ANNA UNIVERSITY TIRUCHIRAPPALLI
Tiruchirappalli – 620 024
Regulations 2007
Curriculum

M.E. COMPUTER AIDED 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	**CD5101**	Computer Aided Graphics	3	0	0	100
3	**CD5102**	Finite Element Analysis	3	0	0	100
4	**CD5103**	Integrated Mechanical Design	3	0	0	100
5	**ED5102**	Engineering System Dynamics	3	0	0	100
6	**E1******	Elective I	3	0	0	100
Practical						
7	**CD5104**	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	2	100
2	**ED5101**	Concept of Engineering Design	3	0	0	100
3	**CD5152**	Metallic Materials and Manufacturing Processes	3	0	0	100
4	**CC5153**	Integrated Product and Processes Development	3	0	0	100
5	**E2******	Elective II	3	0	0	100
6	**E3******	Elective III	3	0	0	100
Practical						
7	**CD5154**	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	**CD5251**	Project Work Phase I	0	0	12	100

SEMESTER IV

S.No.	Subject Code	Subject	L	T	P	Max. Marks
Practical						
1	**CD5251**	Project Wok Phase II	0	0	24	100

LIST OF ELECTIVES

S.No.	Subject Code	Subject	L	T	P	Max. Marks
Theory						
1	**CD5001**	Modal Analysis of Mechanical Systems	3	0	0	100
2	**CD5002**	Rapid Prototyping and Tooling	3	0	0	100
3	**CD5003**	Tribology in Design	3	0	0	100
4	**CD5051**	Design of Hydraulic and Pneumatic Systems	3	0	0	100
5	**CD5052**	Composite Materials and Mechanics	3	0	0	100
6	**CD5053**	Advanced Tool Design	3	0	0	100
7	**CD5011**	Design for Manufacture and Assembly and Environments	3	0	0	100
8	**CD5014**	Plasticity and Metal Forming	3	0	0	100
9	**ED5005**	Vibration Control and Condition Monitoring	3	0	0	100
10	**ED5007**	Industrial Robotics and Expert Systems	3	0	0	100
11	**IE5011**	Enterprise Resource Planning	3	0	0	100

ANNA UNIVERSITY TIRUCHIRAPPALLI

Tiruchirappalli - 620 024

Regulations 2007

Syllabus

M.E. COMPUTER AIDED 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. Rogers, D.F. and Adams, J, M, “Mathematical Elements for Computer Graphics”, Second Edition, Tata McGraw Hill Pub. Co. Ltd, 2003.
2. Kreyszig, E., “Advanced Engineering Mathematics”, Eighth Edition, John Wiley & Sons, Inc., 2002.

REFERENCES

1. Andrews, L.C. and Shivamoggi, B.K., “Integral Transforms for Engineers”, Prentice Hall of India P.Ltd., 1987.
2. Elsgolts, L., “Differential Equations and the Calculus of Variations”, MIR Publishers, 1973.
3. Sankara Rao, K., “Introduction to Partial Differential Equations”, Prentice – Hall of India, 1995.
4. Gupta, A.S., “Calculus of Variations with Applications”, Prentice Hall of India Pvt. Ltd, 1997.

CD5101 – COMPUTER AIDED GRAPHICS

L	T	P
3	0	0

UNIT I INTRODUCTION 8

Output primitives – Line drawing algorithm – Circles and other curves – Attributes of output – primitives – 2D, 3D transformations – Translation, Rotation, Scaling – Concatenation.

UNIT II TECHNIQUES FOR GEOMETRIC MODELING 12

Representation of curves – Bezier curves – cubic spline curve – B-Spline curves – Rational curves – Surface Modeling techniques – surface patch – Coons patch – bi-cubic patch – Bezier and B-spline surfaces – Volume modeling – Boundary models – CSG-other modeling techniques.

UNIT III THREE DIMENSIONAL COMPUTER GRAPHICS 10

Viewing transformations – perspective projection – techniques for visual realism – hidden line – Surface removal – Algorithms for shading and Rendering.

UNIT IV GRAPHICS STANDARDS FOR CAD 8

Graphics and computing standards – GKS – Bitmaps – Open GL Data Exchange standards – IGES – STEP – CALS – DXF – Communication standards – WAN – LAN.

UNIT V 3D MODELING APPLICATIONS AND SPECIAL TO TOPICS 7

2D Representations – Development of surfaces – Integration of design Analysis and CAD - Graphical aid for preprocessing in FEA – mesh generation techniques – Post processing - Machining from 3D Model – generative machining – cutter location – gouge detection – tool path generation from solid models – STL formats – for rapid prototyping – Slicing techniques – Introduction to fractional geometry.

Total: 45

TEXT BOOK

1. Chris McMohan and Jimmi Browne, “CAD/CAM principles, practice and manufacturing management”, Pearson Education Ltd., 2000.

REFERENCES

1. Donald Hearn and M. Pauline Baker, “Computer Graphics”, Prentice Hall, 1992.
2. Ibrahim Zeid “CAD/CAM – Theory and Practice”, McGraw Hill International Edition, 1998.

WEB REFERENCES

1. www.cadcamnet.com
2. www.cc.utah.edu/~asn8200/rapid.html

CD51002 – 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 V 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 “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. S.S.Rao, “Finite Element Analysis”, 2002 Edition.

WEB REFERENCE

1. http://www.vector-space.com/

CD5103 – INTEGRATED MECHANICAL DESIGN

(Use of Approved Data Book Is Permitted)

L	T	P
3	0	0

UNIT I INTRODUCTION 6

Phases of design – Standardization and interchangeability of machine elements - Tolerances from process and function – Individual and group tolerances – Selection of fits for different design situations – Design for assembly and modular constructions – Concepts of integration.

UNIT II SHAFTING 6

Analysis and Design of shafts for different applications – detailed design – preparation of production drawings – integrated design of shaft, bearing and casing – design for rigidity.

UNIT III GEARS AND GEAR BOXES 18

Principles of gear tooth action – Gear correction – Gear tooth failure modes – Stresses and loads – Component design of spur, helical, bevel and worm gears – Deign for sub assembly – Integrated design of speed reducers and multi-speed gear boxes – application of software packages.

UNIT IV CLUTCHES 5

Integrated design of automobile clutches – over running clutches.

UNIT V BRAKES 10

Dynamics and thermal aspects of vehicle braking – Integrated design of brakes for machine tools – automobiles and mechanical handling equipments

Total: 45

REFERENCES

1. Newcomb, T.P. and Spur, R.T., “Automobile Brakes and Braking Systems”, Second Edition, Chapman and Hall, 1975.
2. Juvinall, RL.C., “Fundamentals of Machine Component Design”, John Wiley, 1983.
3. Maitra G.M., “Hand Book of Gear Design”, Tata McGraw Hill, 1985.
4. Shigley, J.E., “Mechanical Engineering Design”, McGraw Hill, 1986.
5. Tech. P.S.G., “Design Data Book”, Kalaikathir Achchagam, 2003.
6. Lingaiah. K.& Narayana Iyengar, “Machine Design Data Hand Book”, Vol.1 & 2, Suma Publishers, 1983

WEB REFERENCE

1. http://agma.org/

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.

REFERENCES

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.

ED5104 – CAD LABORATORY

L	T	P
0	0	3

Computer Aided Drafting – Operating systems – Wire Frame – Surface and Solid Modeling – Simulation and Machining using CNC / DNC Machine Tools – Use of FEM Packages – Relational Data Base – Networking – Practice on Computer Aided Measuring Instruments – Image Processing – Software Development for Manufacturing – CNC Controllers – Use of advanced CNC Machining Packages – Business Data Processing.

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 / CAM Laboratory

1.	CAD Workstations	:	10 Nos
2.	CAD, 3D Modeling Software with assembly, mechanism simulation and drafting modules	:	10 Nos
3.	CAM Software for tool path generation for planer machining, contour machining, drilling, turning etc. & post processing modulus for different CNC controllers	:	10 Nos
4.	Medium production type CNC turning center with popular industrial type controller	:	1
5.	Medium production type CNC machining center with popular industrial type controller	:	1
6.	Bench Model CMM	:	1
7.	Vision & image processing software	:	2
8.	Data Processing Software	:	2

SEMESTER II

CD5151 – MECHANICAL VIBRATIONS

L	T	P
3	0	2

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

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, International Editions, 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.

CD5152 – METALLIC MATERIALS AND MANUFACTURING PROCESSES

L	T	P
3	0	0

UNIT I INTRODUCTION 7

Factors for design based on mechanical, electrical and thermal properties – Dimensional geometrical tolerances – Factors considered for selection of materials.

UNIT II TYPES OF MATERIALS 8

Ferrous metals and alloys – Steel, Stainless steel – Non-ferrous metals and alloys – Aluminium – Brass – Gun Metal

UNIT III MANUFACTURING METHODS 12

Design consideration in methods of manufacturing such as Casting – Sand casting , die casting, investment casting – Machining: Turning, drilling, milling and grinding – Unconventional – EDM, ECM – Forming techniques – Forging, extrusion, sheet metal forming – Powder metallurgy.

UNIT IV ASSEMBLY OF COMPONENTS 10

Press fitting – riveting – screw fastening – flanged connections of tubular parts – Joining of parts by welding, brazing and soldering.

UNIT V CASE STUDIES 8

Case studies on optimization of design for cost – material – methods – Economics of machining.

Total: 45

REFERENCES

1. Crane, F.A.A. and Charles, J.A., “Selection and use of Engineering Materials”, Third Edition, Butterworth’s and Co., 1997.
2. Gladius Lewis., “Selection of Engineering Materials”, PHI, 2002.
3. Scrope Kalpakgain and Steven Schmid., “Manufacturing processes for Engineering materials”, Fourth Edition, Pearson Education Pvt. Ltd., 2003.
4. Dieter G.E., “Mechanical metallurgy”, McGraw Hill, 2002.
5. James Brown, “Advanced Machining Technology Hand book”, McGraw-Hill, 1998
6. Kenneth G.Budingski, “Surface Engineering for wear Resistance”, Prentice Hall, 1988.

CC5153 – INTEGRATED PRODUCT AND PROCESSES DEVELOPMENT

L	T	P
3	0	0

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, Neyourk, NY, 1991, ISBN 0-202-41639-5

CD5154 – 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, acceleration for mechanical linkages of different mechanisms

EQUIPMENTS REQUIRED

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

ELECTIVES

CD5001 – MODAL ANALYSIS OF MECHANICAL SYSTEMS

L	T	P
3	0	0

UNIT I OVERVIEW 6

Introduction to Modal Testing – Applications of Modal Testing – Philosophy of Modal Testing – Summary of Theory – Summary of Measurement Methods – Summary of Analysis – Review of Test Procedure

UNIT II THEORETICAL BASIS 12

Introduction – Single Degree of Freedom (SDOF) System Theory – Presentation and Properties of FRF Data for SDOP System – Undamped Multi-degree of freedom (MDOF) system – Proportional Damping – Hysteretic Damping – General Case – Viscous Damping – General Case – Characteristics and presentation of MDOF – FRF Data – Complete and incomplete models – Non-sinusoidal vibration and FRF Properties – Analysis of Weakly Nonlinear Structures.

UNIT III MOBILITY MEASUREMENT TECHNIQUES 10

Introduction – Basic Measurement System – Structure preparation – Excitation of the Structure – Transducers and Amplifiers – Analyzers – Digital Signal Processing – Use of Different Excitation types – Calibration – Mass Cancellation – Rotational Mobility Measurement – Measurement on Non linear structures – Multi point excitation methods.

UNIT IV MODAL PARAMETER EXTRACTION METHODS 11

Introduction – Preliminary checks of FLRF Data – SDOF Modal Analysis-I – Peak-amplitude – SDOF Modal Analysis-II – Circle Fit Method – SDOF Modal Analysis III – Inverse Method – Residuals – MDOF curve-fitting procedures – MDOF curve fitting in the Time Domain – Global or Multi-Curve fitting – Non linear systems.

UNIT V DERIVATION OF MATHEMATICAL MODELS 6

Introduction – Modal Models – Display of Modal Model – Response Models – Spatial Models – Mobility Skeletons and System Models

Total: 45

REFERENCES

1. Ewins D J, “Modal Testing: Theory and Practice”, John Wiley & Sons Inc., 1988
2. Nuno Manuel Mendes Maia et al, “Theoretical and Experimental Modal Analysis”, Wiley John & sons, 1997.

WEB REFERENCES

1. www.vibetech.com/tech.paper.htm
2. http://scholar.lib.vt.edu/ejournals/MODAL/abstracts/ijaema-1987.html

CD5002 – RAPID PROTOTYPING AND TOOLING

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

L	T	P
3	0	0

UNIT I **7**

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

UNIT II **9**

Classification of RP systems, 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 **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 **10**

Solid Ground Curing – 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 **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.

REFERENCES

1. Terry wohlers, "Wohlers Report 2000", Wohlers Associates, 2000.
2. Paul F Jacobs, "Rapid Prototyping and manufacturing – Fundamentals of Streolithography", Society of Manufacturing Engineering Dearborn, 1992.
3. Rapid Prototyping and Tooling, Industrial Design Centre, IIT, 1998.

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., 1981
2. Hulling, J., “Principles of Tribology “, Mac-millian, 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 – Inter-laminar 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.

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. Kozyrey, Yu. “Industrial Robots”, MIR Publishers Moscow, 1985.
3. Deb, S.R.” Robotics Technology and Flexible Automation”, Tata Mc Graw-Hill, 1994.
4. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey,” Industrial Robotics Technology, Programming and Applications”, Mc Graw-Hill, Int. 1986.

WEB REFERENCES

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

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, 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

CD5011 – DESIGN FOR MANUFACTURE, ASSEMBLY AND ENVIRONMENTS

(Common for M.E. CAD and M.E. CAD/CAM)

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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 and Design – Possible solutions – Materials choice – Influence of materials on form design – form design of welded members – forging 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, "Design for Assembly Automation and Product Design", Marcel Dekker, 1980.
2. Bralla, "Design for Manufacture handbook", McGraw hill, 1999.
3. Fixel, J., "Design for the Environment", McGraw hill, 1996.
4. Graedel T. Allen By. B, "Design for the Environment Angle Wood Cliff', Prentice Hall, Reason Pub., 1996.
5. Kevien Otto and Kristin Wood, "Product Design", Pearson Publication, 2004.

Website

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

IE5011 – ENTERPRISE RESOURCE PLANNING

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UNIT I ENTERPRISE RESOURCE PLANNING 10

Principle – ERP framework – Business Blue Print – Business Engineering vs Business process Re-Engineering – Tools – Languages – Value chain – Supply and Demand chain – Extended supply chain management – Dynamic Models –Process Models

UNIT II TECHNOLOGY AND ARCHITECTURE 10

Client / Server architecture – Technology choices – Internet direction – Evaluation framework – CRM – CRM pricing – chain safety – Evaluation framework

UNIT III ERP SYSTEM PACKAGES 10

SAP – People soft, Baan and Oracle – Comparison – Integration of different ERP applications – ERP as sales force automation – Integration of ERP and Internet – ERP Implementation strategies – Organizational and social issues.

UNIT IV ORACLE 7

Overview – Architecture – AIM – applications – Oracle SCM – SAP: Overview – Architecture – applications – Before and after Y2k – critical issues – Training on various modules of IBCS ERP Package – Oracle ERP and MAXIMO, including ERP on the NET

UNIT V ERP PROCUREMENT ISSUES 8

Market Trends – Outsourcing ERP – Economics – Hidden Cost Issues – ROI – Analysis of cases from five Indian Companies.

Total: 45

REFERENCES

1. Sadagopan. S , “ERP – A Managerial Perspective”, Tata McGraw Hill, 1999.
2. Jose Antonio Fernandez, “The SAP R/3 Handbook”, Tata McGraw Hill, 1998.
3. Vinod Kumar Crag and N.K.Venkitakrishnan, “Enterprise Resource Planning – Concepts and Practice”, Prentice Hall of India, 1998.
4. Garg & Venkitakrishnan, “ERPWARE, ERP Implementation Framework”, Prentice Hall, 1999.
5. Thomas E Vollmann and Bery Whybark, “Manufacturing and Control Systems’, Galgothia Publications, 1998.

ED5005 – 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 – 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 – 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”, 1996.

WEB REFERENCES

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

CD5014 – PLASTICITY AND METAL FORMING

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UNIT I THEORY OF PLASTICITY 9

Theory of plastic deformation – Engineering stress and strain relationship – Stress tensor – Strain tensor – Yield criteria's – Plastic stress strain relationship – Plastic work – Equilibrium conditions – Incremental plastic strain

UNIT II CONSTITUTIVE RELATIONSHIPS AND INSTABILITY 7

Uniaxial tension test – Mechanical properties – Work hardening – Compression test – bulge test – plane strain compression stress – plastic instability in uniaxial tension stress – plastic instability in biaxial tension stress

UNIT III ANALYSIS OF METAL FORMING PROBLEMS 12

Slab analysis – Slip line method – upper bound solutions – statistically admissible stress field – numerical methods – contact problems – effect of friction – thermo elastic Elasto plasticity – elasto visco plasticity – Thermo mechanical coupling – Analysis of forging – rolling – extrusion and wire drawing processes – Experimental techniques of the evaluation of metal forming

UNIT IV SHEET METAL FORMING 8

Bending theory – Cold rolling theory – Hill's anisotropic theory – Hill's general yield theory – Sheet metal forming – Elements used – Mesh generation and formulation – Equilibrium equations – Consistent full set algorithm – Numerical solutions procedures – examples of simulation of simple parts – Bench mark tests – Forming limit diagrams

UNIT V ADVANCES IN METAL FORMING 9

Orbital forging – Isothermal forging – Warm forging – Hot and Cold isotropic pressing – high speed extrusion – rubber pad forming – micro blanking – Overview of Powder Metal techniques – Powder rolling – Tooling and process parameters

Total: 45

REFERENCES

1. Wagoner. R H., and Chenot. J.J., "Metal Forming Analysis", Cambridge University Press, 2002.
2. Slater. R.A.C., "Engineering Plasticity - Theory & Applications to Metal Forming", John Wiely and Sons, 1987.
3. Shiro Kobayashi, Altan. T, "Metal Forming and Finite Element Method", Oxford University Press, 1989.
4. Narayanaswamy. R, "Theory of Metal Forming Plasticity", Narosa Publishers, 1999.
5. Hosford. W. F and Caddell. RM., "Metal Forming Mechanics and Metallurgy", Prentice Hall Eaglewood Cliffs, 1993.