
2. Calculus of Variations - by Elsgole; Addison Wesley.
3. Applied Numerical Methods with MATLAB by Steven C Chapra, TMH.
4. Introductory Methods of Numerical Analysis by S.S. Shastry,
5. Calculus of Variations - by Galfand & Fomin; Prentice Hall.
6. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Hill.
7. Advance Engineering Mathematics by Ervin Kreszig, Wiley Easten Edd.
8. Numerical Solution of Differential Equation by M. K. Jain
9. Numerical Mathematical Analysis By James B. Scarborough
10. Fuzzy Logic in Engineering by T. J. Ross
11. Fuzzy Sets Theory & its Applications by H. J. Zimmersoms

**PRODUCT DESIGN AND DEVELOPMENT
MID-102**

UNIT 1

Introduction

Significance of product design, product design and development process, sequential engineering design method, the challenges of product development,

Product Planning and Project Selection: Identifying opportunities, evaluate and prioritize projects, allocation of resources.

UNIT 2

Identifying Customer Needs: Interpret raw data in terms of customers need, organize needs in hierarchy and establish the relative importance of needs.

Product Specifications: Establish target specifications, setting final specifications,

UNIT 3

Concept Generation: Activities of concept generation, clarifying problem, search both internally and externally, explore the output,

Industrial Design: Assessing need for industrial design, industrial design process, management, assessing quality of industrial design,

UNIT 4

Concept Selection: Overview, concept screening and concept scoring, methods of selection.

Theory of inventive problem solving (TRIZ): Fundamentals, methods and techniques, General Theory of Innovation and TRIZ, Value engineering Applications in Product development and design, Model-based technology for generating innovative ideas.

UNIT 5

Concept Testing: Elements of testing: qualitative and quantitative methods including survey, measurement of customers' response,

Intellectual Property: Elements and outline, patenting procedures., claim procedure,

Design for Environment: Impact, regulations from government, ISO system.,

Text books and references:

1. Ulrich K. T, and Eppinger S.D, Product Design and Development, Tata McGraw Hill
2. Otto K, and Wood K, Product Design, Pearson
3. Engineering of creativity: introduction to TRIZ methodology of inventive Problem Solving, By Semyon D. Savransky, CRC Press.
4. Inventive thinking through TRIZ: a practical guide, By Michael A. Orloff, Springer.
5. Systematic innovation: an introduction to TRIZ ; (theory of inventive Problem Solving), By John Terninko, Alla Zusman, CRC Press.

MATERIALS AND MANUFACTURING TECHNOLOGY
MID-103

UNIT 1

Scope and classification of Engineering Materials and Manufacturing Techniques.

Types, properties and uses of Metals and Alloys.

UNIT 2

Manufacturing processes for shaping – casting, deforming, sheet metal forming, particulate processing, machining, and finishing and joining. , Advanced methods of manufacturing: Abrasive jet cutting, Ultrasonic machining, Laser beam machining, Electron beam and electrochemical machining.

UNIT 3

Superalloys: Types, properties, uses and their processing techniques. Nickel-base, Cobalt- base and iron-base superalloys, remelting, Particulate processing, casting, machining, rolling, forging and welding of superalloys,

Polymers: Classifications Plastics: Types, properties, uses and manufacturing processing techniques. Thermoplastics, Thermosets, and Elastomers.

UNIT 4

Composites: Types, properties, uses and manufacturing processing techniques. Metal matrix composites, polymer matrix composites, ceramic matrix composites, FGM.

Glass: Types, properties, uses and shaping processes,

Ceramics: Types, properties, uses and shaping processes.

UNIT 5

Property enhancing and surface processing operations: cleaning and surface treatments., Surface coating technology: Scope and classification of coating techniques. Electroplating (metal or composite coatings), Electroless plating (metal or composite coatings), Weld overlays (metal or ceramic coatings), Thermal spraying (metal, plastic, ceramic, or composite coatings), Cladding (thick metal coatings), Chemical vapor deposition (metals, graphite, diamond, diamond like carbon, and ceramics), Physical vapor deposition (metals, ceramics, or solid lubricants), Thermoreactive deposition/diffusion process (carbides, nitrides, or carbonitrides)., Recent development in materials and manufacturing technology.,

REFERENCES

- 1.**Groover, M.P.**, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Wiley Student Edition, John Wiley and Sons, 2005.
- 2.**Budinski, K. G.**, (1998), 'Engineering Materials, Properties and Selection,' Pub. Prentice-Hall of India, New Delhi, India.
- 3.**Batchelor, A.W., Lam, L.N. and Chandrasekaran, M**, "Materials Degradation and its Control by Surface Engineering." 2nd Edition, Imperial College Press, 2003.
- 4.**Bunshah, R. F.**, "Handbook of Hard Coatings: Deposition Technologies, Properties and Applications,' Noyes Pub. Park Ridge, New Jersey, U. S. A./William Andrew Publishing, LLC, Norwich, New York, U.S.A., 2001.
- 5.**Sims, C. T., Stoloff, N. S., and Hagel, W.C.**, Superalloys II, John Wiley and Sons, 1987.
- 6.**Callister W. D., Jr.**, Material Science and Engineering An Introduction, John Wiley & Sons, Inc., 6th Ed., 2003.
- 7.**Patton, W.J.**, Plastic Technology, Theory, Design and Manufacture; Lenton Publishing Company.

**COMPUTER-AIDED GEOMETRIC DESIGN
MID-104**

UNIT 1

Introduction: Design Methodology, Historical Development. Application of computers in Product Development and Design.

UNIT 2

Curve Modeling: Explicit and Implicit Equations, Intrinsic Equations, Parametric Equations, Coordinate Systems, Hermite curve, four point form, Straight lines. Splines , Bezier curves, B-spline curves, Bezier and B-Spline curve fit. Rational Polynomials, Introduction to NURBS.

UNIT 3

Surface Modeling: Sixteen point form, Algebraic and Geometric form, Tangent and Twist Vectors, Normal, Parametric space of a surface, Blending Functions, Four Curve Form, Plane surface, Cylindrical Surface, Ruled surface, Surfaces of Revolution. Introduction to Bezier Surface, B-Spline Surface and NURBS surface.

UNIT 4

Solid Modeling: Introduction to solid Modeling: CSG and B-Rep schemes.

Transformations: Translation, Rotation, Scaling Symmetry and Reflection, Homogeneous Transformations.

UNIT 5

Reverse Engineering: Place of Reverse Engineering in Product Development. Data Acquisition Methods, Practical Problems in data acquisition, Preprocessing: Registration, Segmentation, Triangulation, Definition, Surface Fitting Methods- Bezier, B-spline & NURBS, CAD model creation.

Reference Books:

1. Mathematical Elements of Computer Graphics, Rogers and Adams, McGraw Hill, 1994
2. CAD CAM Theory and Practice: I. Zeid, Tata-McGraw Hill, 2006
3. Computer-Aided Design, R K Srivastava, Umesh Publications, Delhi, 2007, 3rd edition
4. Geometric Modeling: Michael E. Mortenson, John Wiley, 1992.
5. Computer-Aided Engineering Design, B Sahay and A Saxena, 2004.
6. Kathryn A. Ingle, "Reverse Engineering", McGraw-Hill, 2004.
7. Vinesh Raja, Kiran J. Fernades, "Reverse Engineering: An Industrial Perspective, Springer Verlag, 2006.

**ADVANCE MACHINE DESIGN
MID-105**

Unit 1 Introduction to Advanced Mechanical Engineering Design, Review of materials & processes for machine elements, Case studies of mechanical engineering design failures, Review of static strength failure analysis, theories of failure including Von-Mises theory based strength design, Fatigue Strength Design of Mechanical Elements, Exercises of fatigue design of shafting and gears. Surface fatigue design failures. Exercises of surface fatigue design of rolling contact bearings including linear bearings.

Unit 2 Stiffness based design. Design for creep, combined creep and fatigue failure prevention, Tribo-design with applications to design of sliding bearings and mechanical seals, Selection of lubrication systems, Design for corrosion, wear, hydrogen-embrittlement, fretting, fatigue and other combined modes of mechanical failure.

Unit 3 Dynamically sound designs of machine elements like springs and shafts, Introduction to dynamic design of mechanical equipment and its implementation.

Unit 4 Gear and Gear Trains, Synthesis of tooth profile for circular spur gears, noncircular spur gears with constant distance, Generation of logarithmic function, Elliptical gears, equiangular spirals teeth of lion 'circular, Gear trains, Determination of gear train for a given velocity-ratio up to a desired degree of accuracy, Change speed gears, preferred numbers, three shaft, step change of speed, arrangement of change speed gear box.

Unit 5 Cams, Forces in rigid system, Mathematical models, analytical methods, position error, jump, shock, unbalance, spring, surge and winding, Synthesis of cams, High speed cam design, kloomoek and Muffley analytical function of cycloid, harmonic and eightu power polynomial. Analytical cam design, Analytical ram design, Disc cam with radial flat faced follower, disc cam with radial roller follower and oscillating roller follower, Linkages, Number synthesis , type synthesis dimensional synthesis four bar linkage Freudenstein's Equation.

References:

1. Budynas Richard, Nisbett JK; Shigly's mechanical engineering design; TMH
2. Hall AS, Holowenko AR, Laughlin, Somani SK; Schaums outline Machine design; TMH
3. Spotts; Design of machine elements; Pearson Education
4. Juvinal; Fundamentals of machine component design; John Wiley
4. Sharma Purohit; design of machine elements; PHI
5. M.H.Magic, P.W.Oevirk, J.S. Beggs; Mechanism and dynamics of machinery
6. Baggs; Mechanisms -
7. Dudley; Gears - Hand book
8. Rothbart; Cams -
9. Ghosh and Malik; Mechanisms and Machines -