ANNA UNIVERSITY TIRUCHIRAPPALLI
Tiruchirappalli – 620 024
Regulations 2007
Curriculum

M.E. ENGINEERING DESIGN

SEMESTER I

S.No	Subject Code	Subject	L	T	P	Max. Marks
Theory						
1	**MA5141**	Applied Mathematics for Engineering Design	3	1	0	100
2	**CC5101**	Computer Applications in Design	3	0	0	100
3	**CD5102**	Finite Element Analysis	3	0	0	100
4	**ED5101**	Concepts of Engineering Design	3	0	0	100
5	**ED5102**	Engineering System Dynamics	3	0	0	100
6	**E1******	Elective I	3	0	0	100
Practical						
7	**ED5103**	CAD Laboratory	0	0	3	100

SEMESTER II

S.No	Subject Code	Subject	L	T	P	Max. Marks
Theory						
1	**CD5151**	Mechanical Vibrations	3	0	0	100
2	**ED5151**	Optimization Techniques in Design	3	0	0	100
3	**ED5152**	Advanced Mechanisms Design and Simulation	3	1	0	100
4	**CD5011**	Design for Manufacture, Assembly and Environments	3	0	0	100
5	**E2******	Elective II	3	0	0	100
6	**E3******	Elective III	3	0	0	100
Practical						
7	**ED5154**	Analysis and Simulation Laboratory	0	0	3	100

SEMESTER III

S.No	Subject Code	Subject	L	T	P	Max. Marks
Theory						
1	**E4******	Elective IV	3	0	0	100
2	**E5******	Elective V	3	0	0	100
3	**E6******	Elective VI	3	0	0	100
Practical						
4	**ED5251**	Project Work Phase I	0	0	12	*

SEMESTER IV

S.No	Subject Code	Subject	L	T	P	Max. Marks
Practical						
1	**ED5251**	Project Wok Phase II	0	0	24	*

ELECTIVES

S.No	Subject Code	Subject	L	T	P	Max. Marks
Theory						
1	**CC5153**	Integrated Product and Processes Development	3	0	0	100
2	**CC5011**	Mechatronics in Manufacturing systems	3	0	0	100
3	**CD5002**	Rapid Prototyping and Tooling	3	0	0	100
4	**CD5003**	Tribology in Design	3	0	0	100
5	**CD5051**	Design of Hydraulic and Pneumatic systems	3	0	0	100
6	**CD5052**	Composite Materials and Mechanics	3	0	0	100
7	**CD5053**	Advanced Tool Design	3	0	0	100
8	**CM5017**	Productivity Management and Re-Engineering	3	0	0	100
9	**ED5001**	Advanced Finite Element Analysis	3	0	0	100
10	**ED5002**	Applied Engineering Acoustics	3	0	0	100
11	**ED5004**	Mechanics for Fracture	3	0	0	100
12	**ED5005**	Vibration control and Condition Monitoring	3	0	0	100
13	**ED5006**	Design of Pressure Vessel and Piping	3	0	0	100
14	**ED5007**	Industrial Robotics and Expert systems	3	0	0	100
15	**ED5011**	Design of Heat Exchangers	3	0	0	100
16	**ED5013**	Applied Object Oriented Programming	3	0	0	100
17	**ED5015**	Integrated Manufacturing System	3	0	0	100
18	**ED5017**	Advanced Strength of Materials	3	0	0	100
19	**ED5018**	Design of Material Handling Equipments	3	0	0	100
20	**ED5019**	Experimental Stress Analysis	3	0	0	100
21	**ED5020**	Theory of Plates and Shells	3	0	0	100

ANNA UNIVERSITY TIRUCHIRAPPALLI
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Regulations 2007

Syllabus

M.E. ENGINEERING DESIGN

SEMESTER I

MA5141 – APPLIED MATHEMATICS FOR ENGINEERING DESIGN

L	T	P
3	1	0

UNIT I ONE DIMENSIONAL WAVE AND HEAT EQUATIONS 8

Laplace transform methods for one-dimensional wave equation – Displacements in a line string – longitudinal vibration of an elastic bar – Fourier transform methods for one-dimensional heat conduction problems in infinite and semi-infinite rods

UNIT II ELLIPTIC EQUATION 8

Laplace equation – Properties of harmonic functions – Solution of Laplace's equation by means of Fourier transforms in a half plane, in an infinite strip and in a semi-infinite strip – Solution of Poisson equation by Fourier transform method.

UNIT III CALCULUS OF VARIATIONS 10

Concept of variation and its properties – Euler's equation – Functional dependant on first and higher order derivatives – Functional dependant on functions of several independent variables – Variational problems with moving boundaries – Isoperimetric Problems – Direct methods – Ritz and Kantorovich methods.

UNIT IV SPACE CURVES AND SURFACES 10

Representation of space curves – Normalized cubic splines – Alternate cubic spline end conditions – Bezier curves – Hermite interpolation – Representation of surfaces – Tangent plane and surface normal – Bezier surfaces.

UNIT V CONFORMAL MAPPING AND APPLICATIONS 9

The Schwarz – Christoffel transformation – Transformation of boundaries in parametric form – Physical applications – Fluid flow and heat flow – Problems.

L: 45 T: 15 Total: 60

TEXT BOOKS

1. Sankara Rao, K., “Introduction to Partial Differential Equations”, Prentice – Hall of India, 1995.
2. Gupta, A.S., “Calculus of Variations with Applications”, Prentice Hall of India Pvt. Ltd, 1997
3. Kreyszig, E., “Advanced Engineering Mathematics”, Eighth Edition, John Wiley & Sons, Inc., 2002.
4. Rogers, D.F. and Adams, J, M, “Mathematical Elements for Computer Graphics”, Second Edition, Tata McGraw Hill Pub. Co. Ltd, 2003.
5. Spiegel, M.R., “Theory and Problems of Complex Variables and its Application”, McGraw Hill Book Co., 1981

REFERENCES

1. Andrews, L.C. and Shivamoggi, B.K., “Integral Transforms for Engineers”, Prentice Hall of India P.Ltd.
2. Elsgolts, L., “Differential Equations and the Calculus of Variations”, MIR Publishers, 1973
3. Mathews, J.H. and Howell, R.W., “Complex Analysis for Mathematics and Engineering”, Narosa Publishing House, 1997.
4. Sneedon, I.N., “Elements of Partial Differential Equations”, Mc Graw-Hill, 1986.
5. Churchill, R.V., “Operational Mathematics”, McGraw Hill Kogakusha Ltd, 1981
6. Sneddon, I.N., “Elements of Partial Differential Equations”, McGraw Hill Book Co.

CC5101 – COMPUTER APPLICATIONS IN DESIGN

(Common to M.E. CAD/CAM and M.E. Engineering Design)

L	T	P
3	0	0

UNIT I INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS 10

Output primitives (points, lines, curves etc.) – 2-D & 3-D transformation (Translation, scaling, rotators) windowing – view ports clipping transformation.

UNIT II INTRODUCTION TO CAD SOFTWARE 10

Writing interactive programs to solve design problems and production of drawings, using any languages like Auto LISP/C/FORTRAN etc. – creation of surfaces, solids etc., using solid modeling pack (prismatic and revolved parts).

UNIT III VISUAL REALISM 10

Hidden – Line – Surface – solid removal algorithms shading – coloring – Introduction to parametric and variational geometry based software's and their principles creation of prismatic and lofted parts using these packages.

UNIT IV ASSEMBLY OF PARTS 8

Assembly of parts – tolerances analysis mass property calculations – mechanism simulation.

UNIT V SOLID MODELING 7

Rapid prototyping – Data exchange – Documentation – Customizing Solid Modeling system.

Total: 45

REFERENCES

1. William M Neumann and Robert F. Sproul, "Principles of Computer Graphics", Mc Graw Hill Book Co., 1989.
2. Donald Hearn and M. Pauline Baker, "Computer Graphics", Prentice Hall, Inc., 1992.
3. Mikell, P. Grooves and Emory W.Zimmers Jr., "CAD/CAM Computer – Aided Design and Manufacturing", Prentice Hall Inc., 1995.
4. Ibrahim Zeid, "CAD/CAM – Theory and Practice", McGraw Hill International Edition, 1998.

CD5102 – FINITE ELEMENT ANALYSIS

L	T	P
3	0	0

UNIT I INTRODUCTION 10

Relevance of finite element analysis in design – Modeling and discretization Interpolation, elements, nodes and degrees-of-freedom – applications of FEA

One-Dimensional Elements and Computational Procedures: Bar element – beam element – bar and beam elements of arbitrary orientation – assembly of elements – properties of stiffness matrices – boundary conditions – solution of equations-mechanical loads and stresses – thermal loads and stresses – example problems.

UNIT II BASIC ELEMENTS 10

Interpolation and shape functions – element matrices – linear triangular elements (CST) – quadratic triangular elements – bilinear rectangular elements – quadratic rectangular elements – solid elements – higher order elements – nodal loads – stress calculations – example problems.

UNIT III ISOPERIMETRIC ELEMENTS 8

Introduction – bilinear quadrilateral elements – quadratic quadrilaterals – hexahedral elements – Numerical Integration – quadrature – static condensation – load considerations – stress calculations – examples of 2D and 3D applications.

UNIT IV FINITE ELEMENTS IN STRUCTURAL DYNAMICS APPLICATIONS 9

Dynamic equations – mass and damping matrices – natural frequencies and modes – damping – reduction of number of degrees-of-freedom – response history – model methods – Ritz vectors – component mode synthesis – harmonic response – direct integration techniques – explicit and implicit methods – analysis by response spectra – example problems.

UNIT V HEAT TRANSFER AND FLUID MECHANICS APPLICATIONS 8

Heat transfer – element formulation – reduction – nonlinear problems – transient thermal analysis – acoustic frequencies and modes – fluid structure interaction problems – plane incompressible and rotational flows – example problems.

Total: 45

TEXT BOOK

1. Cook, Robert Davis et al, “Concepts and Applications of Finite Element Analysis “, Wiley, John & Sons, 1999.

REFERENCES

1. Reddy J.N., “An Introduction to the Finite Element Method”, McGraw Hill, International Edition, 1993.
2. Chandrupatla & Belagundu, “Finite Elements in Engineering”, Prentice Hall of India Private Ltd., 1997.
3. George R Buchaman , “ Schaum’s Outline of Finite Element Analysis” , McGraw Hill Company , 1994.
4. S.S.Rao, Finite Element Analysis, 2002.

WEB REFERENCES

1. http://www.vector-space.com/
2. http://www.mech.port.ac.uk/sdalby/mbm/CTFRProg.htm

ED5101 – CONCEPTS OF ENGINEERING DESIGN

L	T	P
3	0	0

UNIT I THE DESIGN PROCESS 9

The design process – Morphology of Design – Design Drawings – Computer Aided Engineering – Designing of standards – Concurrent Engineering – Product life cycle – Technological Forecasting – Market Identification – Competition Bench marking – Systems Engineering – Life Cycle Engineering – Human Factors in Design – Industrial Design.

UNIT II DESIGN METHODS 9

Creativity and Problem Solving – Product Design Specifications – Conceptual design – Decision Theory – Decision Tree – Embodiment Design – Detail Design – Mathematical Modeling – Simulation – Geometric Modeling – Finite Element Modeling – Optimization – Search Methods – Geometric Programming – Structural and Shape Optimization.

UNIT III MATERIAL SELECTION PROCESSING AND DESIGN 9

Material Selection Process – Economics – Cost Vs Performance – Weighted property Index – Value Analysis – Role of Processing in Design – Classification of Manufacturing Process – Design for Manufacture – Design for Assembly –Designing for castings, Forging, Metal Forming, Machining and Welding – Residual Stresses – Fatigue, Fracture and Failure.

UNIT IV ENGINEERING STATISTICS AND RELIABILITY 9

Probability – Distributions – Test of Hypothesis – Design of Experiments – Reliability Theory – Design for Reliability – Reliability centered Maintenance.

UNIT V LEGAL AND ETHICAL ISSUES IN DESIGN AND QUALITY ENGINEERING 9

Introduction – The origin of laws – Contracts – Liability – Tort law – Product liability – Protecting intellectual property – Legal and ethical domains – Codes of ethics – Solving ethical conflicts – case studies – Total Quality Concept – Quality Assurance – Statistics Process Control – Taguchi Methods – Robust Design – Failure Model Effect Analysis.

Total: 45

TEXT BOOKS

1. Dieter, George E., “Engineering Design - A Materials and Processing Approach”, McGraw Hill, 2000.
2. Karl T. Ulrich and Steven D. Eppinger, “Product Design and Development”, McGraw Hill 2000.

REFERENCES

1. Pahl, G and Beitz, W., “Engineering Design”, Springer – Verlag, 1984.
2. Ray, M.S., “Elements of Engg. Design”, Prentice Hall Inc. 1985.
3. Suh, N.P., “The principles of Design”, Oxford University Press, 1990.

ED5102 – ENGNEERING SYSTEM DYNAMICS

(Common for M.E. CAD and M.E. Engineering Design)

L	T	P
3	0	0

UNIT I INTRODUCTION 9

Introduction – Dynamic system classification – Analysis and Design of Dynamic system – Mathematical modeling of Dynamic systems – Mechanical systems – Electrical systems – Electromechanical Systems – Fluid & Thermal system – Review of vibration of single degree, Two degree freedom systems – Review of matrix algebra and Laplace Transforms.

UNIT II INTRODUCTION TO CONTROL SYSTEMS 9

Introduction – Control systems – Control system configurations – Control system Terminology – Control system classes – Feedback systems – Analysis of Feedback – Historical Developments of control systems – Control system analysis and Design Objectives.

UNIT III SYSTEM REPRESENTATION 9

Introduction – Block Diagrams – Block Diagrams Representation – Block Diagram Reduction – Signal flow graphs – Signal flow graph algebra – Mason's Gain formula – Zeros and Additional poles.

UNIT IV PERFORMANCE AND STABILITY OF FEEDBACK SYSTEMS 9

Introduction – Properties of feedback – Transient response specifications – Controller types and actions – Stability of control systems – Routh-Hurwitz criterion – Steady state error – Control system types.

UNIT V ANALYSIS OF CONTROL SYSTEMS 9

Introduction – Analysis of control systems – Root-Locus analysis – Bode analysis – Nyquist analysis - Nyquist stability criterion – Nichols chart analysis – Frequency Domain specifications.

Total: **45**

TEXT BOOK

1. Rao.V.Dukkipati, "Engineering system Dynamics", Narosa Publishing House, 2004.

REFERENCE

1. Benjamin C.Kuo, "Automatic Control systems", Prentice-Hall of India Pvt. Ltd., 1995.
2. Thomson W.T., "Theory of Vibration with Applications", CBS Publishers and Distributors, 1990.

ED5103 – CAD LABORATORY

L	T	P
0	0	3

Exercises in Modeling and Analysis of Mechanical Components and assembly using Parametric and feature based Packages like PRO-E / SOLIDE WORKS /CATIA / NX / ANSYS / NASTRAN etc.

Total: 45

Equipments for CAD Laboratory

1.	CAD Workstations	:	10 Nos
2.	CAD, 3D Modeling Software with assembly, mechanism simulation and drafting modules	:	10 Nos

SEMESTER II

CD5151 – MECHANICAL VIBRATIONS

L	T	P
3	0	0

UNIT I FUNDAMENTALS OF VIBRATION 8

Review of Single degree freedom systems – Response to arbitrary periodic Excitations – Duhamel's Integral – Impulse Response function – Virtual work – Lagrange's equation – Single degree freedom forced vibration with elastically coupled viscous dampers – System Identification from frequency response – Transient Vibration – Laplace transformation formulation.

UNIT II TWO DEGREE FREEDOM SYSTEM 8

Free vibration of spring – Coupled system – Mass coupled system – Vibration of two degree freedom system – Forced vibration – Vibration Absorber – Vibration isolation

UNIT III MULTI-DEGREE FREEDOM SYSTEM 12

Normal mode of vibration – Flexibility Matrix and Stiffness matrix – Eigen values and Eigen vectors – orthogonal properties – Modal matrix – Modal Analysis – Forced Vibration by matrix inversion – Modal damping in forced vibration – Numerical methods for fundamental frequencies.

UNIT IV VIBRATION OF CONTINUOUS SYSTEMS 8

Systems governed by wave equations – Vibration of strings – vibration of rods – Euler Equation for Beams – Effect of Rotary inertia and shear deformation – Vibration of plates.

UNIT V EXPERIMENTAL METHODS IN VIBRATION ANALYSIS 9

Vibration instruments – Vibration exciters Measuring Devices – Analysis – Vibration Tests – Free and Forced Vibration tests. Examples of Vibration tests – Industrial, case studies.

Total: 45

REFERENCES

1. Thomson, W.T., "Theory of Vibration with Applications", CBS Publishers and Distributors, 1990.
2. Rao, J.S., & Gupta, K., "Ind. Course on Theory and Practice Mechanical Vibration", New Age International (P) Ltd., 1984.
3. Den Hartog, J.P, "Mechanical Vibrations," Dover Publications, 1990.
4. Rao, S.S., "Mechanical Vibrations," Addison Wesley Longman, 1995.

WEB REFERENCES:

1. http://www.ecgcorp.com/velav/
2. http://www.auburn.edu/isvd/
3. www.vibetech.com/techpaper.htm

ED5151 – OPTIMIZATION TECHNIQUES IN DESIGN

L	T	P
3	0	0

UNIT I INTRODUCTION 5

General Characteristics of mechanical elements – adequate and optimum design – principles of optimization – formulation of objective function – design constraints – Classification of optimization problem.

UNIT II OPTIMIZATION TECHNIQUES 10

Single variable and multivariable optimization – Techniques of unconstrained minimization – Golden section, Random, pattern and gradient search methods – Interpolation methods – Optimization with equality and inequality constraints.

UNIT III MULTI OBJECTIVE OPTIMIZATION 10

Direct methods – Indirect methods using penalty functions – Lagrange multipliers – Geometric programming and stochastic programming – Multi objective optimization – Genetic algorithms and Simulated Annealing techniques.

UNIT IV STATIC APPLICATIONS 10

Structural applications – Design of simple truss members – Design applications – Design of simple axial – transverse loaded members for minimum cost – maximum weight – Design of shafts and torsionally loaded members – Design of springs.

UNIT V DYNAMIC APPLICATIONS 10

Dynamic Applications – Optimum design of single, two degree of freedom systems vibration absorbers – Application in Mechanisms – Optimum design of simple linkage mechanisms.

Total: 45

REFERENCES

1. Johnson Ray, C., “Optimum design of mechanical elements”, Wiley, John & Sons, 1990.
2. Goldberg, D.E., “Genetic algorithms in search, optimization and machine”, Barnen, Addison-Wesley, 1989.
3. Kalyanamoy Deb, “Optimization for Engineering design algorithms and Examples”, Prentice Hall of India Pvt., 1995.

ED5152 – ADVANCED MECHANISMS DESIGN AND SIMULATION

L	T	P
3	1	0

UNIT I INTRODUCTION 5

Review of fundamentals of kinematics – mobility analysis – formation of one D.O.F. multi loop kinematic chains – Network formula – Gross motion concepts.

UNIT II KINEMATIC ANALYSIS 5

Position Analysis – Vector loop equations for four bar, slider crank, inverted slider crank, geared five bar and six bar linkages – Analytical methods for velocity and acceleration Analysis – four bar linkage jerk analysis – Plane complex mechanisms.

UNIT III PATH CURVATURE THEORY 6

Fixed and moving centrodes – inflection points and inflection circle – Euler Savary equation – graphical constructions – cubic of stationary curvature.

UNIT IV SYNTHESIS OF MECHANISMS 15

Type synthesis – Number synthesis – Associated Linkage Concept – Dimensional synthesis – function generation, path generation, motion generation – Graphical methods – Cognate linkages – Coupler curve synthesis – design of six-bar mechanisms – Algebraic methods – Application of instant center in linkage design – Cam Mechanisms – determination of optimum size of Cams.

UNIT V DYNAMICS OF MECHANISMS AND SPATIAL MECHANISMS AND ROBOTICS 14

Static force analysis with friction – Inertia force analysis – combined static and inertia force analysis, shaking force, Kinetostatic analysis – Introduction to force and moment balancing of linkages – Kinematic Analysis of Spatial RSSR mechanism – Denavit – Hartenberg Parameters – Forward and inverse Kinematics of Robotic Manipulators.

Study and use of Mechanism using Simulation Soft-ware packages.

L: 45 T: 15 Total: 60

REFERENCES

1. Sandor G.N., and Erdman A.G., “Advanced Mechanism Design Analysis and Synthesis”, Prentice Hall, 1984.
2. Shigley, J.E., and Uicker, J.J., “Theory of Machines and Mechanisms”, McGraw Hill, 1995.
3. Amitabha Ghosh and Asok Kumar Mallik, “Theory of Mechanism and Machines”, EWLP, Delhi, 1999.
4. Nortron R.L., “Design of Machinery”, McGraw Hill, 1999.
5. Kenneth J, Waldron, Gary L. Kinzel, “Kinematics, Dynamics and Design of Machinery”, John Wiley-sons, 1999.

WEB REFERENCES

1. http://www.machinedesign.com/

CD5011 – DESIGN FOR MANUFACTURE, ASSEMBLY AND ENVIRONMENTS

L	T	P
3	0	0

UNIT I INTRODUCTION 5

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.

UNIT II FACTORS INFLUENCING FORM DESIGN 13

Working principle, Material, Manufacture, Design- Possible solutions - Materials choice - Influence of materials on form design - form design of welded members, forgings and castings.

UNIT III COMPONENT DESIGN - MACHINING CONSIDERATION 8

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 - Design for clampability - Design for accessibility - Design for assembly.

UNIT IV COMPONENT DESIGN - CASTING CONSIDERATION 10

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 - Computer Applications for DFMA

UNIT V DESIGN FOR THE ENVIRONMENT 9

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.

Total: 45

REFERENCES

1. Boothroyd, G, 1980 Design for Assembly Automation and Product Design. New York, Marcel Dekker.
2. Bralla, Design for Manufacture handbook, McGraw hill, 1999.
3. Dickson, John. R, and Corroda Poly, Engineering Design and Design for Manufacture and 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.
7. Kevien Otto and Kristin Wood, Product Design. Pearson Publication, 2004.

WEBSITES

1. www.ulrich – Epingar. Net 2. www.dfma.com

ED5154 – ANALYSIS AND SIMULATION LABORATORY

L	T	P
0	0	3

Analysis of Mechanical Components – Use of FEA Packages, like ANSYS NASTRON etc., Excesses shell include FEA analysis of

i) Machine elements under static loads
ii) Heat transfer in mechanical systems
iii) Determination of natural frequency
iv) Axi-Symmetric
v) Non-linear systems

Use of kinematics and dynamics simulation software like ADAMS software. Analysis of velocity and acceleration for mechanical linkages of different mechanisms.

Total: 45

Equipments Required:

CAD work station / Pentium 4	:	10 Nos
ADAMS Software	:	2 Licenses
ANSYS / NASTRAN / ABACUS	:	10 Licenses

CD5003 – TRIBOLOGY IN DESIGN

L	T	P
3	0	0

UNIT I SURFACES, FRICTION AND WEAR 8

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.

UNIT II LUBRICATION THEORY 8

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.

UNIT III DESIGN OF FLUID FILM BEARINGS 12

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.

UNIT IV ROLLING ELEMENT BEARINGS 10

Geometry and kinematics – Materials and manufacturing processes – contact stresses – Hertzian stress equation – Load divisions – Stresses and deflection – Axial loads and rotational effects – Bearing life capacity and variable loads – ISO standards – Oil films and their effects – Rolling Bearings Failures.

UNIT V TRIBO MEASUREMENT IN INSTRUMENTATION 7

Surface Topography measurements – Electron microscope, friction and wear measurements – Laser method – instrumentation – International standards – bearings performance measurements – bearing vibration measurement.

Total: 45

REFERENCES

1. Cameron, A., “Basic Lubrication Theory”, Ellis Herward Ltd., OK, 1981
2.. Hulling, J., “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.

WEB REFERENCES

1. http://www.csetr.org/link.htm
2. http://www.me.psu.edu/research/tribology.html

CD5051 – DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS

L	T	P
3	0	0

UNIT I OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS 5

Hydraulic Power Generators – Selection and specification of pumps – pump characteristics – Linear and Rotary Actuators – selection, specification and characteristics.

UNIT II CONTROL AND REGULATION ELEMENTS 12

Pressure – direction and flow control valves – relief valves – non-return and safety valves – actuation systems.

UNIT III HYDRAULIC CIRCUITS 5

Reciprocation, quick return, sequencing, synchronizing circuits – accumulator circuits – industrial circuits – press circuits – hydraulic milling machine – grinding, planning, copying, - forklift, earth mover circuits- design and selection of components – safety and emergency mandrels.

UNIT IV PNEUMATIC SYSTEMS AND CIRCUITS 16

Pneumatic fundamentals – control elements, position and pressure sensing – logic circuits – switching circuits – fringe conditions modules and these integration – sequential circuits – cascade methods – mapping methods – step counter method – compound circuit design – combination circuit design.

UNIT V INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS 7

Pneumatic equipments – selection of components – design calculations – application – fault finding – hydro pneumatic circuits – use of microprocessors for sequencing – PLC, Low cost automation – Robotic circuits.

Total: 45

REFERENCES

1. Antony Espossito, “Fluid Power with Applications”, Prentice Hall, 1980.
2. Dudleyt, A. Pease and John J. Pippenger, “Basic fluid power”, Prentice Hall, 1987.
3. Andrew Parr, “Hydraulic and Pneumatics”, Jaico Publishing House, 1999.
4. Bolton. W., “Pneumatic and Hydraulic Systems”, Butterworth –Heinemann, 1997.

WEB REFERENCES:

1. www.pneumatics .com
2. www.fluidpower.com.tw

CD5052 – COMPOSITE MATERIALS AND MECHANICS

L	T	P
3	0	0

UNIT I INTRODUCTION **10**

Definition – Need – General Characteristics, Applications – Fibers: Glass, Carbon, Ceramic and Aramid fibers – Matrices: Polymer, Graphite, Ceramic and Metal Matrices – Characteristics of fibers and matrices – Smart materials – Types and Characteristics.

UNIT II MECHANICS AND PERFORMANCE **10**

Characteristics of Fiber-reinforced Lamina – Laminates – Interlaminar stresses – Static Mechanical Properties – Fatigue and Impact Properties – Environmental effects – Fracture Behavior and Damage Tolerance.

UNIT III MANUFACTURING **5**

Bag Moulding – Compression Moulding – Pultrusion – Filament Winding – Other Manufacturing Processes – Quality Inspection methods.

UNIT IV ANALYSIS **10**

Stress Analysis of Laminated Composites Beams, Plates and Shells – Vibration and Stability Analysis – Reliability of Composites – Finite Element Method of Analysis – Analysis of Sandwich structures.

UNIT V DESIGN **10**

Failure Predictions – Laminate Design Consideration – Bolted and Bonded Joints Design Examples.

Total: 45

TEXT BOOK

1. Mallick, P.K., “Fiber-Reinforced Composites: Materials, Manufacturing and Design”, Maneel Dekker Inc, 1993.

REFERENCES

1. Halpin, J.C., “Primer on Composite Materials, Analysis”, Techomic Publishing Co., 1984.
2. Agarwal, B.D., and Broutman L.J., “Analysis and Performance of Fiber Composites”, John Wiley and Sons, 1990.
3. Mallick, P.K. and Newman, S., “Composite Materials Technology: Processes and Properties”, Hansen Publisher, 1990.

ED5001 – ADVANCED FINITE ELEMENT ANALYSIS

L	T	P
3	0	0

UNIT I BENDING OF PLATES AND SHELLS 9

Review of Elasticity Equations – Bending of Plates and Shells – Finite Element Formulation of Plate and Shell Elements – Conforming and Non Conforming Elements – C_0 and C_1 Continuity Elements – Application and Examples.

UNIT II NON-LINEAR PROBLEMS 10

Introduction – Iterative Techniques – Material non-linearity – Elasto Plasticity – Plasticity – Visco Plasticity – Geometric Non linearity – large displacement Formulation – Application in Metal Forming Process and Contact Problems.

UNIT III DYNAMIC PROBLEM 8

Direct Formulation – Free, Transient and Forced Response – Solution Procedures – Subspace Iterative Technique – Houbolt, Wilson, Newmark Methods – Examples.

UNIT IV FLUID MECHANICS AND HEAT TRANSFER 9

Governing Equations of Fluid Mechanics – Inviscid and Incompressible Flow – Potential Formulations – Slow Non-Newtonian Flow – Metal and Polymer Forming – Navier Stokes Equation – Steady and Transient Solution.

UNIT V ERROR ESTIMATES AND ADAPTIVE REFINEMENT 9

Error norms and Convergence rates – h-refinement with adaptivity – Adaptive refinement.

Total: 45

TEXT BOOK

1. Zienkiewicz, O.C. and Taylor, R.L., “The Finite Element Method”, Volumes 1 & 2, Fourth Edition, McGraw Hill International Edition, 1991.

REFERENCES

1. Cook R.D., “Concepts and Applications of Finite Element Analysis”, John Wiley and Sons Inc., 1989.
2. Bathe K.J., “Finite Element Procedures in Engineering Analysis”, Prentice Hall, 1990.

ED5002 – APPLIED ENGINEERING ACOUSTICS

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UNIT I BASIC CONCEPTS OF ACOUSTICS 9

Scope of Acoustics – Sound pressure – Sound intensity – Sound power level Sound power – Wave motion – Alteration of wave paths – Measurement of sound waves – sound spectra – Sound fields – Interference – Standing waves – Acoustic energy density and intensity – Specific acoustic impedance.

UNIT II CHARACTERISTICS OF SOUND 10

The one dimensional wave equation – Solution of 1D wave equation – Velocity in gaseous medium – Velocity of plane progressive sound wave through a thin solid rod – Velocity of plane wave in a bulk of solid – Transverse wave propagation along a string stretched under tension – Wave equation in two dimension.

UNIT III TRANSMISSION PHENOMENA 6

Changes in media – Transmission from one fluid medium to another, normal incidence, oblique incidence – Reflection at the surface of a solid, normal incidence, oblique incidence – Standing wave pattern – Transmission through three media.

UNIT IV AN INTRODUCTION TO THE ASSESSMENT AND MEASUREMENT OF SOUND 10

Introduction – The decibel scale for the measurement of sound power – Sound level meter – Weighted sound pressure level – Equal Loudness contours – Perceived noisiness – Loudness, Loudness level, perceived noise and perceived noise level – Equivalent sound level – Identified level – Frequency and Amplitude measurement

UNIT V BASIC CONCEPTS OF NOISE CONTROL 10

Noise Control at source, path, and receiver – Noise control by acoustical treatment – Machinery noise – Types of machinery involved – Determination of sound power and sound power level – Noise reduction procedures – Acoustic enclosures.

Total: 45

REFERENCES

1. Lawrence E. Kinsler, Austin R. Frey, “Fundamentals of Acoustics”, John Wiley and Sons Inc., 1986.
2. Bies, David, A. and Hansen, Colin H., “Engineering Noise Control – Theory and Practice”, E and FN Spon, Second Edition, Chapman-Hall, 1996.
3. Hansen C.H. and Snyder, S.D., “Active Control of Sound and Vibration”, E and FN Spon, 1996.

WEB REFERENCES

1. http://www.ecgcorp.com/velav/
2. http://www.auburn.edu/isvd/

CD5053 – ADVANCED TOOL DESIGN

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UNIT I TOOL-DESIGN METHODS 5

Introduction – The Design Procedure – Statement of the problem – The Needs Analysis – Research and Ideation – Tentative Design Solutions – The Finished Design – Drafting and Design Techniques in Tooling drawings – Screws and Dowels – Hole location – Jig – boring practice – Installation of Drill Bushings – Punch and Die Manufacture – Electro – discharge machining – Electro-discharge machining for cavity.

UNIT II TOOLING MATERIALS AND HEAT TREATMENT 9

Introduction – Properties of Materials – Ferrous Tooling Materials – Tool steels – Cast Iron, Mild and low-carbon Steel – Nonmetallic Tooling Materials – Nonferrous Tooling Materials – Metal cutting Tools – Single-point cutting tools – Milling cutters – Drills and Drilling – Reamer classification – Taps – Tap classification – the selection of carbide cutting tools – Determining the insert thickness for carbide tools

UNIT III DESIGN OF DRILL JIGS 9

Introduction – Fixed Gages – Gage Tolerances – The selection of material for Gages – Indicating Gages – Automatic gages – Principles of location – Locating methods and devices – Principles of clamping – Drill jigs – Chip formation in drilling – General considerations in the design of drill jigs – Drill bushings – Methods of construction – Drill jigs and modern manufacturing

UNIT IV DESIGN OF FIXTURES AND DIES 14

Introduction – Fixtures and economics – Types of Fixtures – Vise Fixtures – Milling Fixtures – Boring Fixtures – Broaching Fixtures – Lathe Fixtures – Grinding Fixtures – Types of Die construction – Die-design fundamentals – Blanking and Piercing die construction – Pilots – Strippers and pressure pads- Presswork materials – Strip layout – Short-run tooling for Piercing – Bending dies – Forming dies – Drawing operations.

UNIT V TOOL DESIGN FOR NUMERICALLY CONTROLLED MACHINE TOOLS 8

Introduction – The need for numerical control – A basic explanation of numeric control – Numerical control systems in use today – Fixture design for numerically controlled machine tools – Cutting tools for numerical control – Tool holding methods for numerical control – Automatic tool changers and tool positioners – Tool presetting – Introduction – General explanation of the Brown and sharp machine – tooling for Automatic screw machines

Total: 45

REFERENCES

1. Cyrll Donaldson, George H.LeCain, V.C. Goold, “Tool Design”, Tata McGraw Hill Publishing Company Ltd., 2000.
2. Prakash Hiralal Joshi, “Tooling data”, Wheeler Publishing, 2000

WEB REFERENCES

1. www.irdi.on.ca/irdi/front.htm
2. www.techsolve.org/flashhome.htm

ED5004 – MECHANICS OF FRACTURE

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UNIT I ELEMENTS OF SOLID MECHANICS 5

The geometry of stress and strain, elastic deformation, plastic and elasto-plastic deformation – limit analysis.

UNIT II STATIONARY CRACK UNDER STATIC LOADING 10

Two dimensional elastic fields – Analytical solutions yielding near a crack front – Irwin's approximation – plastic zone size – Dugdaale model – J integral and its relation to crack opening displacement

UNIT III ENERGY BALANCE AND CRACK GROWTH 8

Griffith analysis – Linear Fracture Mechanics – Crack Opening displacement – Dynamic energy balance – crack arrest.

UNIT IV FATIGUE CRACK GROWTH CURVE 10

Empirical Relation describing crack growth by fatigue – Life calculations for a given load amplitude – effects of changing the load spectrum – Effects of Environment

UNIT V ELEMENTS OF APPLIED FRACTURE MECHANICS 12

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.

Total: 45

REFERENCES

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

WEB REFERENCES

www.elsevier.com/locate/engfracmech

ED5005 V – VIBRATION CONTROL AND CONDITION MONITORING

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UNIT I INTRODUCTION 11

Review of Fundamentals of Single Degree Freedom Systems – Two Degree Freedom Systems, Multi Degree Freedom System and Continuous system – Determination of Natural frequencies and mode shapes – Numerical methods in Vibration Analysis.

UNIT II VIBRATION CONTROL 12

Introduction – Reduction of Vibration at the Source – Control of Vibration – by Structural design – Material Selection – Localized additions – Artificial damping – Resilient isolation, Vibration isolation and Vibration absorbers.

UNIT III ACTIVE VIBRATION CONTROL 6

Introduction – Concepts and applications, Review of smart materials – Types and Characteristics – Review of smart structures – Characteristics Active vibration control in smart structures.

UNIT IV CONDITION BASED MAINTENANCE PRINCIPLES AND APPLICATIONS 10

Introduction – Condition Monitoring Methods – The Design of Information system, selecting methods of monitoring, Machine condition monitoring and diagnosis – Vibration severity criteria – Machine maintenance techniques – Machine condition monitoring techniques – Vibration monitoring techniques – Instrumentation systems – Choice of monitoring parameter.

UNIT V DYNAMIC BALANCING AND ALIGNMENT OF MACHINERY 6

Introduction – Dynamic Balancing of Rotors – Field Balancing in one Plane, two Planes, and in several Planes – Machinery Alignment, “Rough” Alignment Methods, The Face-Peripheral Dial Indicator Method, Reverse Indicator Method, Shaft-to-coupling spool method.

Total: 45

TEXT BOOK

1. Singiresu S. Rao, “Mechanical Vibrations”, Addison-Wesley Publishing Company, 1995.

REFERENCES

1. K.J. Bathe and F.I., Wilson, “Numerical Methods in Finite Element Analysis”, Prentice Hall of India Pvt. Ltd., 1978.
2. J.O. Den Hartog, “Mechanical Vibrations”, McGraw Hill, 1985.
3. Rao, J.S. “Vibratory Condition Monitoring of Machines”, CRC Press, 2000.
4. Science Elsevier, “Hand Book of Condition Monitoring”, Elsevier Science, 1996.

WEB REFERENCES

1. http://www.ecgcorp.com/velav/
2. http://www.auburn.edu/isvd/
3. www.vibetech.com/techpaper.htm

ED5006 – DESIGN OF PRESSURE VESSELS AND PIPING

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UNIT I INTRODUCTION 3

Methods for determining stresses – Terminology and Ligament Efficiency – Applications

UNIT II STRESSES IN PRESSURE VESSELS 15

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.

UNIT III DESIGN OF VESSELS 15

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

UNIT IV BUCKLING AND FRACTURE ANALYSIS IN VESSELS 8

Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading

UNIT V PIPING 4

Introduction – Flow diagram – piping layout and piping stress Analysis.

Total: 45

TEXT BOOK

1. John F. Harvey, “Theory and Design of Pressure Vessels”, CBS Publishers and Distributors, 1987.

REFERENCES

1. Henry H. Bedner, “Pressure Vessels, Design Hand Book”, CBS publishers and Distributors, 1987.
2. Stanley, M. Wales, “Chemical process equipment, selection and Design”, Buterworths series in Chemical Engineering, 1988.
3. William. J., Bees, “Approximate Methods in the Design and Analysis of Pressure Vessels and Piping”, Pre ASME Pressure Vessels and Piping Conference, 1997.

ED5007 – INDUSTRIAL ROBOTICS AND EXPERT SYSTEMS

(Common for M.E. CAD, M.E. CAD/CAM and M.E. Engineering Design)

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UNIT I INTRODUCTION AND ROBOT KINEMATICS 10

Definition need and scope of Industrial robots – Robot anatomy – Work volume – Precision movement – End effectors – Sensors – Robot Kinematics – Direct and inverse kinematics – Robot trajectories – Control of robot manipulators – Robot dynamics – Methods for orientation and location of objects.

UNIT II ROBOT DRIVES AND CONTROL 9

Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.

UNIT III ROBOT SENSORS 9

Transducers and Sensors – Sensors in Robot – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Gribbing – Image processing and analysis – Image segmentation – Pattern recognition – Training of vision system.

UNIT IV ROBOT CELL DESIGN AND APPLICATION 9

Robot work cell design and control – Safety in Robotics – Robot cell layouts – Multiple Robots and machine interference – Robot cycle time analysis – Industrial application of robots

UNIT V ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPORT SYSTEMS 8

Methods of Robot Programming – Characteristics of task level languages lead through programming methods – Motion interpolation – Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques – problem representation in AI – Problem reduction and solution techniques – Application of AI and KBES in Robots.

Total: 45

TEXT BOOK

1. K.S.Fu, R.C. Gonzalez and C.S.G. Lee, “Robotics Control, Sensing, Vision and Intelligence”, Mc Graw Hill, 1987.

REFERENCES

1. Yoram Koren, “Robotics for Engineers”, Mc Graw-Hill, 1987.
2. Deb, S.R. “Robotics Technology and Flexible Automation”, Tata Mc Graw-Hill, 1994.
3. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey, “Industrial Robotics Technology, Programming and Applications”, Mc Graw-Hill, Int., 1986.
4. Timothy Jordanides et al, “Expert Systems and Robotics”, Springer –Verlag, 1991.

WEB REFERENCES

1. http://www.ifr.org/gallery/type.htm

ED5011 – DESIGN OF HEAT EXCHANGERS

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UNIT I CONSTRUCTIONAL DETAILS AND HEAT TRANSFER 8

Types – Shell and Tube Heat Exchangers – Regenerators and Recuperators Industrial Applications Temperature Distribution and its Implications – LMTD – Effectiveness

UNIT II FLOW DISTRIBUTION AND STRESS ANALYSIS 7

Effect of Turbulence – Friction Factor – Pressure Loss – Channel Divergence Stresses in Tubes – Heater sheets and Pressure Vessels – Thermal Stresses – Shear Stresses – Types of Failures

UNIT III DESIGN ASPECTS 10

Heat Transfer and Pressure Loss – Flow Configuration – Effect of Baffles – Effect of Deviations from Ideality – Design of Typical Liquid – Gas-Gas-Liquid Heat Exchangers

UNIT IV CONDENSERS AND EVAPORATORS DESIGN 10

Design of Surface and Evaporative Condensers – Design of Shell and Tube – Plate Type Evaporators

UNIT V COOLING TOWERS 10

Packings – Spray Design – Selection of Pumps – Fans and Pipes – Testing and Maintenance – Experimental Methods

Total: 45

REFERENCES

1. T. Taborek, G.F. Hewitt and N.Afgan, “Heat Exchangers”, Theory and Practice, McGraw Hill Book Co., 1980
2. Walker, “Industrial Heat Exchangers - A Basic Guide”, McGraw Hill Book Co., 1980
3. Nicholas Cheremisioff, “Cooling Tower”, Ann Arbor Science Pub 1981
4. Arthur P. Fraas, “Heat Exchanger Design”, John Wiley & Sons, 1988

WEBSITES

1. http://www.thermomax.com
2. http://www.tata.com
3. http://www.altalevel.com

CM5017 – PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING

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UNIT I INTRODUCTION 5

Productivity concepts – Macro and Micro factors of productivity – Productivity benefit model – productivity cycle

UNIT II PRODUCTIVITY MODELS 12

Productivity measurement at International, National and Organizational level – Total productivity models – Productivity management in manufacturing and service sector – Productivity evaluation models – Productivity improvement models and techniques

UNIT III ORGANIZATIONAL TRANSFORMATION 8

Principles of organizational transformation and re-engineering – fundamentals of process reengineering – preparing the workforce for transformation and reengineering, methodology, guidelines, DSMCQ and PMP model

UNIT IV RE-ENGINEERING PROCESS IMPROVEMENT MODELS 10

PMI models, Edosomwan model, Moen and Nolan strategy for process improvement – LMICIP model – NPRDC model.

UNIT V RE-ENGINEERING TOOLS AND IMPLEMENTATION 10

Analytical, process tools and techniques – Information and communication technology – Enabling role of IT, RE-opportunities, process redesign – cases – Software methods in BPR – specification of BP – case study – Order, processing, user interfaces, maintainability and reusability

Total: 45

REFERENCES

1. Sumanth, D.J., “Productivity engineering and management”, TMH, 1990.
2. Edosomwan, J.A., “Organizational transformation and process re-engineering”, British Library cataloging in pub. data, 1996.
3. Rastogi, P.N. “Re-Engineering and Re-inventing the enterprise”, Wheeler pub., 1995.
4. Premvrat, Sardana, G.D. and Sahay, B.S, “Productivity Management - A systems approach”, Narosa Publications, 1998.

ED5013 – APPLIED OBJECT ORIENTED PROGRAMMING

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UNIT I FUNDAMENTALS OF OBJECT ORIENTED PROGRAMMING 5

Elements of OOP – classes – subjects – messaging – inheritance – polymorphism – OOP paradigm versus Procedural paradigm – object-oriented design

UNIT II C++ DATA TYPES 15

Expression and statements – operators – precedence – type conversion – flow control – Arrays structures – argument passing – reference argument – overloaded function

UNIT III C++ CLASS 5

Definition – class objects – member functions – pointer friends – class member pointer – scope – unions – bit-fields – class argument – ellises – Class member functions – initialization – operator overloading – user defined conversions.

UNIT IV CLASS DERIVATION 10

Derivation specification – Information hiding under derivation public and private base classes – standard conventions under derivation – class scope – Intialization and assignment under derivation

UNIT V APPLICATION 10

OOP's applications in linear programming – integer programming – simulation.

Total: 45

REFERENCES

1 Wiener, Richard, S. and Pinson Lewis, J., “An introduction to objective oriented programming and C++”, 1999.

2 Stanley B.Lippman, “C++ primer”, Addison - Wesley Pub. Co., 1989.

3. Robert Lafore, “Object Oriented programming in Turbo C++”, Galgotia Publication, 1992.

4. Strousstrup, Bjarne, The “C++ programming languages”, Addison Wesley, 1986.

CC5011 – MECHATRONICS IN MANUFACTURING SYSTEMS

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UNIT I INTRODUCTION 3

Introduction to Mechatronics – Systems – Mechatronics in Products – Measurement Systems – Control Systems – Traditional design – Mechatronics Design

UNIT II SENSORS AND TRANSDUCERS 12

Introduction – Performance Terminology – Displacement, Position and Proximity – Velocity and Motion – Fluid pressure – Temperature sensors – Light sensors – Selection of sensors – Signal processing – Servo systems.

UNIT III MICROPROCESSORS IN MECHATRONICS 15

Introduction – Architecture – Pin configuration – Instruction set – Programming of Microprocessors using 8085 instructions – Interfacing input and output devices – Interfacing D/A converters and A/D converters – Applications – Temperature control – Stepper motor control – Traffic light controller.

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS 8

Introduction – Basic structure – Input / Output processing – Programming – Mnemonics Timers, Internal relays and counters – Data handling – Analog input / output – Selection of PLC.

UNIT V DESIGN AND MECHATRONICS 7

Designing – Possible design solutions – Case studies of Mechatronics systems

Total: 45

TEXT BOOKS

1. Michael B.Histand and David G. Alciatore, “Introduction to Mechatronics and Measurement Systems”, McGraw-Hill International Editions, 1999.
2. Bradley, D.A., Dawson, D, Buru, N.C. and Loader, AJ., “Mechatronics”, Chapman and Hall, 993.
3. Ramesh.S, Gaonkar, “Microprocessor Architecture, Programming and Applications” Wiley Eastern, 1998.
4. Lawrence J.Kamm, “Understanding Electro-Mechanical Engineering, An Introduction to Mechatronics”, Prentice-Hall, 2000.
5. Ghosh, P.K. and Sridhar, P.R., 0000 to 8085, “Introduction to Microprocessors for Engineers and Scientists”, Second Edition, Prentice Hall, 1995.

WEB REFERENCE

1. www.cs.indiana.edu.

ED5015 – INTEGRATED MANUFACTURING SYSTEMS

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UNIT I INTRODUCTION 5

Objectives of a manufacturing system – identifying business opportunities and problems classification production systems – linking manufacturing strategy and systems analysis of manufacturing operations.

UNIT II GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING 5

Introduction – part families – parts classification and cooling – group technology machine cells – benefits of group technology – Process planning function CAPP – Computer generated time standards.

UNIT III COMPUTER AIDED PLANNING AND CONTROL 10

Production planning and control – cost planning and control – inventory management – Material requirements planning (MRP) – shop floor control – Factory data collection system – Automatic identification system – barcode technology – automated data collection system.

UNIT IV COMPUTER MONITORING 10

Types of production monitoring systems – structure model of manufacturing process – process control & strategies – direct digital control – supervisory computer control – computer in QC – contact inspection methods non – contact inspection method – computer-aided testing – integration of CAQC with CAD/CAM.

UNIT V INTEGRATED MANUFACTURING SYSTEM 15

Definition – application – features – types of manufacturing systems – machine tools – materials handling system – computer control system – DNC systems manufacturing cell – Flexible manufacturing systems (FMS) – The FMS concept – transfer systems – head changing FMS – variable mission manufacturing system – CAD/CAM system – human labor in the manufacturing system – computer integrated manufacturing system benefits – Rapid prototyping – Artificial Intelligence and Expert system in CIM.

Total: 45

TEXT BOOK

1. Groover, M.P., “Automation, Production System and CIM”, Prentice-Hall of India, 1998.

REFERENCES

1. David Bedworth, “Computer Integrated Design and Manufacturing”, TMH, 1998.
2. Yorem Koren, "Computer Integrated Manufacturing Systems", McGraw Hill, 1983.
3. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International 1986.
4. R.W. Yeomamas, A. Choudry and P.J.W. Ten Hagen, "Design rules for a CIM System", North Holland Amsterdam, 1985.

CC5153 – INTEGRATED PRODUCT AND PROCESSES DEVELOPMENT

L	T	P
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UNIT I INTRODUCTION 9

Characteristics of Successful Product Development – Who Designs and Develops Products – Duration and Costs of Product Development – Challenges of Product Development – Development Processes and Organizations – A Generic Development Process – Concept Development: The Front-End Process Adapting the Genetic Product Development Process – Product Development Process Flows – The AMF Development Process – Product Development Organizations – The AMF Organization

UNIT II PRODUCT PLANNING 9

Product Planning Process – Identify Opportunities – Evaluating and Prioritizing Projects – Allocating Resources and Timing – Pre-Project Planning – Reflect on the Results and the Process – Identifying Customer Needs – Raw Data from Customers – Interpreting Raw Data in Terms of Customer Needs – Organizing the Needs into a Hierarchy – Establishing the Relative Importance of the Needs – Reflecting on the Results and the Process

UNIT III PRODUCT SPECIFICATIONS 9

What Are Specifications – When Are Specifications Established – Establishing Target Specifications – Setting the Final Specifications – Concept Generation – The Activity of Concept Generation – Clarify the Problem – Search Externally – Search Internally – Explore Systematically – Reflect on the Results and the Process.

UNIT IV CONCEPT SELECTION 9

Concept Selection – Overview of Methodology – Concept Screening – Concept Testing – Define the Purpose of the Concept Test – Choose a Survey Population – Choose a Survey Format – Communicate the Concept – Measure Customer Response – Interpret the Results – Reflect on the Results and the Process

UNIT V PRODUCT ARCHITECTURE 9

Product Architecture – Implications of the Architecture – Establishing the Architecture – Delayed Differentiation – Platform Planning – Related System – Level Design Issues

Total: 45

TEXT BOOK

1. Karl T.Ulrich and Steven D. Eppinger, “Product Design and Development”, McGraw-Hill International Edition, 1999

REFERENCES

1. Kemnneth Crow, “Concurrent Engg. /Integrated Product Development”, DRM Associates, 26/3, Via Olivera, Palos Verdes, CA 90274(310) 377-569.
2. Stephen Rosenthal, “Effective Product Design and Development”, Business One Orwin, Homewood, 1992, ISBN, 1-55623-603-4.
3. Stuart Pugh, “Tool Design – Integrated Methods for successful Product Engineering”, Addison Wesley Publishing, 1991

WEB REFERENCES

1. www.me.mit/2.7444

ED5017 – ADVANCED STRENGTH OF MATERIALS

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UNIT I ELASTICITY 7

Stress-Strain relations and general equations of elasticity in Cartesian – Polar and spherical coordinates differential equations of equilibrium – compatibility – boundary conditions – representation of three-dimensional stress of a tension generalized hook's law – St. Venant's principle – plane stress – Airy's stress function.

UNIT II SHEAR CENTER AND UNSYMMETRICAL BENDING 10

Location of shear center for various sections – shear flows – Stresses and deflections in beams subjected to unsymmetrical loading – kern of a section.

UNIT III CURVED FLEXIBLE MEMBERS AND STRESSES IN FLAT PLATES 12

Circumference and radial stresses – deflections – curved beam with restrained ends – closed ring subjected to concentrated load and uniform load – chain links and crane hooks – Stresses in circular and rectangular plates due to various types of loading and end conditions buckling of plates.

UNIT IV TORSION OF NON-CIRCULAR SECTIONS 7

Torsion of rectangular cross section – S.Venants theory – elastic membrane analogy Prandtl's stress function torsional stress in hollow thin walled tubes

UNIT V STRESSES DUE TO ROTARY SECTIONS AND CONTACT STRESSES 9

Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness allowable speeds – Methods of computing contact stress – deflection of bodies in point and line contact applications.

Total: 45

REFERENCES

1. Seely and Smith, “Advanced Mechanics of Materials”, John Wiley International Edition, 1952.
2. Rimoahwnko, “Strength of Materials”, Van Nostrand.
3. Timoshenko and Goodier, “Theory of Elasticity”, McGraw Hill.
4. Wang, “Applied Elasticity”, McGraw Hill.
5. Cas, “Strength of Materials”, Edward Arnold, 1957.
6. Robert D. Cook, Warren C. Young, “Advanced Mechanics of Materials”, Mc-millan pub. Co.,1985.

ED5018 – DESIGN OF MATERIAL HANDLING EQUIPMENTS

(Use of Approved Data Book Is Permitted)

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UNIT I MATERIALS HANDLING EQUIPMENT 5

Types – selection and applications

UNIT II DESIGN OF HOISTS 10

Design of hoisting elements: Welded and roller chains – Hemp and wire ropes – Design of ropes, pulleys, pulley systems, sprockets and drums – Load handling attachments – Design of forged hooks and eye hooks – crane grabs – lifting magnets – Grabbing attachments – Design of arresting gear – Brakes: shoe, band and cone types.

UNIT III DRIVES OF HOISTING GEAR 10

Hand and power drives – Traveling gear – Rail traveling mechanism – cantilever and monorail cranes – slewing, jib and luffing gear – cogwheel drive – selecting the motor ratings.

UNIT IV CONVEYORS 10

Types – description – design and applications of Belt conveyors – apron conveyors and escalators Pneumatic conveyors – Screw conveyors and vibratory conveyors.

UNIT V ELEVATORS 10

Bucket elevators: design – loading and bucket arrangements – Cage elevators – shaft way, guides, counter weights, hoisting machine, safety devices – Design of form lift trucks.

Total: 45

TEXT BOOKS

1. Rudenko, N., “Materials Handling Equipment”, Elnvee Publishers, 1970.
2. Spivakovsy, A.O. and Dyachkov, V.K., “Conveying Machines”, Volumes I and II, MIR Publishers, 1985.

REFERENCES

1. Alexandrov, M., “Materials Handling Equipments”, MIR Publishers, 1981.
2. Boltzharol, A., “Materials Handling Handbook’, The Ronald Press Company, 1958.
3. Tech. P.S.G., “Design Data Book”, Kalaikathir Achchagam, 2003.
4. Lingaiah. K. and Narayana Iyengar, “Machine Design Data Hand Book”, Vol. 1 & 2, Suma Publishers, 1983

ED5019 – EXPERIMENTAL STRESS ANALYSIS

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UNIT I FORCES AND STRAIN MEASUREMENT 9

Strain gauge, principle, types, performance and uses – Photo elasticity – principle and applications – Moire Fringe – Hydraulic jacks and pressure gauges – Electronic load cells – Proving Rings – Calibration of Testing Machines.

UNIT II VIBRATION MEASUREMENTS 9

Characteristics of Structural Vibrations – Linear Variable Differential Transformer (LVDT) – Transducers for velocity and acceleration measurements – Vibration meter – Seismographs – Vibration Analyzer – Display and recording of signals – Cathode Ray Oscilloscope – XY Plotter – Chart Plotters – Digital data Acquisition systems.

UNIT III ACOUSTICS AND WIND FLOW MEASURES 9

Principles of Pressure and flow measurements – pressure transducers – sound level meter – venturimeter and flow meters – wind tunnel and its use in structural analysis – structural modeling – direct and indirect model analysis

UNIT IV DISTRESS MEASUREMENTS 9

Diagnosis of distress in structures – crack observation and measurements – corrosion of reinforcement in concrete – Half-cell, construction and use – damage assessment – controlled blasting for demolition.

UNIT V NON DESTRUCTIVE TESTING METHODS 9

Load testing on structures, buildings, bridges and towers – Rebound Hammer – acoustic emission – ultrasonic testing principles and application – Holography – use of laser for structural testing – Brittle coating

Total: 45

REFERENCES

1. Sadhu Singh, “Experimental Stress Analysis”, Khanna Publishers, 1996.
2. JW Dalley and WF Riley, “Experimental Stress Analysis”, McGraw Hill Book Company, 1991
3. L.S.Srinath et al, “Experimental Stress Analysis”, Tata McGraw Hill Company, 1984
4. R.S.Sirohi, HC Radhakrishna, “Mechanical Measurements”, New Age International (P) Ltd., 1997
5. F.K Garas, J.L. Clarke and GST Armer, “Structural assessment”, Butterworths, 1987
6. D.E. Bray & R. K.Stanley, “Non-destructive Evaluation”, McGraw Hill Publishing Company, 1989

CD5002 – RAPID PROTOTYPING AND TOOLING

(Common for M.E. CAD/CAM, M.E. CAD, M.E. Engineering Design and M.E. Product Design & Development)

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UNIT I INTRODUCTION 7

Need for time compression in product development – Product development – conceptual design – development – detail design – prototype – tooling.

UNIT II CLASSIFICATION OF RP SYSTEMS 9

Stereo lithography systems – Principle – process parameters – process details – machine details, Applications – Direct Metal Laser Sintering (DMLS) system – Principle – process parameters – process details – machine details, Applications.

UNIT III MODELING 9

Fusion Deposition Modeling – Principle – process parameters – process details – machine details, Applications – Laminated Object Manufacturing – Principle – process parameters – process details – machine details, Applications.

UNIT IV SOLID GROUND CURING 10

Principle – process parameters – process details – machine details, Applications. 3-Dimensional printers – Principle – process parameters – process details – machine details, Applications – other concept modelers like thermo jet printers, Sander's model maker, JP system 5, Object Quadra system.

UNIT V RAPID TOOLING 10

Laser Engineering Net Shaping (LENS) – Ballistic Particle Manufacturing (BPM) – Principle – Introduction to rapid tooling – direct and indirect method – software for RP – STL files, Magics, Mimics – Application of Rapid prototyping in Medical field

Total: 45

TEXT BOOK

1. Pham,D.T. & Dimov.S.S., "Rapid manufacturing", Springer-Verlag, 2001.

REFERENCE

1. Terry wohlers, "Wohlers Report 2000", Wohlers Associates, 2000.

ED5020 – THEORY OF PLATES AND SHELLS

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UNIT I **8**

Thin Plates with small deflection – Laterally loaded thin plates – governing differential equation – various boundary conditions

UNIT II **12**

Rectangular plates – Simply supported rectangular plates – Navier solution and Levy's method – Rectangular plates with various edge conditions – plates on elastic foundation – Symmetrical bending of circular plates.

UNIT III **6**

Energy methods – Finite difference methods – Finite element methods.

UNIT IV **12**

Classification of shells – types of shells – structural action – membrane theory – shells of revolution and shells of translation – examples – limitations of membrane theory – Folded Plate structures – structural behavior – types – design by ACI – ASCE Task Committee method

UNIT V **7**

Space frames – configuration – types of nodes – general principles of design Philosophy – Behavior.

Total: 45

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1. Szilard, R., “Theory and Analysis of Plates”, Prentice Hall Inc., 1995
2. Timoshenko, S. and Krieger S.W., “Theory of Plates and Shells”, McGraw Hill Book Company, 1990.
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4. Timoshenko, S. “Theory of Plates and Shells”, McGraw Hill, 1990
5. Ramasamy, G.S., “Design and Construction of Concrete Shells Roofs”, CBS Publishers, 1986
6. Dr.N.Subramanian, Principles of Space Structures , Wheeler Publishing Co. 1999
7. Proceedings of International Conference on Space Structures, Anna University, November 1997.