



MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Accredited by NAAC, NBA & Affiliated to Anna University)
Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.

M.E-CAD/CAM Curriculum/Syllabus Regulation-2016



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(Approved by AICTE, Accredited by NAAC & NBA, Affiliated to Anna University)

Rasipuram - 637 408, Namakkal Dt, Tamil Nadu.

Ph. No.: 04287-220837

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RASIPURAM

M.E. CAD/CAM

TOTAL NO. OF CREDITS TO BE EARNED FOR THE AWARD OF DEGREE = 68

GROUPING OF COURSES

1. Foundation Course (FC)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1	16CMA01	Advanced Numerical Methods	FC	5	3	2	0	4
2	16CMA02	Applied Mathematics	FC	5	3	2	0	4
3	16CMA03	Applied Probability and Statistics	FC	5	3	2	0	4
4	16CMA04	Design of Experiments and Research Methodology	FC	5	3	2	0	4

2. Professional Core (PC)



S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1	16CMB01	Computer Applications in Design	PC	5	3	0	2	4
2	16CMB02	Competitive Manufacturing Systems	PC	3	3	0	0	3
3	16CMB03	Design for Manufacture and Assembly	PC	3	3	0	0	3
4	16CMB04	CNC Machines and Robotics	PC	5	3	0	2	4
5	16CMB05	Advanced Strength of Materials	PC	4	2	2	0	3
6	16CMB06	Finite Element Analysis and Applications	PC	5	3	0	2	4
7	16CMB07	Integrated Product and Process Development	PC	3	3	0	0	3
8	16CMB08	Industrial Safety Management	PE	3	3	0	0	3
9	16CMB09	Applied Materials Engineering	PC	3	3	0	0	3
10	16CMB10	Computational Fluid Dynamics	PE	4	2	2	0	3
11	16CMB11	Data communications in CAD/CAM	PE	3	3	0	0	3
12	16CMB12	Mechanisms Design and Simulation	PE	3	3	0	0	3

3. Professional Electives (PE)


S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1	16CMC01	Optimization Techniques in Design	PE	4	2	2	0	3
2	16CMC02	Advanced Tool Design	PE	4	2	2	0	3
3	16CMC03	Computer Control in Process Planning	PE	4	2	2	0	3
4	16CMC04	Reliability in Engineering Systems	PE	4	2	2	0	3
5	16CMC05	Tribology in Composite Materials Design	PE	4	2	2	0	3
6	16CMC06	Design of Material Handling Equipments	PE	3	3	0	0	3
7	16CMC07	Mechatronics Applications in Manufacturing	PE	3	3	0	0	3
8	16CMC08	Modeling and Analysis of Manufacturing Systems	PC	3	3	0	0	3
9	16CMC09	Productivity Management and Re-Engineering	PE	3	3	0	0	3
10	16CMC10	Design and Manufacturing of Composite Materials	PE	3	3	0	0	3
11	16CMC11	Integrated Mechanical Design	PE	3	3	0	0	3
12	16CMC12	Additive Manufacturing	PE	3	3	0	0	3

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1.	16CMD01	Project Work Phase -I	EEC	12	0	0	12	6
2.	16CMD02	Project work Phase -II	EEC	24	0	0	24	12
3.	16CMD03	Comprehension and Paper Presentation	EEC	4	0	0	4	2
4.	16CMD04	Simple Design & Analysis Project	EEC	4	0	0	4	2


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		MUTHAYAMMAL ENGINEERING COLLEGE (Autonomous) (Approved by AICTE & Affiliated to Anna University), RASIPURAM – 637 408					CURRICULUM PG R - 2016	
Department		Mechanical						
Programme		M.E CAD/CAM						
SEMESTER - I								
Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours	
			L	T	P			
THEORY								
1.	16CMA01	Advanced Numerical Methods	2	2	0	4	4	
2.	16CMB01	Computer Applications in Design	3	0	2	4	5	
3.	16CMB02	Competitive Manufacturing Systems	3	0	0	3	3	
4.	16CMB03	Design for Manufacture and Assembly	3	0	0	3	3	
5.	16CMB04	CNC Machines and Robotics	3	0	2	4	5	
6.	16CMB05	Advanced Strength of Materials	2	2	0	3	4	
Total Credits						21		
		MUTHAYAMMAL ENGINEERING COLLEGE (Autonomous) (Approved by AICTE & Affiliated to Anna University), RASIPURAM – 637 408					CURRICULUM PG R - 2016	
Department		Mechanical						
Programme		M.E CAD/CAM						
SEMESTER - II								
Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours	
			L	T	P			
THEORY								
1.	16CMB06	Finite Element Analysis and Applications	3	0	2	4	5	
2.	16CMB07	Integrated Product and Process Development	3	0	0	3	3	
3.	16CMB08	Industrial Safety Management	3	0	0	3	3	
4.	16CMC**	Elective I	2	2	0	3	4	
5.	16CMC**	Elective II	3	0	0	3	3	
6.	16CMD03	Comprehension and Paper Presentation	0	0	4	2	4	
7.	16CMD04	Simple Design & Analysis Project	0	0	4	2	4	
Total Credits						20		

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Sl. No.		Course Code	Course Name	Hours/ Week			Credit	Contact Hours
				L	T	P	C	
SEMESTER - III								
THEORY								
1.	16CMC**	Elective III		2	2	0	3	4
2.	16CMC**	Elective IV		3	0	0	3	5
3.	16CMC**	Elective V		3	0	0	3	3
PRACTICAL								
4	16CMD01	Project Work Phase I		0	0	12	6	12
Total Credits							15	
		MUTHAYAMMAL ENGINEERING COLLEGE (Autonomous) (Approved by AICTE & Affiliated to Anna University), RASIPURAM – 637 408					CURRICULUM PG R - 2016	
Department			Mechanical					
Programme			M.E CAD/CAM					
SEMESTER - IV								
PRACTICAL								
1.	16CMD02	Project Work Phase II		0	0	24	12	12
Total Credits							12	


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16CMA01 ADVANCED NUMERICAL METHODS I

L T P C
3 2 0 4

COURSE OBJECTIVES

- To learn the algebraic equations which finds applications in many engineering branches.
- To make the student acquire sound knowledge of computational techniques in solving ordinary differential equations that model engineering.
- To solve Elliptic equations by using computational techniques
- To introduce numerical tools for the solutions of partial differential equations that model several physical processes
- To deal with interpolation and approximation for the application of finite element analysis
- To impart knowledge on numerical methods that will come in handy to solve numerically the problems that arise in engineering and technology.

COURSE OUTCOMES

1. Demonstrate understanding and implementation of numerical solution algorithms applied to solve algebraic equations
2. Be familiar with numerical solutions of ordinary differential equation and partial differential equations.
3. Be competent with finite difference method and finite element method.
4. Understanding the theoretical and practical aspects of the use of numerical methods. Implementing numerical methods for a variety of multidisciplinary applications. Establishing the limitations, advantages, and disadvantages of numerical methods
5. The students will have a clear perception of the power of numerical Techniques. This will also serve as a precursor for future research.
6. Students would be able to demonstrate the applications of numerical techniques to problems drawn from industry, management and other engineering fields.

UNIT I: ALGEBRAIC EQUATIONS

9+6

Systems of linear equations: Gauss Elimination method, pivoting techniques, Thomas algorithm for tridiagonalsystem – Jacobi, Gauss Seidel, SOR iteration methods - Systems of nonlinear equations: Fixed point iterations, Newton Method, Eigenvalue problems: power method, inverse power method, Faddeev – Leverrier Method.

UNIT II: ORDINARY DIFFERENTIAL EQUATIONS

9+6

RungeKutta Methods for system of IVPs, numerical stability, Adams - Bashforth multistep method, solution of stiff ODEs, shooting method, BVP: Finite difference method, orthogonal collocation method, orthogonal collocation with finite element method, galerkin finite element method.

UNIT III: FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATIONS

9+6

Parabolic equations: explicit and implicit finite difference methods, weighted average approximation - Dirichlet and Neumann conditions – Two dimensional parabolic equations – ADI method; First order hyperbolic equations – method of characteristics, different explicit and implicit methods; numerical stability analysis, method of lines – Wave equation: Explicit scheme - Stability of above schemes.

UNIT IV: FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS

9+6

Laplace and Poisson's equations in a rectangular region: Five point finite difference schemes, Leibmann's iterative methods, Dirichlet and Neumann conditions – Laplace equation in polar coordinates: finite difference schemes – approximation of derivatives near a curved boundary while using a square mesh.

UNIT V: FINITE ELEMENT METHOD

9+6

Partial differential equations – Finite element method – orthogonal collocation method, orthogonal collocation with finite element method, Galerkin finite element method.

TOTAL: P: 45 + T: 30 = 75

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	M.K. Jain , S.R.K. Iyengar,R.K. Jain	Computational Methods for Partial Differential Equations, 2 nd Edition	New Age Publishers	2016
2.	S. K. Gupta	Numerical Methods for Engineers, 3 rd Edition	New Age International Pvt Ltd Publishers	2015
3.	SaumyenGuha and Rajesh Srivastava	Numerical methods for Engineering and Science	Oxford Higher Education, New Delhi	2010
4.	M.K. Jain	Numerical Methods for Scientific & Engineering Computation, 6 th Edition	New Age International Publishers	2010
5.	Burden, R.L., and Faires, J.D.	Numerical Analysis –Theory and Applications	Cengage Learning, India Edition, New Delhi	2009

WEB URLs

1. http://nptel.ac.in/courses/103101111/downloads/Lecture-notes/Module_4_Solving_Ax=b.pdf
2. www.youtube.com/watch?v=FmhMUTmUjhM
3. https://mat.iitm.ac.in/home/sryedida/public_html/caimna/pde/fifth/example.html
4. www.youtube.com/watch?v=BERb9PRiVB4
5. www.math.tifr.res.in/~publ/ln/tifr49.pdf

16CMA02

APPLIED MATHEMATICS

L T P C
3 2 0 4

COURSE OBJECTIVES

- To realize the use of matrix theory techniques in engineering applications and to develop for future applications.
- To analyze and solve the fundamental problem with prescribed or free boundary conditions in simple cases
- Demonstrate knowledge of mathematics and mechanics to construct, analyze and interpret real world problems
- Provide a foundation and motivation for exposure to statistical ideas subsequent to the course.
- To formulate and construct a mathematical model for a linear programming problem in real life situation
- To introduce Fourier series analysis which is central to many applications in engineering

COURSE OUTCOMES

1. Explain geometrical concepts related to orthogonality and least squares solutions and perform calculations related to orthogonality.
2. The variational calculus makes access to mastering in a wide range of classical results of variational calculus. Students get up apply results in technical problem solutions
3. The students will have a basic knowledge of the main fields of mathematics and mechanics, including differential equations, elasticity theory, fluid mechanics.
4. The students will have an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable
5. The knowledge gained on this course helps the students to do engineering optimization.
6. Demonstrate an understanding of the basic concepts of Fourier series analysis

UNIT I: MATRIX THEORY

9+6

The Cholesky decomposition - Generalized Eigen vectors, Canonical basis - QR factorization - Least squares method - Singular value decomposition.

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UNIT II: CALCULUS OF VARIATIONS

9+6

Concept of variation and its properties – Euler’s equation – Functional dependant on first and higher order derivatives – Functionals dependant on functions of several independent variables – Variational problems with moving boundaries – problems with constraints - Direct methods: Ritz and Kantorovich methods.

UNIT III: ONE DIMENSIONAL RANDOM VARIABLES

9+6

Random variables - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a Random Variable.

UNIT IV: LINEAR PROGRAMMING

9+6

Formulation – Graphical solution – Simplex method – Two phase method - Transportation and Assignment Models

UNIT V: FOURIER SERIES AND EIGEN VALUE PROBLEMS

9+6

Fourier Trigonometric series: Periodic function as power signals – Convergence of series – Even and odd function: cosine and sine series – Non-periodic function: Extension to other intervals - Power signals: Exponential Fourier series – Parseval’s theorem and power spectrum – Eigen value problems and orthogonal functions – Regular Sturm-Liouville systems – Generalized Fourier series.

TOTAL: L: 45 + T: 30 = 75

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Mital.K.V. Mohan and Chander	Optimization Methods in Operations Research and Systems Analysis, 4 th Edition	New Age International Publishers	2016
2.	Stark. H., and Woods. J.W.	Probability and Random Processes with Applications to Signal Processing, 4 th Edition	Pearson Education, Asia	2014
3.	Hamdy ATaha	Operations Research, 9 th Edition (Asia)	Pearson Education, Asia	2014
4.	Gupta, A.S.	Calculus of Variations with Applications	Prentice Hall of India Pvt. Ltd., New Delhi	2011
5.	Richard Bronson	Matrix Operation, Schaum’s outline series, 2 nd Edition	McGraw Hill	2011

WEB URLs

1. <http://nptel.ac.in/courses/111108066/>
<http://www.cs.utexas.edu/~pingali/CS378/2011sp/lectures/chol4.pdf>
2. <http://www.math.uni-leipzig.de/~miersemann/variabook.pdf>
3. http://nptel.ac.in/courses/IIT-MADRAS/Principles_of_Communication1/Pdfs/1_5.pdf
4. <http://nptel.ac.in/courses/111104027/>
5. <http://nptel.ac.in/courses/111106046/>

16CMA03

APPLIED PROBABILITY AND STATISTICS

L T P C
3 2 0 4

COURSE OBJECTIVES

- To introduce the basic concepts of one dimensional and two dimensional Random Variables.
- To gain knowledge in the application of family of random variables in real life situations
- To provide information about Correlation and Regression
- Learn about maximum likelihood estimation, unbiased estimation and least square methods.
- To understand concepts of testing of hypothesis

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- To enable the students to use the concepts of multivariate normal distribution and principle components analysis.

COURSE OUTCOMES

- Analyze random or unpredictable experiments and investigate important features of random experiments. Construct probabilistic models for observed phenomena through distributions which play an important role in many engineering applications.
- Associate random variables by designing joint distributions and correlate the random variables
- Perform and interpret correlation and regression analysis and develop correlation models to predict changes in processes and products for linear and non-linear relationships
- Provides knowledge to apply testing of hypothesis to real life problems.
- Be familiar with multivariate analysis.
- The student will able to acquire the basic concepts of Probability and Statistical techniques for solving mathematical problems which will be useful in solving Engineering problems

UNIT I: ONE DIMENSIONAL RANDOM VARIABLES 9+6

Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Functions of a Random Variable.

UNIT II: TWO DIMENSIONAL RANDOM VARIABLES 9+6

Joint distributions – Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve – Correlation.

UNIT III: ESTIMATION THEORY 9+6

Unbiased Estimators – Method of Moments – Maximum Likelihood Estimation - Curve fitting by Principle of least squares – Regression Lines.

UNIT IV: TESTING OF HYPOTHESES 9+6

Sampling distributions - Type I and Type II errors - Tests based on Normal, t, Chi-Square and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit.

UNIT V: MULTIVARIATE ANALYSIS 9+6

Random Vectors and Matrices - Mean vectors and Covariance matrices - Multivariate Normal density and its properties - Principal components Population principal components – Principal components from standardized variables.

TOTAL: L: 45 +T: 30=75

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Douglas C. Montgomery, George C. Runger	Applied Statistics and Probability for Engineers (International Student Version), 6 th Edition	John Wiley & Sons, Inc.	2016
2.	Richard A. Johnson and Dean W. Wichern,	Applied Multivariate Statistical Analysis, 6 th Edition	Pearson Education, Asia	2015
3.	Gupta S.C. and Kapoor V.K	Fundamentals of Mathematical Statistics	Sultan Chand & Sons	2014
4.	HweiP.Hsu,	Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes	Tata McGraw Hill Edition, New Delhi	2014
5.	Walpole. R.E., Myers. R.H., Myers. S.L., and Ye. K.,	Probability and Statistics for Engineers and Scientists, 8th Edition	Pearson Education, Asia	2013

WEB URLs

1. <http://www.maths.qmul.ac.uk/~pettit/MAS109/chp4.pdf>
<http://nptel.ac.in/courses/111105041/>
2. <http://nptel.ac.in/courses/117104117/>
3. http://www.efunda.com/math/least_squares/least_squares.cfm
4. <http://nptel.ac.in/courses/111105041/33>
5. <http://nptel.ac.in/courses/110105060/>

16CMA04 DESIGN OF EXPERIMENTS AND RESEARCH METHODOLOGY

L T P C
3 2 0 4

COURSE OBJECTIVES

- To introduce different research methods
- To understand different testing methods of hypotheses
- To understand the terminology in design of experiments
- To illustrate the interaction between different input data
- To familiarize the statistical approach in experimental data analysis
- To design different experimental design

COURSE OUTCOMES

1. Understand the fundamentals of research methodology.
2. Illustrate the different testing methods in research
3. Develop different design of experiments
4. Comprehend the interaction between input data
5. Identify and construct various statistical approach
6. Construct experimental design and provide recommendation

UNIT I: INTRODUCTION OF RESEARCH METHODOLOGY

9

Research methodology - definition, mathematical tools for analysis, Types of research, exploratory research, conclusive research, modeling research, algorithmic research, Research process- steps. Data collection methods

UNIT II: TESTING METHODS

9

Hypotheses testing - Testing of hypotheses concerning means (one mean and difference between two means -one tailed and two tailed tests), concerning variance - one tailed Chi-square test.

UNIT III: DESIGN OF EXPERIMENTS

9

Special Terminology - Design of Experiments, Response variable, Measured output value, Factors- Input variables that can be changed, Levels - Specific values of factors (inputs), Continuous or discrete, Replication- Completely re-run experiment with same input levels - Used to determine impact of measurement error, Interaction- Effect of one input factor depends on level of another input factor.

UNIT IV: STATISTICAL APPROACH

9

Design of Experiments (DOE) - A statistics-based approach to design experiments, A methodology to achieve a predictive knowledge of a complex, multi-variable process with the fewest acceptable trials, An optimization of the experimental process itself, Major Approaches to DOE - Factorial Design, Taguchi Method and Response Surface Design.

UNIT V: INTRODUCTION AND OVERVIEW OF EXPERIMENTAL DESIGN

9

Introduction and Overview of Experimental Design - The seven essential components of designing - Choosing the response (i.e. the dependent variable to be measured), Choosing the factors and levels (i.e. the independent variables and their values), Choosing experimental plan, Conduct the experiment, Analyze the data, Draw conclusions and make recommendations.

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TOTAL: L: 45+ T: 30 = 75

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	C.R.Kothari, Gaurav Garg	Research methods and techniques	3 rd edition, new age international publications	2014
2	Montgomery, Douglas C	Design and Analysis of Experiments” (International Student Version)	8th edition, John Wiley & Sons	2012
3	Douglas C. Montgomery, George C. Runger	Applied Statistics and Probability for Engineers (International Student Version)	6 th Edition, John Wiley & Sons, Inc	2016
4	Montgomery, Douglas C., Runger, George C. and Hubele, Norma F.	Engineering Statistics	5th edition, John Wiley & Sons	2012
5	Jeffrey A. Gliner George A. Morgan, and Nancy L. Leech	Research methods in applied settings: an integrated approach to design and analysis	Taylor & Francis	2016

WEB URLs

1. <https://explorable.com/research-methodology>
2. www.jestr.org/downloads/volume2/fulltext1809.pdf
3. www.me.udel.edu/old-meeg401/06/design-resources-testing.html
4. <https://mecheng.adelaide.edu.au/current-students/projects/>
5. <https://explorable.com/research-methodology>

16CMB01 COMPUTER APPLICATIONS IN DESIGN

L T P C
3 0 2 4

COURSE OBJECTIVES

- To impart the fundamental theory of the computer graphics.
- To understand the computer application and design for curves and surface modeling.
- To familiarize the basic fundamental of NURBS and solid modeling.
- To understand the algorithms of shading, coloring in visual realism.
- To impart knowledge on the various aspects of modeling of assembly parts.
- To understand the various analyses in product data exchange

COURSE OUTCOMES

1. Explain the primitives in computer graphics, 2D and 3D transformations
2. Explain different types of curves in surface modelling
3. Discuss the various types of curves in solid modeling.
4. Explain the algorithms and principles of creation of prismatic and lofted parts
5. Examine the mechanism involved in assembly modeling.
6. Understand and analysis the product data exchange.

UNIT I: INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS

9

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

UNIT II: CURVES AND SURFACES MODELLING 9
Introduction to curves - Analytical curves: line, circle and conics - synthetic curves - Hermit cubic spline- Bezier curve and B-Spline curve - curve manipulations- Introduction to surfaces - Analytical surfaces: Plane surface, ruled surface, surface of revolution and tabulated cylinder - synthetic surfaces - Hermit bicubic surface- Bezier surface and B-Spline surface- surface manipulations.

UNIT III: NURBS AND SOLID MODELING 9
NURBS – Basics- curves, lines, arcs, circle and bi linear surface - primitive instancing - sweep representations -boundary representations - constructive solid Geometry - comparison of representations - user interface for solid modeling.

UNIT IV: VISUAL REALISM 9
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 V: ASSEMBLY OF PARTS AND PRODUCT DATA EXCHANGE 9
Assembly modeling - interferences of positions and orientation - tolerances analysis - mass property calculations - mechanism simulation - Graphics and computing standards - IGES, STEP etc-Communication standards

TOTAL: L: 45 = 45

List of Experiments

Design

1. Sketcher
2. Solid modeling
3. Surface modeling
4. Feature manipulation
5. Assembly
6. Drafting

Analysis of mechanical components

7. Machine elements under Static loads
8. Thermal Analysis of mechanical systems
9. Modal Analysis
10. Machine elements under Dynamic loads
11. Non-linear systems

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	John F. Hughes, Andries van Dam, Morgan McGuire, David F. Sklar, James D. Foley, Steven K. Feiner, Kurt Akeley	Computer Graphics: Principles and Practice	Addison-Wesley Professional; 3rd edition	2013
2	Donald Hearn and M. Pauline Baker	Computer Graphics	Prentice Hall, Inc	2016
3	Ibrahim Zeid	Mastering CAD/CAM	McGraw-Hill, Inc	2007
4	Foley, Wan Dam, Feiner and Hughes	Computer graphics principles & practices	Pearson Education	2003

5	David F. Rogers, James Alan Adams	Mathematical elements for computer graphics	second edition, Tata McGraw-Hill	2010
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WEB URLs

1. href="http://www.engineerthink.com/blog/2016/07/computer-graphics-c-version-2nd-edition-by-donald-hearn-pdf/
2. www.saylor.org/site/wp-content/.../09/ME101-4.1-Engineering-Design-Process.pdf
3. https://archive.org/details/DonaldHearnM.PaulineBakerComputerGraphicsBookFi.org
4. www.cadcamnet.com
5. www.goodreads.com/author/show/541271.Ibrahim_Zeid

16CMB02 COMPETITIVE MANUFACTURING SYSTEMS

L T P C
3 0 0 3

COURSE OBJECTIVES

- To emphasize the knowledge on quality improvement and automation
- To know how to create highest caliber products quickly and inexpensively.
- To know the principles of flexible manufacturing systems.
- To understand the modern methods required for manufacturing competitive environment.
- To comprehend the necessity of customer focused manufacturing.
- To understand the factors to consider for the quality manufacturing.

COURSE OUTCOMES

1. Understand the principles of manufacturing in a competitive environment.
2. Understand and explain group technology and flexible manufacturing
3. Explain the hierarchy of computer control
4. Explain the software required for simulation and database for flexible manufacturing systems.
5. Understand and explain the principles and methods of lean manufacturing.
6. Explain the elements involved in Just in time process.

UNIT I: MANUFACTURING IN A COMPETITIVE ENVIRONMENT

9

Automation of manufacturing process - Numerical control - Adaptive control - material handling and movement - Industrial robots - Sensor technology - flexible fixtures - Design for assembly, disassembly and service

UNIT II: GROUP TECHNOLOGY & FLEXIBLE MANUFACTURING

9

Part families - classification and coding - Production flow analysis - Machine cell design - Benefits. Components of FMS - Application work stations - Computer control and functions - Planning, scheduling and control of FMS - Scheduling - Knowledge based scheduling - Hierarchy of computer control - Supervisory computer.

UNIT III: COMPUTER SOFTWARE, SIMULATION AND DATABASE OF FMS

9

System issues - Types of software - specification and selection - Trends - Application of simulation - software - Manufacturing data systems - data flow - CAD/CAM considerations - Planning FMS database.

UNIT IV: LEAN MANUFACTURING

9

Origin of lean production system -Customer focus -Muda (waste) -Standards -5S system -Total Productive Maintenance -standardized work -Man power reduction -Overall efficiency - Kaizen - Common layouts - Principles of JIT - Jidoka concept -Poka-Yoke (mistake proofing) - Worker Involvement-Quality circle activity -Kaizen training - Suggestion Programmes-Hoshin Planning System (systematic planning methodology) - Lean culture.

UNIT V: JUST IN TIME

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Characteristics of JIT - Pull method - quality -small lot sizes - work station loads - close supplier ties - flexible work force - line flow strategy - preventive maintenance - Kanban system - strategic implications - implementation

TOTAL: L: 45= 45

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Pascal Dennis	Lean Production Simplified: A Plain-Language Guide to the World's Most Powerful Production System	Second edition, Productivity Press, New York	2016
2	Groover M.P	Automation, Production Systems and Computer Integrated Manufacturing	Third Edition, Prentice-Hall	2014
3	Jha, N.K	Handbook of Flexible Manufacturing Systems	Academic Press Inc	2012
4	Wilson	How to Implement Lean Manufacturing	McGraw-Hill Publishing Company	2015
5	Allen N. Mendl	Just in Time	Solution Tree	2005

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2. www.worldcat.org/title/lean-production...a...to.../editions?...editions View.
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4. <https://didattica.uniroma2.it/files/scarica/insegnamento/.../13265-Lesson-1-Introduction>
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16CMB03 DESIGN OF MANUFACTURE AND ASSEMBLY

L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand the selection of materials, methods, fits and tolerance concepts to design a Product.
- To familiarize the basic concept of design for castings, forming and machining.
- To understand the factors influencing the manufacturing processes.
- To comprehend the factors influencing the designing of cast and machined components.
- To understand the basic procedure of design for assembly and environments.
- To familiarize the tools required in various manufacturing processes..

COURSE OUTCOMES

1. Understand the basic principles for manufacturability.
2. Understand and explain the factors influencing the form design systems
3. Demonstrate the design considerations required for machined components
4. Comprehend and explain the design consideration for cast components.
5. Demonstrate the need for designing for environment
6. Explain life cycle assessment.

UNIT I: BASICS OF DESIGNING PRINCIPLES

20

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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 SYSTEMS 9
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 9
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 9
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: L: 45= 45

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Kevin Otto and Kristin Wood	Product Design	Pearson Publication	2011
2	Boothroyd, G, Hertz and Nike	Product Design for Manufacture	Marcel Dekker	2010
3	A. K. Chitale and R. C. Gupta	Product Design and Manufacturing	Prentice Hall Inc	2007
4	Fixel, J	Design for the Environment	McGraw hill	1996
5	Dickson, John. R, and Corroda Poly	Engineering Design and Design for Manufacture and Structural Approach	Field Stone Publisher, USA.	1995


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2. www.mgu.ac.in/.../advanced%20manufacturing%20and%20production%20managem.
3. <https://www.crcpress.com/...Design-for-Manufacture-and-Assembly.../book/9781420>.
4. <https://www.nptel.ac.in/courses/107103012/module1/lec1.pdf>
5. <https://www.books.google.co.in> > Technology & Engineering > Industrial Design > General.

16CMB04 CNC MACHINES AND ROBOTICS

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COURSE OBJECTIVES


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- To familiarize in the field of automated machines like computer numerical control and robotics.
- To understand the construction principles of CNC machines.
- To comprehend and explain the elements of control systems in CNC machines
- To understand and develop a computer numerical control program for lathe and milling machine.
- To be able to write programs for robot motion.
- To understand the anatomy of robots and its applications.

COURSE OUTCOMES

1. Understand and explain the CNC lathe and milling machines
2. Identify and explain the types of feedback and control systems in CNC machines
3. Construct and experiment various part programming of CNC lathe and milling
4. Apply and practice basic principles of robotic design.
5. Understand and write programs for various robot motion controls.
6. Understand and explain robot working principles for various applications.

UNIT I: CONSTRUCTIONAL FEATURES OF CNC MACHINES

9

CNC Machines - Concept, Classifications, working principle, advantages and limitation - Constructional features - Machine structure - Friction and Antifriction LM guide ways - Recirculating ball bearings, Linear motion bearings - Feed and spindle drives - Tool turret - Tool changer - ATC, APC - Chip conveyors.

UNIT II: FEEDBACK AND CONTROL SYSTEMS

9

Open loop and closed loop systems - Interpolator - Feedback devices - Digital absolute and incremental measuring system - Incremental rotary encoder, Moiré fringes and absolute rotary encoders - Configuration of CNC system and Interfacing.

UNIT III: PART PROGRAMMING OF CNC LATHE AND MILLING

9

Tooling - Preset, semi-qualified and qualified tooling - Absolute and incremental programming - G and M codes for Lathe and Milling machine - CNC Lathe - Single and multi-pass canned cycle programming - Turning, profile turning, grooving, threading and drilling cycle programming - Tool offset - Tool nose radius compensation CNC Milling - Profile and pocket milling, drilling, boring cycle programming - Cutter diameter compensation CNC Lathe - Single and multi-pass canned cycle programming - Turning, profile turning, grooving, threading and drilling cycle programming - Tool offset - Tool nose radius compensation CNC Milling - Profile and pocket milling, drilling, boring cycle programming - Cutter diameter compensation.

UNIT IV: FUNDAMENTAL CONCEPT OF ROBOTICS

9

History, Robot Anatomy - work volume - drive system - Control system and Dynamic performance - End effector, Gripper - Mechanical, hydraulic and Pneumatic gripper and Tool as end effector - Robotic sensor, Tactile and Proximity sensors - Robot applications in material handling system, processing and its assembly.

UNIT V: ROBOT MOTION CONTROL AND PROGRAMMING


9

Introduction to manipulator kinematics - Homogeneous co-ordinates and Homogeneous transformations for the manipulator - Manipulator path control, motion types - Robot dynamics - Methods of robot programming - Lead through and Robot programming languages - Simple commands in VAL- Working and configurations of five axis CNC machines - Latest CNC tool materials - Applications of robots in automotive industry

TOTAL: L: 45 = 45

List of Experiments

1. Simulation and Machining using CNC / DNC Machine Tools using FEM Packages, Relational Data Base, Networking.
2. Practice on Computer Aided Measuring Instruments.
3. Image Processing.
4. Software Development for Manufacturing.


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5. Use of advanced CNC Machining Packages.
6. Business Data Processing.

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	PM Agarwal and VJ Patel	CNC Fundamentals and Programming	Charotar Publishing House	2014
2	P Radhakrishnan	Computer Numerical Control CNC machines	New central book agency	2013
3	A. K. Chitale and R. C. Gupta	Mechatronics	Tata McGraw Hill Publications	2009
4	Mikell P Groover, Mitchell weiss, Roger N Nagel G Odrey	Industrial Robotics	TATA Mc-Graw Hill	2012
5	KhushdeepGoyal	CNC Machines and Automation	S.K. Kataria & Sons	2014

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3. <https://www.youtube.com/watch?v=3o1waj2fxgY>
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16CMB05ADVANCED STRENGTH OF MATERIALS

L T P C
2 2 0 3

COURSE OBJECTIVES

- To understand the basic concepts of stress, strain, displacement and transformations
- To be able to estimate strength and predict failure of materials
- To able to find the shear stress and shear strain centre.
- To understand and use energy methods to find force, stress and displacement in simple structures.
- To understand stresses in open and closed sections in torsion and bending
- To understand stress functions, and understand stresses in plates and shells, thick circular cylinders and discs, contact stresses and stress concentration.

COURSE OUTCOMES

1. Understand the basic concepts of elasticity and stress strain relationship
2. Locate the shear centre and understand the shear flows for various sections.
3. Solve stress related problems in curved flexible members and plates
4. Examine the torsion forces in non- circular sections
5. Analyze the stress in rotating members
6. Analyze the contact stresses and explain the methods of computing them.

UNIT I: ELASTICITY

6

Stress - Strain relations and equilibrium equations of elasticity in Cartesian, Polar and Spherical coordinates-Differential equations of equilibrium-Compatibility-Boundary conditions -Airy's stress - Representation of three-dimensional stress of a tension-Generalized Hook's law.

UNIT II: SHEAR CENTRE AND UNSYMMETRICAL BENDING 6
 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 PLATES 6
 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.

UNIT IV: TORSION OF NON-CIRCULAR SECTIONS 6
 Torsion of rectangular cross section-St.Venants theory-Elastic membrane analogy-Prandtl's stress function-Torsional stress in hollow thin walled tubes.

UNIT V: STRESSES IN ROTATING MEMBER AND CONTACT STRESSES 6
 Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness with allowable speeds-Methods of computing contact stress-Deflection of bodies in point and line contact applications.

TOTAL: L: 30+ T: 30=60

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Allan F. Bower	Applied Mechanics of Solids	CRC press – Special Indian Edition -2012	2010
2	Srinath. L.S	Advanced Mechanics of solids	Tata McGraw Hill	2009
3	K. Baskar and T.K. Varadan	Theory of Isotropic/Orthotropic Elasticity	Ane Books Pvt. Ltd	2009
4	Boresi, Arthur P. and Schmidt Richard J	Advanced Mechanics of Materials	6th Ed,," John Wiley - Sons	2003
5	G H Ryder	Strength of Materials	Macmillan, India Ltd	2007

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2. <https://books.google.co.in/books?isbn=0486654079>
3. nptel.ac.in/courses/112101095
4. <http://www.myopencourses.com/subject/advanced-strength-of-materials#>
5. <http://textofvideo.nptel.iitm.ac.in/112101095/lec27.pdf>

16CMB06FINITE ELEMENT ANALYSIS AND APPLICATIONS

L T P C
3 0 2 4

COURSE OBJECTIVES

- To obtain an understanding of the fundamental theory of the FEA method.
- To understand the application and use of the FE method for heat transfer problems.

- To understand the use of the basic finite elements for structural applications using truss, beam, frame, and plane elements.
- To be able to use the basic finite elements for structural applications using plane stress, plane strain problems.
- To understand the overview of application packages such as ANSYS and DEFORM.
- To be able to develop code for one dimensional analysis and validation.

COURSE OUTCOMES

1. Apply the procedure involved to solve a structural problem using Finite Element Methods.
2. Develop the element stiffness matrices using different approach.
3. Develop the global and natural co-ordinates, shape functions for one and two dimensional elements
4. Analyze a 2D problem using line, triangular, Axisymmetry, quadrilateral element, Tetrahedral and hexahedral elements.
5. Develop FEA/FEM general pre and post processing solutions.
6. Develop code for one dimensional analysis and validation.

UNIT I: INTRODUCTION

9

Basics of FEM - Initial value and boundary value problems - weighted residual Galerkin and Raleigh Ritz methods - review of Variational calculus - Integration by parts - Basics of Variation formulation.

UNIT II: ONE DIMENSIONAL ANALYSIS

9

Steps in FEA - Discretization, function - derivation of element characteristics matrix, shape function, assembly and imposition of boundary conditions - solution and post processing - One dimensional analysis in solid mechanics and heat transfer.

UNIT III: SHAPE FUNCTIONS AND HIGHER ORDER FORMULATIONS

9

Global and Natural Co-ordinates - Shape functions for one and two dimensional elements - Three Noded triangular and four Noded quadrilateral element - Nonlinear analysis -Isoparametric elements - Basics of two dimensional axi symmetric analyses

UNIT IV: TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS

9

Equations of elasticity - Plane stress, plane strain and Axisymmetry problems - Body forces and temperature effects - Stress calculations - Plate and shell elements.

UNIT V: COMPUTER IMPLEMENTATION

9

Pre Processing, Mesh generation, elements connectivity, boundary conditions, input of material and processing characteristics - Solution and post processing - Overview of application packages such as ANSYS and DEFORM - Development of code for one dimensional analysis and validation.

TOTAL: L: 45 = 45

LIST OF EXPERIMENTS:

1. Assembly modeling of various parts of the clamping device
2. Assembly modeling of various parts of the center lathe.
3. Assembly modeling of piston, gudgeon pin and the crank shaft of IC engines
4. Assembly modeling of various parts of a Fixture
5. Assembly modeling of various parts of the shaper
6. Surface modeling a piston of an I.C. engine.
7. Assembly modeling and simulation of a valve operating mechanism of internal combustion engine.
8. Assembly modeling and simulation of a Mechanism of Hand Pump.
9. Assembly modeling and simulation of a Mechanism of wiper.
10. Assembly modeling and simulation of a transmission system used in automobiles

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Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	S. S. Rao	The Finite Element Method in Engineering	Elsevier Publishers,	2014
2	D. L .Logan	A First Course in the Finite Element Method	Cengage Learning	2012
3	S. S. Bhavikati	Finite Element Analysis	New Age International Publishers	2010
4	Seshu, P	Text Book of Finite Element Analysis	Prentice-Hall of India Pvt. Ltd., New Delhi	2010
5	Reddy. J.N	An Introduction to the Finite Element Method	3rd Edition, Tata McGraw-Hill	2009

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1. <https://www.switch2011.upa.edu.mx/.../EbookFinite%20Element%20Procedures%20in%20Engineering...>
2. web.mit.edu/kjb/www/Principal_Publications/FEP_solutions.pdf
3. <https://books.google.co.in/books?id=2mVqtW7BDpgC&printsec=frontcover#v=onepage&q&f=false>
4. www.vmkvec.ac.in/departments/mechanical/me-manu-ft.pdf
5. <http://nptel.ac.in/courses/112106130>

16CMB07INTEGRATED PRODUCT AND PROCESS DEVELOPMENT

L T P C
3 0 0 3

COURSE OBJECTIVES

- To emphasize the need for integrated product development process
- To understand the significance of customer role in product development
- To be able to generate concepts and test them.
- To know to design for industry requirement and establish the best architecture
- To understand the factors influencing the product development.
- To understand the basics and need of prototyping.

COURSE OUTCOMES

1. Understand the basic principles of product development
2. Identify and demonstrate the concept generation, selection and testing process
3. Demonstrate the establishment of product architecture
4. Apply various tools in industrial design process
5. Explain the elements involved in design for manufacturability.
6. Explain the principles involved in prototyping.

UNIT I: BASIC CONCEPTS OF PRODUCT DEVELOPMENT

9

Need for IPPD-Strategic importance of Product development - integration of customer, designer, material supplier and process planner, Competitor and customer - behavior analysis - Understanding customer-promoting customer understanding-involve customer in development and managing requirements - Organization process management.

UNIT II: CONCEPT GENERATION, SELECTION AND TESTING

9

Plan and establish product specifications. Task - Structured approaches - clarification - search externally and internally-Explore systematically - reflect on the solutions and processes - concept selection - methodology - benefits. Implications - Product change - variety - component standardization - product performance - manufacturability - Concept Testing Methodologies.

UNIT III: PRODUCT ARCHITECTURE

9

Product development management - establishing the architecture - creation - clustering - geometric layout development - Fundamental and incidental interactions - related system level design issues -

secondary systems -architecture of the chunks - creating detailed interface specifications-Portfolio Architecture.

UNIT IV: INDUSTRIAL DESIGN 9

Integrate process design - Managing costs - Robust design - Integrating CAE, CAD, CAM tools - Simulating product performance and manufacturing processes electronically - Need for industrial design-impact - design process - investigation of customer needs - conceptualization - refinement - management of the industrial design process - technology driven products - user - driven products - assessing the quality of industrial design.

UNIT V: DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT 9

Definition - Estimation of Manufacturing cost-reducing the component costs and assembly costs - Minimize system complexity - Prototype basics - Principles of prototyping - Planning for prototypes - Economic Analysis - Understanding and representing tasks-baseline project planning - accelerating the project-project execution.

TOTAL: L: 45 = 45

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Karl T.Ulrich and Steven D.Eppinger	Product Design and Development	McGraw-Hill International Edns	2012
2	G. Dieter and L. Schmidt	Engineering Design	4th ed., McGraw-Hill	2009
3	K Otto and K Wood	Product Design	Pearson Publication	2008
4	Stuart Pugh	Tool Design-Integrated Methods for successful Product Engineering	Addison Wesley Publishing,	2005
5	S Rosenthal	Effective Product Design and Development	Business One Orwin, Homewood	2004

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3. <http://www.ulrich-eppinger.net/>
4. www.acqnotes.com/.../integrated-product-and-process-development
5. www.acq.osd.mil/se/.../DoD-IPPD-Handbook-Aug98.pdf

16CMB08INDUSTRIAL SAFETY MANAGEMENT

L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand the modern safety concepts.
- To be able to understand the role of employee in safety measures
- To provide a structured management approach to control safety risks in various operations.
- To be able to integrate health & safety measures into all tasks.
- To understand the techniques involved in accident prevention
- To know safety, health, welfare and laws.

COURSE OUTCOMES

1. Explain the modern safety concepts and safety management functions.
2. Acquire, articulate and apply specialized knowledge relevant to operational safety.
3. Demonstrate the safety measures in various types of working places.
4. Explain the causes and costs of accidents
5. Illustrate the methods of accident prevention.
6. Comprehend various laws and welfare activities related to safety and health.

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UNIT I: SAFETY MANAGEMENT

9

Evaluation of modern safety concepts - Safety management functions - safety organization, safety department - safety committee, safety audit - performance measurements and motivation - employee participation in safety - safety and productivity.

UNIT II: OPERATIONAL SAFETY

9

Hot metal Operation - Boiler, pressure vessels - heat treatment shop - gas furnace operation - electroplating-hot bending pipes - Safety in welding and cutting. Cold-metal Operation - Safety in Machine shop - Cold bending and chamfering of pipes - metal cutting - shot blasting, grinding, painting - power press and other machines.

UNIT III: SAFETY MEASURES

9

Layout design and material handling - Use of electricity - Management of toxic gases and chemicals - Industrial fires and prevention - Road safety - highway and urban safety - Safety of sewage disposal and cleaning - Control of environmental pollution - Managing emergencies in Industries - planning, security and risk assessments, on-site and off site. Control of major

UNIT IV: ACCIDENT PREVENTION

9

Human side of safety - personal protective equipment - Causes and cost of accidents -Accident prevention programmer - Specific hazard control strategies - HAZOP - Training and development.

UNIT V: SAFETY, HEALTH, WELFARE & LAWS

9

Safety and health standards - Industrial hygiene - occupational diseases prevention - Welfare facilities - History of legislations related to Safety-pressure vessel act-Indian boiler act - The environmental protection act - Electricity act - Explosive act.

TOTAL: L: 45= 45

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	BHEL	Occupational Safety Manual BHEL.	BHEL	2014
2	Singh U.K. and Dewan J.M.,	Safety, Security and risk management”,	APH Publishing Company, New Delhi,	1996.
3	Krishnan N.V	Safety in Industry	Jaico Publisher House,	1996
4.	P M C Nair	Industrial safety and the law : an introduction	Attam Publishers, Thiruvananthapuram	1994
5	John V. Grimaldi and Rollin H. Simonds	Safety Management	All India Travellers bookseller, New Delhi	1989

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3. <https://www.youtube.com/watch?v=3Q0ycQMmmt8>
4. [https://www.youtube.com/watch? V=9l4RpocQBMc](https://www.youtube.com/watch?V=9l4RpocQBMc)
5. <https://renradcradumapenglafursymplesla.wordpress.com/2014/07/19/occupational-safety-manual-bhel-pdf/>

16CMB09APPLIED MATERIALS ENGINEERING

L T P C
3 0 0 3

COURSE OBJECTIVES

- To provide the knowledge about the behaviors and various strengthening mechanisms of materials.
- To impart knowledge on fracture mechanism and failure analysis of materials.
- To provide the knowledge on material properties, material cost and factors to be considered while selecting materials for various applications.
- To study various cases in material selection for different applications.

- To educate the material processing concepts and various process induced defects.
- To familiarize the modern materials and heat treatment of materials.

COURSE OUTCOMES

1. Familiarize the fundamentals of material behaviour
2. Explain the various strengthening mechanisms of materials
3. Comprehend fracture mechanism and discover the material failure defects
4. Select the suitable material for different applications
5. Propose the suitable process for materials and analyze the process induced defects
6. Explain the characteristics of modern materials

UNIT I: ELASTIC AND PLASTIC BEHAVIOUR

9

Mechanism of Elastic and Plastic deformation, An elasticity and viscoelasticity- role of dislocations, yield stress, shear strength of perfect and real crystals - Strengthening mechanism, work, hardening, solid solution, grain boundary strengthening, Poly phase mixture, precipitation, particle fiber and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behavior- Super plasticity.

UNIT II: FRACTURE BEHAVIOUR

9

Griffith's theory - stress intensity factor and fracture toughness-Toughening mechanisms - Ductile, brittle transition in steel-High temperature fracture, creep - Larson-Miller, Parameter - Deformation and fracture mechanism maps - Fatigue - Low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law - Residual Life Estimation- Effect of surface and metallurgical parameters on fatigue - fracture of non metallic materials - Failure analysis, sources of failure, procedure of failure analysis.

UNIT III: SELECTION OF MATERIALS

9

Motivation, cost basis and service requirements - selection for Mechanical properties, strength, toughness, fatigue and creep - Selection for surface durability corrosion and wear resistance - Relationship between materials selection and processing - Case studies in materials selection with Relevance to aero, auto, marine, machinery and nuclear applications.

UNIT IV: MATERIAL PROCESSING

9

Processing of engineering materials - Primary and Secondary processes -stability, Weldability, forge ability and malleability Criteria - Process induced defects - Monitoring and control.

UNIT V MODERN MATERIALS AND TREATMENT

9

Dual phase steels, high strength low alloy steel, transformation included plasticity steel, maraging steel, smart materials, properties and applications of engineering plastics and composites materials - advanced structural ceramics - WC, TiC, TaC, Al₂O₃, SiC, Si₃N₄, CBN, diamond - Plasma, PVD, CVD- thick and thin film deposition - Functionally Gradient Materials , Nano materials.

TOTAL: L: 45 = 45

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Norman E. Dowling	Mechanical Behaviour of Materials	McGraw-Hill	2012
2	Burakonsa, T.Z. and Wierzchan. T	Surface Engg of Meterials"- Principles of Equipment, Techniques. 5. Courtney, T.H., "Mechanical Behavior of Materials	(2nd edition), McGraw Hill	2000

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3	Dieter, G.E	Mechanical Metallurgy	McGraw Hill	1988
4	R.A.Flinn and P.K.Trojan	Engineering Materials and their Applications	Wiley	2006
5	James, K.W., Wiley, Intersam, John	The Hand book of Advance Materials	Wilson Publishers.	2004

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2. www.appliedmaterials.com/carrers/agu-ei.html
3. <https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&cad=rja&uact=8..>
4. <https://cse.umn.edu/.../Materials-Science-and-Engineering.pdf>
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16CMC10COMPUTATIONAL FLUID DYNAMICS

L T P C
2 2 0 3

COURSE OBJECTIVES

- To emphasize the knowledge on boundary conditions, finite difference method, and numerical errors
- To understand the analysis of heat conduction in one dimensional and two dimensional method
- To understand the Governing equations and Boundary layer flow for Incompressible fluid
- To understand the basic concepts of one dimensional and two dimensional convection problems.
- To understand the basics of analysis by FEM
- To understand the algebraic models and heat transfer using standard codes

COURSE OUTCOMES

1. Understand the principles of governing differential equation and finite difference method.
2. Understand and explain heat conduction in various dimensional method
3. Explain the equations for Incompressible fluid flow by difference approach.
4. Understand and explain the principles of convection heat transfer
5. Explain the FEM analysis of conduction and incompressible flow
6. Explain the fundamentals involved in turbulence models

UNIT I: GOVERNING DIFFERENTIAL EQUATION AND FINITE DIFFERENCE METHOD

6

Classification, Initial and Boundary conditions - Initial and Boundary Value problems - Finite difference method, Central, Forward, Backward difference, Uniform and non-uniform Grids, Numerical Errors, Grid Independence Test.

UNIT II: CONDUCTION HEAT TRANSFER

6

Dimensional conduction, Two and three dimensional steady state problems, Transient one-dimensional problem, Two-dimensional Transient Problems

UNIT III: INCOMPRESSIBLE FLUID FLOW

6

Governing Equations, Stream Function -Vorticity method, Determination of pressure for viscous flow, SIMPLE Procedure of Patankar and Spalding, Computation of Boundary layer flow, finite difference approach.

UNIT IV: CONVECTION HEAT TRANSFER AND FEM

6

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Steady One-Dimensional and Two-Dimensional Convection - diffusion, Unsteady one-dimensional convection - diffusion, Unsteady two-dimensional convection - Diffusion - Introduction to finite element method - solution of steady heat conduction by FEM - Incompressible flow - simulation by FEM.

UNIT V: TURBULENCE

6

Algebraic Models - One equation model, K - ε Models, Standard and High and Low Reynolds number models, Prediction of fluid flow and heat transfer using standard codes.

TOTAL: L: 30+ T: 30 = 60

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Jiri Blazek	Computational Fluid Dynamics: Principles and Applications	Butterworth-Heinemann	2015
2	John Wendt	Computational Fluid Dynamics: An Introduction	Springer Science & Business Media	2013
3	Wei Shyy, H. S. Udaykumar, Madhukar M. Rao	Computational Fluid Dynamics with Moving Boundaries	Courier Corporation	2012
4	Ryoichi Amano, Bengt Sundén	Computational Fluid Dynamics and Heat Transfer: Emerging Topics	WIT Press	2011
5	Eduardo Ramos S	Computational Fluid Dynamics 2010: Proceedings of the Sixth Edition	Springer Science & Business Media	2011

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2. <https://books.google.co.in/books?isbn=1139446835>
3. www.springer.com/in/book/9783540850557
4. www.ceetron.com/3D-cfd
5. www.cfd-software.org/

16CMB11

DATA COMMUNICATIONS IN CAD/CAM

L T P C
3 0 0 3

COURSE OBJECTIVES

- To provide the knowledge on basic functions, operations and languages of digital computers and microprocessors
- To impart knowledge on operating systems.
- To familiarize the functions of compiler.
- To provide the knowledge on data communication, networking, transmissions of communications systems
- To educate the different types of networking structure.
- To familiarize the Internet services and Protocols

COURSE OUTCOMES

1. Explain the basic functions, operations and languages of digital computers and microprocessors
2. Describe various operating systems.

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3. Describe the functioning of a compiler.
4. Illustrate various networking and communication models
5. Choose suitable network structure
6. Explain the internet services and Protocols

UNIT I: DIGITAL COMPUTERS & MICRO PROCESSORS 9

Block diagram - register transfer language - arithmetic, logic and shift micro operations - instruction code - training and control instruction cycle - I/O and interrupt design of basic computer. Machine language - assembly language - assembler. Registers ALU and Bus Systems - timing and control signals - machine cycle and timing diagram - functional block diagrams of 80 x 86 and modes of operation - Features of Pentium Processors

UNIT II: OPERATING SYSTEM & ENVIRONMENTS 9

Types - functions - UNIX & WINDOWS NT - Architecture - Graphical User Interfaces - Compilers - Analysis of the Source program - the phases of a compiler - cousins of the compiler, the grouping of phases - compiler construction tools.

UNIT III: COMMUNICATION MODEL 9

Data communication and networking - protocols and architecture - data transmission concepts and terminology - guided transmission media - wireless transmission - data encoding - asynchronous and synchronous communication - base band interface standards RS232C, RS449 interface

UNIT IV: COMPUTER NETWORKS 9

Network structure - network architecture - the OSI reference model services - network standardization - example - Managing remote systems in network - network file systems - net working in manufacturing.

UNIT V: INTERNET 9

Internet services - Protocols - intranet information services - mail based service - system and network requirements - Internet tools - UseNet - e-mail - IRC - www - FTP - Telnet.

TOTAL: L: 45 = 45

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	William Stallings	Data of Computer Communications	Prentice Hall of India	2013
2	Alfred V. Aho, Ravi Setjhi, Jeffrey D Ullman	Compilers Principles Techniques and Tools	Addison Wesley	2011
3	Gaonkar R.S	Microprocessor Architecture, Programming and Applications of 8085	Penram International	2014
4	Andrew S. Tanenbanum	Computer Networks	Prentice Hall of India 3 rd Edition	2012.
5	Morris Mano. M	Computer System Architecture",	Prentice Hall of India	2013

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2. http://ebook-dl.com/item/computer_system_architecture_3rd_edition_m_morris_mano
3. <http://www.goodreads.com/book/show/5031681-microprocessor-architecture-programming-and-applications-with-the-8085>
4. <https://it325blog.files.wordpress.com/2012/09/operating-system-concepts-7-th-edition.pdf>
5. <https://abmpk.files.wordpress.com/2013/04/data-and-computer-comm-8e-william-stallings.pdf>

16CMB12

MECHANISMS DESIGN AND SIMULATION

L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand the layout of linkages and kinematic analysis of various links.
- To impart the knowledge of kinematics simulations of various mechanisms.
- To learn the Path Curvature Theory used in mechanisms.
- To study the synthesis analysis of four bar mechanisms.
- To comprehend synthesis of cam mechanisms
- To understand coupler curve based mechanisms.

COURSE OUTCOMES

1. Comprehend the basics of mechanism design
2. Determine and analyze the kinematics attributes of various links.
3. Illustrate the path curvature theory and its applications
4. Design four bar based mechanisms of real time applications.
5. Analyze the cam mechanisms of real time applications
6. Describe the coupler curve based mechanisms

UNIT I: INTRODUCTION

9

Introduction to kinematics and mechanisms-Mobility analysis-Formation of one degree of freedom Multi loop kinematic chains-Grass motion concepts-compliant and equivalent mechanisms.

UNIT II: KINEMATIC ANALYSIS

9

Position Analysis-vector loop equations for four bar, slider crank, inverted slider crank, geared five bar and six bar links-Analytical and Graphical methods-displacement, velocity and acceleration analysis of simple mechanisms.

UNIT III: PATH CURVATURE THEORY

9

Fixed and moving centrodes-Inflection points and inflection circle-Euler Savary equation- Bobillier's construction-Hartmann's construction-cubic of stationary curvature.

UNIT IV: SYNTHESIS OF FOUR BAR MECHANISMS

9

Type and number synthesis- linkage concept-Dimensional synthesis-Function generation, path generation and motion generation-Graphical methods-Pole technique and inversion technique-Point position reduction-two, three and four position synthesis of four bar mechanisms-Analytical methods-Freudenstein's equation-Bloch's synthesis.

UNIT V: SYNTHESIS OF CAM AND COUPLER CURVE BASED MECHANISMS

9

Cognate linkages-parallel motion linkages-design of six bar, Single dwell, double dwell and double stroke-multi dwell -CAM mechanisms - determination of optimum size of cams- mechanism defects - Case Study-Kinematic analysis of spatial mechanisms-simulation mechanisms using software package.

TOTAL: L: 45 = 45

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Kenneth J. Waldron, Gary L. Kinzel, Sunil K. Agrawal	Kinematics, Dynamics, and Design of Machinery	3 rd Edition, John Wiley-Sons	2016
2	David H. Myszka,	Machines & Mechanisms: Applied Kinematic Analysis	Pearson Education, 4 th revised edition	2011

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3	J. J. Uicker, G. R. Pennock and J.E. Shigley	Theory of Machines and Mechanisms	Oxford University Press, NY, II nd Edition	2014
4	Robert L. Norton	Kinematics and Design of Machinery	McGraw Hill Higher Education, 2 nd revised edition	2012
5	A. Hernandez	Kinematic analysis of mechanisms via a velocity equation based in a geometric matrix	Mechanism and machine theory, vol. 38(12), pp 1413-1429	2013

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3. <https://www.youtube.com/watch?v=hgkKE8szT18>
4. <https://www.youtube.com/watch?v=gGbo2xj-k5c>
5. <https://www.youtube.com/watch?v=LkCbdXoHC9c>

16CMC01OPTIMIZATION TECHNIQUES IN DESIGN

L T P C
2 2 0 4

COURSE OBJECTIVES

- To acquire concepts of design optimization, and model the engineering problem mathematically.
- To impart knowledge on various optimization methods for obtaining approximate structural design solutions.
- To impart knowledge on single and multi variable optimization techniques.
- To solve problems on design of experiments.
- To familiarize the selecting algorithms for solving multi-objective and non-traditional optimization problems.

COURSE OUTCOMES

1. Understand the principles of optimization in design.
2. Analyze and solve using single variable optimization techniques.
3. Analyze and solve using multi variable and constrained optimization techniques.
4. Select proper design of experiments and modeling.
5. Solve problems on design of experiments and modeling
6. Solve the engineering problems using suitable non-traditional optimization techniques.

UNIT I: INTRODUCTION

6

Introduction to optimum design - Principles of optimization - Conventional versus Optimal design process - Problem formulation - Classification of Engineering optimization problem

UNIT II: SINGLE VARIABLE OPTIMIZATION TECHNIQUES

6

Optimality Criteria - Bracketing Methods: Exhaustive search method - Bounding phase method - Region Elimination Methods: Interval halving method - Fibonacci search method - Golden section search method - Gradient based Methods: Newton - Raphson method - Bisection method - Cubic search method.

UNIT III: MULTI VARIABLE AND CONSTRAINED OPTIMIZATION TECHNIQUES

6

Unconstrained optimization techniques - Direct search Method: Simplex search methods - Hooke-Jeeve's pattern search method - Powell's conjugate direction method - Gradient based method:

Cauchy's method - Newton's method - Conjugate gradient method - Constrained optimization techniques - Kuhn - Tucker conditions - Penalty Function methods - Solution by the method of Lagrangian multiplier.

UNIT IV: DESIGN OF EXPERIMENTS AND MODELLING 6
 Introduction – ANOVA- Factorial Design, Fractional factorial Design, Regression Approach- Two, and multi variable Design, Orthogonal Array Design, Response Surface Methods- Simple Problems.

UNIT V: NON TRADITIONAL OPTIMIZATION 6
 Introduction to non-traditional optimization - Genetic Algorithm - Bee Colony Algorithm - Particle Swarm Optimization (PSO) and Neural Networks in optimization, Simple Applications.

TOTAL: L: 30+ T: 30= 60

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	R. PanneerSelvam	Design and Analysis of Experiments	PHI Learning Private Limited	2012
2	Ashok D. Belegundu, R. Tirupathi and Chandrupatla	Optimization Concepts and Applications in Engineering	Pearson Education	2014
3	K. Deb	Optimization for Engineering Design Algorithms and Examples	Prentice Hall of India Pvt	2010
4	Panos Y. Papalambros and Douglass J. Wilde	Principles of Optimal Design: Modelling and Computation	Cambridge University Press	2000
5	G. V. Reklaitis, A. Ravindram and K. M. Ragsdell	Engineering Optimization - Methods & Application	Wiley	2006

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3. https://www.youtube.com/watch?v=49V_hbKu-Lc
4. <https://www.youtube.com/watch?v=mmCsdTy93s4>
5. <https://www.youtube.com/watch?v=1M8t6AXCyGk>

16CMC02ADVANCED TOOL DESIGN

L T P C
2 2 0 3

COURSE OBJECTIVES

- To introduce design process of tools.
- To develop solutions for the design of tools.
- To develop skills to reduce the overall cost to manufacture a product by making acceptable parts at the lowest cost.
- To understand the basics of designing jigs and fixtures.
- To familiarize the methods to increase the production rate by designing tools to produce parts as quickly as possible.
- To design tools that produce parts with the required precision ✓

COURSE OUTCOMES

1. Familiarize the cutting tools, tool holders and cutting fluids.
2. Comprehend and design cutting tool systems.
3. Understand the design consideration of jigs and fixtures.
4. Design jigs and fixtures for various operations.
5. Design and draft press tool dies.
6. Design and analyze tools for CNC machine tools.

UNIT I: INTRODUCTION TO TOOL DESIGN

6

Introduction - Tool Engineering - Tool Classifications - Tool Design Objectives - Tool Design in manufacturing - Challenges and requirements - Standards in tool design - Tool drawings - Surface - Fits and Tolerances - Tooling Materials- Ferrous and Non ferrous Tooling Materials- Carbides, Ceramics and Diamond -Non metallic tool materials-Designing with relation to heat treatment

UNIT II: DESIGN OF CUTTING TOOLS SYSTEMS

6

Mechanics of Metal cutting - Oblique and orthogonal cutting- Chip formation and shear angle - Single-point cutting tools - Milling cutters - Hole making cutting tools- Broaching Tools - Design of Form relieved and profile relieved cutters-Design of gear and thread milling cutters.

UNIT III: DESIGN OF JIGS AND FIXTURES

6

Introduction - Fixed Gages - Gage Tolerances - 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 - Thrust and Turning Moments in drilling - Drill jigs and modern manufacturing- Types of Fixtures - Vise Fixtures - Milling Fixtures - Boring Fixtures - Broaching Fixtures - Lathe Fixtures - Grinding Fixtures - Modular Fixtures - Cutting Force Calculations

UNIT IV: DESIGN OF PRESS TOOL DIES

6

Types of Dies - Method of Die operation - Clearance and cutting force calculations- Blanking and Piercing die design - Pilots - Strippers and pressure pads- Presswork materials - Strip layout - Short-run tooling for Piercing - Bending dies - Forming dies - Drawing dies-Design and drafting.

UNIT V: TOOL DESIGN FOR CNC MACHINE TOOLS

6


Introduction - Tooling requirements for Numerical control systems - Fixture design for CNC machine tools- Sub plate and tombstone fixtures-Universal fixtures - Cutting tools - Tool holding methods - Automatic tool changers and tool positions- Tool presetting - General explanation of the Brown and Sharp machine.

TOTAL: L: 30+ T: 30=60

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Wilson F.W	Fundamentals of Tool Design	ASTME,Prentice Hall India,	2010
2	E.G.Hoffman	Jig and Fixture Design	Thomson Asia Pvt Ltd, Singapore	2004
3	Venkataraman K	Design of Jigs, Fixtures and Press tools	TMH	2005
4	Donaldson Cyrll, George H.LeCain and Goold V.C	Tool Design	TMH ,36th Reprint,.	2006
5	G.C Sen and A.Bhattacharaya	Principle of Machine Tools	New Central Book Agency Kolkata	2009

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2. <https://www.youtube.com/watch?v=pMAQTpY0JHA>
3. http://www.seoexpertcompany.com/aa.php?isbn=ISBN:9780070153929&name=Tool_Design
4. <https://www.youtube.com/watch?v=ThjfM0QI4vg>
5. <http://www.me.ust.hk/~mech152/Lectures/LT25/L25%20-%20Tool%20Design%201.ppt>

16CMC03COMPUTER CONTROL IN PROCESS PLANNING

L T P C
2 2 0 3

COURSE OBJECTIVES

- To impart knowledge about the basics of process planning.
- To impart knowledge on conventional tolerances used in part design.
- To comprehend various group technology coding systems.
- To understand the basic concept of process engineering and various process planning approaches.
- To familiarize the various systems and tools required for computer aided process planning.
- To provide the knowledge about structure and operations of integrated process planning systems

COURSE OUTCOMES

1. Explain the various process activities of process planning.
2. Construct geometrical modeling for process planning.
3. Understand and explain various group technology coding systems.
4. Comprehend and explain the process engineering and various process planning approaches.
5. Recommend the suitable systems for computer aided process planning.
6. Discuss the structures and operations of integrated process planning systems.

UNIT I: BASIC PRINCIPLES OF PROCESS PLANNING

6

The Place of Process Planning in the Manufacturing cycle - Process Planning and Production Planning - Process Planning and Concurrent Engineering, CAPP, Group Technology.

UNIT II: PART DESIGN REPRESENTATION

6

Design Drafting - Dimensioning - Conventional tolerance - Geometric tolerance - CAD - input / output devices - topology - Geometric transformation - Perspective transformation - Data structure - Geometric modeling for process planning - GT coding - The optiz system - The MICLASS system.

UNIT III: PROCESS ENGINEERING AND PROCESS PLANNING

6

Experienced, based planning - Decision table and decision trees - Process capability analysis - Process Planning - Variant process planning - Generative approach - Forward and Backward planning, Input format, AI.

UNIT IV: COMPUTER AIDED PROCESS PLANNING SYSTEMS

6

Logical Design of a Process Planning - Implementation considerations - manufacturing system components, production Volume - Number of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP.

UNIT V: AN INTERGRATED PROCESS PLANNING SYSTEMS

6

Totally integrated process plans systems - An Overview - Modulus structure - Data Structure, operation - Report Generation, Expert process planning.

TOTAL: L: 30+ T: 30 = 60

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Gideon Halevi and Roland D. Weill	Principles of Process Planning - A logical approach	Chapman & Hall	2010

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2	Nanua Singh	Systems Approach to Computer Integrated Design and Manufacturing	John Wiley & Sons	2008
3	Rao	Computer Aided Manufacturing	Tata McGraw Hill Publishing Co.	2010
4	I. Alevi and R.D. Weill	Principles of Process Planning, A logical approach,	Chapman & Hall	2008
5	H.P. Wang and J.K. Li	Computer-Aided Process Planning (Advances in Industrial Engineering)	Elesvier	1991

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16CMC04RELIABILITY IN ENGINEERING SYSTEMS

L T P C
2 2 0 3

COURSE OBJECTIVES

- To provide the knowledge about reliability concept and functions
- To impart knowledge on failure data analysis
- To understand the process of reliability assessment
- To educate the reliability monitoring methods
- To understand reliability improvement of systems.

COURSE OUTCOMES

1. Explain the reliability concept and functions
2. Comprehend the method of failure data analysis
3. Elaborate about reliability assessment
4. Formulate the reliability monitoring systems
5. Analyze the downtime of systems
6. Improve the reliability of the system.

UNIT I: RELIABILITY CONCEPT

6

Reliability definition - Quality and Reliability- Reliability mathematics - Reliability functions - Hazard rate - Measures of Reliability - Design life -A priori and posteriori probabilities - Mortality of a component -Bath tub curve - Useful life

UNIT II: FAILURE DATA ANALYSIS

6

Data collection -Empirical methods: Ungrouped/Grouped, Complete/Censored data - Time to failure distributions: Exponential, Weibull- Hazard plotting - Goodness of fit tests

UNIT III: RELIABILITY ASSESSMENT

6

Different configurations - Redundancy - m/n system - Complex systems: RBD -Baye's method - Cut and tie sets - Fault Tree Analysis - Standby system.

UNIT IV: RELIABILITY MONITORING

6

Life testing methods: Failure terminated - Time terminated - Sequential Testing -Reliability growth monitoring - Reliability allocation - Software reliability.

UNIT V: RELIABILITY IMPROVEMENT

6

Analysis of downtime - Repair time distribution - System MTTR - Maintainability prediction - Measures of maintainability - System Availability - Replacement theory.

TOTAL: L: 30+ T: 30 = 60

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Singiresu S. Rao	Reliability Engineering	Pearson Education	2016
2	Roy Billington and Ronald N. Allan	Reliability Evaluation of Engineering Systems	Springer	2007
3	Dana Crowe and Alec Feinberg	Design for Reliability	CRC Press	2001
4	Michael Pecht	Product Reliability, Maintainability and Supportability Handbook	CRC Press	2009
5	Charles E. Ebeling	An introduction to Reliability and Maintainability engineering	Tata McGraw Hill	2000

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3. <https://books.google.co.in/books?isbn=1848002718>
4. <https://www.crcpress.com/Design-for-Reliability/Crowe-Feinberg/p/book/9780849311116>
5. <https://www.crcpress.com/Product-Reliability-Maintainability-and-Supportability-Handbook-Second/Pecht/p/book/9780849398797>

16CMC05 TRIBOLOGY IN COMPOSITE MATERIALS DESIGN

L T P C
2 2 0 3

COURSE OBJECTIVES

- To impart knowledge in the friction, wear and lubrication aspects of machine components.
- To describe fundamental measurements in tribology.
- To describe fundamental fabrication processes for polymer matrix, metal matrix, and ceramic matrix composites.
- To understand the characterization of various composites
- To understand testing methods which influence the tribological characteristics of surfaces
- To comprehend the issues involved in tribological diagnosis

COURSE OUTCOMES

1. Summarize the basic principles of friction, wear and lubrication.
2. Recall measurements of friction and wear for different operating conditions
3. Characterize the properties of composite materials
4. Describe various methods of composite materials fabrication.
5. Identify the various testing facilities of different composites.
6. Interpret the tribological problems and diagnose them

UNIT I: FRICTION, WEAR & LUBRICATION

6

Topography of Surfaces - Surface features- Adhesive Theory of Sliding Friction -Rolling Friction- Friction properties of metallic and non-metallic materials - Types of wear - Mechanism of various types of wear - Laws of wear - Lubricants and their physical properties- Viscosity and other properties of oils -Additives-and selection of Lubricants- Lubricants standards - Boundary Lubrication-

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Hydrodynamic lubrication -Elasto and plasto hydrodynamic - Magneto hydrodynamic lubrication - Hydro static lubrication - Gas lubrication.

UNIT II: TRIBOLOGICAL MEASUREMENTS 6

Theoretical wear models Wear of Metals and Non metals- Surface treatments - Surface modifications - surface coatings methods- Surface Topography measurements -Laser methods - instrumentation - International standards in friction and wear measurements - International standards.

UNIT III: CHARACTERIZATION, MANUFACTURING METHODS OF COMPOSITE 6

Introduction to composites - basic concepts, structural applications, classification, strength and stiffness advantages experimental methods for characterization and testing of composite materials - Design of laminates- Manufacture of composite materials: Manufacturing of PMC, MMC, CMC.

UNIT IV: TESTING OF COMPOSITE 6

Testing of composite materials - Determination of physical properties such as density, fibre volume ratio, void volume ratio, coefficient of thermal expansion, determination of tensile, compressive and shear properties of unidirectional lamina, determination of interlaminar and intralaminar strength, biaxial testing, characterization of composites with stress concentration - Composite materials friction and wear.

UNIT V: DIAGNOSING TRIBOLOGICAL PROBLEMS 6

Introduction - introduction to Problem Diagnosis - Planning First Level of Surface Examination - Second Level of Surface Observation: Electron Microscopy - SEM, TEM and FESEM -Selecting Chemical Analysis Instruments

TOTAL: L: 30+ T: 30 = 60

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1	P.K.Mallick	Fiber-Reinforced Composites: Materials, Manufacturing and Design	Maneel Dekker Inc	2007
2	S.K.Basu, S.N.Sengupta &B.B.Ahuja	Fundamentals of Tribology	Prentice – Hall of India Pvt Ltd, New Delhi	2009
3	Rabinowicz.E	Friction and Wear of materials	John Willey &Sons, UK	1995
4	Cameron, A	Basic Lubrication Theory	Ellis Herward Ltd., UK	1981
5	K.C Ludema	Friction, Wear, Lubrication- A TEXTBOOK IN TRIBOLOGY	CRC Press LLC	1996

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1. <http://ocw.mit.edu/courses/mechanical-engineering/2-800-tribology-fall-2004/lecture-notes/>
2. https://www.youtube.com/watch?v=XAS9eG0IT_8
3. <https://www.youtube.com/watch?v=OTDezhVR9H8>
4. <https://www.youtube.com/watch?v=OTDezhVR9H8>
5. <https://www.youtube.com/watch?v=666VH25FeG0>

16CMC06DESIGN OF MATERIAL HANDLING EQUIPMENTS

L T P C
3 0 0 3

COURSE OBJECTIVES

- To impart knowledge on operating principles of various material handling systems and their

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limitations.

- To understand the design procedures of various materials handling equipment used in industry.
- To enhance the knowledge on drives of hoisting gear.
- To understand the working principle of conveyors
- To understand the working principle of elevators
- To design and perform the selection of various material handling equipments

COURSE OUTCOMES

1. Understand the basics of Material Handling equipments
2. Demonstrate the principles involved in design of Hoists
3. Understand and explain the drives of hoisting gear.
4. Demonstrate the working principle conveyors
5. Demonstrate the working principle of elevators
6. Describe various material handling equipments used in industry.

UNIT I: MATERIALS HANDLING EQUIPMENT

9

Introduction - Importance of material handling - Principle of material handling - Factors influences the choice of material handling - Material handling Equipment - Types - Selection and applications - Scope of material handling.

UNIT II: DESIGN OF HOISTS

9

Design of hoisting elements - Hemp and wire ropes - Design of ropes - Pulleys - Pulley systems - Sprockets and drums - Load handling attachments - Design of forged hooks and eye hooks - Brake shoe - Band and cone types.

UNIT III: DRIVES OF HOISTING GEAR

9

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

9

Types - Description - Design and applications of Belt conveyors - Apron conveyors and escalators - Pneumatic conveyors - Screw conveyors.

UNIT V: ELEVATORS

9

Bucket elevators - Design - Loading and bucket arrangements - Cage elevators - Shaft way - Guides - Counter weights - Hoisting machine - Design of fork lift trucks. Case study on popular material handling equipment used in engineering industries.

TOTAL: L: 45 = 45

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Charles Reese	Material handling Systems	Taylor and Francis	2005
2	Myer Kutz	Environmental Conscious Materials Handling	Wiley series In Environmentally Conscious Engineering	2010
3	M. Alexandrov	Materials Handling Equipments	MIR Publishers	2002
4	P.S.G. Tech, Coimbatore	Design Data Book	KalaikathirAchchagam	2012
5	Kari H. E.Kroemer	Ergonomic Design of Material Handling Systems	CRC Press USA	2004

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5. <https://www.youtube.com/watch?v=VgmxNwSHOtQ>

16CMC07MECHATRONICS APPLICATIONS IN MANUFACTURING

L T P C
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COURSE OBJECTIVES

- To provide the knowledge about measurement systems and Mechatronics design.
- To impart knowledge on various types of sensors and transducers
- To understand the difference between microprocessors and microcontrollers
- To provide the knowledge on programming and interfacing of microprocessors
- To illustrate various programmable logic controllers
- To familiarize the design of various mechatronics systems

COURSE OUTCOMES

1. Explain the basic principles of traditional and mechatronics systems.
2. Comprehend the suitable sensor and transducers for various applications
3. Elaborate on architecture of microprocessors.
4. Describe the interfacing of various converters..
5. Design the programmable logic controllers
6. Choose the suitable design for Mechatronics systems

UNIT I: INTRODUCTION

9

Introduction to Mechatronics - Systems - Mechatronics in Products - Measurement Systems - Control Systems - Traditional design and Mechatronics Design.

UNIT II: SENSORS AND TRANSDUCERS

9

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

9

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

9

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

UNIT V: DESIGN AND MECHATRONICS

9

Designing - Possible design solutions - Case studies of Mechatronics systems

TOTAL: L: 45 = 45

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	W.Bolton V	Mechatronics	Pearson 5th Edition , Pearson	2013
2	R.K.Rajput	Introduction to Mechatronics	4th Edition S.Chand & Co	2012

3	Michael B.Histand and David G. Alciatore	Introduction to Mechatronics and Measurement Systems	McGraw-Hill International Editions	2002
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	2004

WEB URLs

1. www.cs.Indiana.edu.
2. <http://robotics.bgu.ac.il/uploads/f/f7/Introduction.to.Mechatronics.and.Measurement.Systems.pdf>
3. <https://ihuqiren.files.wordpress.com/2015/06/microprocessor-8085-by-ramesh-gaonkar-pdf.pdf>
4. <http://as.wiley.com/WileyCDA/WileyTitle/productCd-0780310314,miniSiteCd-IEEE2.html>
5. https://books.google.co.in/books/about/0000_TO_8085_INTRO_TO_MICROPROCS_2_E.html?id=IT5-GTq5PjMC

16CMC08 MODELING AND ANALYSIS OF MANUFACTURING SYSTEMS

L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand the modeling methods, scope, machine utilization of manufacturing systems
- To describe the various concepts of controlling the manufacturing systems.
- To familiarize the concepts of controlling manufacturing processes and evolution analysis in Manufacturing.
- To understand the queuing models in manufacturing system.
- To understand the basic procedure used in the Queuing Networks
- To familiarize the representational power and Stochastic Petri Nets in manufacturing system.

COURSE OUTCOMES

1. Understand the principles of manufacturing system models and communications used in the factory
2. Describe the various concepts uses in controlling of the manufacturing systems.
3. Understand and explain the analysis of manufacturing processes
4. Demonstrate the queuing methods and its analysis
5. Comprehend and explain the consideration for Queuing Networks
6. Explain the elements involved in the Petri NETS

UNIT I: MANUFACTURING SYSTEMS & CONTROL

9

Manufacturing Systems - Modelling - Role of performance modelling - simulation models- Analytical models - Product cycle - Manufacturing automation - Economics of scale and scope - input/output model - plant configurations - Performance measures - Manufacturing lead time - Work in process - Machine utilization - Throughput - Capacity - Flexibility - performability- Quality Control Systems - Control system architecture - Factory communications - Local area networks - Factory net works - Open systems interconnection model - Net work to network interconnections - Manufacturing automation protocol - Database management system.

UNIT II: MANUFACTURING PROCESSES

9

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Examples of stochastic processes - Poisson process Discrete time Markov chain models - Definition and notation - Sojourn times in states - Examples of DTMCs in manufacturing - Chapman-Kolmogorov equation - Steady-state analysis - Continuous Time Markov Chain Models - Definitions and notation - Sojourn times in states - examples of CTMCs in manufacturing - Equations for CTMC evolution - Markov model of a transfer line - Birth and Death Processes in Manufacturing - Steady state analysis of BD Processes - Typical BD processes in manufacturing.

UNIT III: QUEUING MODELS

9

Notation for queues - Examples of queues in manufacturing systems - Performance measures - Little's result - Steady state analysis of M/M/m queue, queues with general distributions and queues with breakdowns - Analysis of a flexible machine center.

UNIT IV: QUEUING NETWORKS

9

Examples of QN models in manufacturing - Little's law in queuing networks - Tandem queue - An open queuing network with feedback - An open central server model for FMS - Closed transfer line - Closed server model - Garden Newell networks

UNIT V: PETRI NETS

9

Classical Petri Nets - Definitions - Transition firing and reach ability - Representational power - properties - Manufacturing models - Stochastic Petri Nets - Exponential timed Petri Nets - Generalized Stochastic Petri Nets - modeling of KANBAN systems - Manufacturing models.

TOTAL: L: 45 = 45

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Stanley B. Gershwin, Yves Dallery, Chrissoleon T. Papadopoulos	Analysis and Modeling of Manufacturing Systems	Springer Science & Business Media	2012
2	Curry, Guy L., Feldman, Richard M	Manufacturing Systems Modeling and Analysis	Springer verlag Berlin Heidelberg	2011
3	David D. Yao	Stochastic Modeling and Analysis of Manufacturing Systems	Springer Science & Business Media	2012
4	James MacGregor Smith, Bartı Tan	Handbook of Stochastic Models and Analysis of Manufacturing System	Springer Science & Business Media	2013
5	S. Joshi, Jeffrey Smith S	Computer control of flexible manufacturing systems	pringer Science & Business Media	2012

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1. [http://onlinelibrary.wiley.com/doi/10.1002/\(SICI\)1099-1115\(199902\)13:1%3C43::AID-ACS512%3E3.0.CO](http://onlinelibrary.wiley.com/doi/10.1002/(SICI)1099-1115(199902)13:1%3C43::AID-ACS512%3E3.0.CO)
2. <https://books.google.co.in/books?isbn=981023029X>
3. nptel.ac.in/courses/111105041/1
4. <https://books.google.co.in/books?isbn=3642166180>
5. <https://books.google.co.in/books?isbn=1461226708>

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16CMC09PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING

L T P C
3 0 0 3

COURSE OBJECTIVES

- To impart knowledge on productivity models and organizational transformations.
- To describe the measurement of productivity.
- To study the organizational transformation
- To impart knowledge reengineering process improvement tools.
- To gather knowledge in reengineering tools and implementation
- To understand the supply chain management.

COURSE OUTCOMES

1. Understand the basic concepts of productivity
2. Demonstrate the productivity models
3. Demonstrate the principles involved in organizational transformation.
4. Explain various re-engineering process improvement models.
5. Describe the various re-engineering tools.
6. Enumerate the principles of supply chain management.

UNIT I: INTRODUCTION

9

Productivity concepts - Macro and Micro factors of productivity, Productivity benefit model, productivity cycle.

UNIT II: PRODUCTIVITY MODELS SYSTEMS

9

Productivity measurement at International, National and Organizational level, total models-Productivity management in manufacturing and service sector-Evaluation models, improvement models and techniques.

UNIT III: ORGANIZATIONAL TRANSFORMATION

9

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

UNIT IV: RE-ENGINEERING PROCESS IMPROVEMENT MODELS

9

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

UNIT V: RE-ENGINEERING TOOLS AND IMPLEMENTATION

9

Analytical and process tools and techniques - Information and communication technology - Enabling role of IT, RE-opportunities, process redesign – case study. Software methods in BPR - specification of BP, case study - Order, processing, user interfaces, maintainability and reusability.
To study the feasibility of implementing business process re-engineering (BPR) in supply chain management of a manufacturing company.

TOTAL: L: 45 = 45

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	G D Premvrat, Sardana and B S Sahay,	Productivity Management - A systems approach	Narosa Publishers, New Delhi,	2008
2	R C Mishra and K Pathak	Maintenance Engineering and Management	PHI	2005

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3	D J Sumant	Productivity engineering and management	TMH, New Delhi	2006
4	J AEdosomwan	Organizational transformation and process re-engineering	British Library cataloging in pub. data	2007
5	S K Srivatsava	Industrial Maintenance Management	S Chand and Company	2007

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1. <http://nptel.ac.in/courses/112102106/>
2. <https://www.youtube.com/watch?v=Wi-BmxkA7YU>
3. https://www.youtube.com/watch?v=_ObRQRKXLzA&list=Plip-k_VHkLg4SLAn1hFIndIHVCxA69-_c
4. <https://www.youtube.com/watch?v=bVCkuMaAAR0>
5. <https://www.youtube.com/watch?v=ov0kQPsqsz4>

16CMC10DESIGN AND MANUFACTURING OF COMPOSITE MATERIALS

L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand the basics of composite materials.
- To describe various types of matrix materials and reinforcements.
- To understand the methods of manufacturing composite materials.
- To comprehend the principles of mechanics of composite laminates
- To demonstrate the testing methods of composite materials
- To familiarize the recent trends in composite materials

COURSE OUTCOMES

1. Familiarize the fundamentals of composite materials
2. Recall the various types of matrix and reinforcements.
3. Demonstrate the manufacturing techniques of composite materials.
4. Demonstrate and design different laminated composite.
5. Illustrate different testing methods of composite materials.
6. Explain the recent trends in composite materials

UNIT I: INTRODUCTION TO COMPOSITE MATERIALS

9

Definition- Classifications - Matrix materials- Polymers – metals – ceramics- properties- Reinforcements-particles- whiskers, Fibers - glass- ceramic- aramid and carbon fibers - fabrication and properties, Metal Matrix Composites - classifications- particle reinforced- dispersed strengthened- fiber reinforced composites - rule of mixture- matrix/reinforcement interface - wettability-advantages - limitations and applications of composites.

UNIT II: MANUFACTURING OF COMPOSITES

9

Manufacturing of Polymer Matrix Composites - Hand lay-up - Spray technique - Bag molding - Compression molding- Filament winding - Pultrusion - Resin transfer molding (RTM) - Structural reaction injection molding (SRIM) - Manufacturing of Metal Matrix Composites - Liquid state process- Liquid infiltration- Vortex method- Squeeze casting techniques - Solid state process-Diffusion bonding- Powder Metallurgy - In situ process - Manufacturing of Ceramic Matrix Composites - Hot pressing- reaction bonding - liquid infiltration- directed oxidation process

UNIT III: MECHANICS OF LAMINA AND LAMINATED COMPOSITES

9

Introduction to lamina and laminate- Characteristics of fiber reinforced lamina – Fundamentals- Orientations of fibers- Elastic properties of lamina- Coefficient of linear thermal expansion- Stress - Strain relationship for thin lamina- Compliance and stiffness Matrices - Laminated Structures - Symmetric laminates- angle ply laminates - Cross ply laminates- Quasi -Isotropic laminates- Inter-laminar Stresses

UNIT IV: TESTING OF COMPOSITE MATERIALS

9

Static Mechanical properties- Tensile – Compressive- Flexural -In plane shear- inter-laminar shear strength – Fatigue- Impact - other properties - Environmental effects - long term properties - creep -

stress rupture- fracture behavior and damage tolerance- methods of improving damage tolerance, wear corrosive- fatigue and flexural behaviour of particulate reinforced composites.

UNIT V: RECENT TRENDS IN COMPOSITE MATERIALS 9

Research trends in polymer, metal and ceramic matrix composites - Advanced composites - Nano, bio and hybrid composites – Applications.

TOTAL: L: 45 = 45

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Robert M. Jones	Mechanics of Composite Materials	CRC Press, NY	2015
2	Krishnan K. Chawla	Composite Materials- Science and Engineering	Springer	2012
3	P.K. Mallick	Fiber-Reinforced Composites: Materials, Manufacturing, and Design	Third Edition- CRC Press	2007
4	M William D. Callister	Materials Science And Engineering - An Introduction	Wiley	2010
5	P.K.Mallick	Fiber Reinforced Composites: Materials, Manufacturing and Design	Maneel DekkerInc,	2007

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1. http://sarrami.iut.ac.ir/sites/sarrami.iut.ac.ir/files//files_course/01mechanics_of_composite_materials_sbookfi.org_.pdf
2. <http://www.cantab.net/users/bryanharris/Engineering%20Composites.pdf>
3. http://svslibrary.pbworks.com/f/FiberReinforced_Composites_Materials_Manufacturing_and_Design_3rd_Ed.rar.pdf
4. <https://www.youtube.com/watch?v=1XYKKDiCroM>
5. <https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=4&cad=rja&-->

16CMC11INTEGRATED MECHANICAL DESIGN

L T P C
3 0 0 3

COURSE OBJECTIVES


- To familiarize the fundamentals in the design process with steady and variable stresses
- To design shafts to satisfy functional and strength requirements.
- To describe the principles of gear and gear boxes.
- To describe characteristics shared by clutches and brakes.
- To learn to use standard practices and standard data and design springs, levers & flywheels.
- To learn to use catalogues and standard conveying equipments.

COURSE OUTCOMES

1. Understand the design fundamentals in mechanical design.
2. Analyze steady and variable stresses in shafts.
3. Acquire, articulate and apply specialized terminology and knowledge relevant to gear and gear boxes.
4. Understand the dynamics and thermal aspects of brakes and clutches and design them.
5. Acquire and demonstrate competency in integrated design.
6. Understand and explain the principles and types of conveying equipments.

UNIT I: FUNDAMENTALS AND DESIGN OF SHAFTS

9


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Phases of design – Standardization and interchangeability of machine elements - Process and Function Tolerances – Individual and group tolerances – Selection of fits for different design situations – Design for assembly and modular constructions – Concepts of integration – BIS, ISO, DIN, BS, ASTM Standards. Oblique stresses – Transformation Matrix – Principal stresses – Maximum shear stress – Theories of Failure – Ductile vs. brittle component design - Analysis and Design of shafts for different applications – integrated design of shaft, bearing and casing – Design for rigidity.

UNIT II: DESIGN OF GEARS AND GEAR BOXES

9

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

UNIT III: BRAKES & CLUTCHES

9

Dynamics and thermal aspects of brakes and clutches – Integrated design of brakes and clutches for machine tools, automobiles and mechanical handling equipments.

UNIT IV: INTEGRATED DESIGN

9

Integrated Design of systems consisting of shaft, bearings, springs, motor, gears, belt, rope, Cam & Follower, Machine Tools.

UNIT V: CONVEYING EQUIPMENTS

9

Belt conveyors - chain conveyors – apron conveyors – escalators – flight conveyors – roller conveyors - oscillating conveyors. Design of belt conveyors, screw conveyors and pneumatic conveyors.

TOTAL: L: 45 = 45

REFERENCE BOOKS:


Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Norton L. R	Machine Design – An Integrated Approach	Pearson Education, Fifth Edition	2014
2	Steve F. Krar	Technology of Machine Tool	McGraw Hill	2013
3	Shigley, J.E	Mechanical Engineering Design	McGraw Hill	2014
4	Dr. Sadhu Singh	Machine Design	KHANNA BOOK PUBLISHING	2015
5	Dr. P.C.Sharma & Dr. D.K.Aggarwal,	Machine Design	S. K. Kataria & Sons, 11th edition	2011

APPROVED DATA BOOKS

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	P.S.G. Tech	Design Data Book	Kalaikathir Achchagam, Coimbatore	2003
2.	Lingaiah. K. and NarayanaIyengar	Machine Design Data Hand Book	Vol. 1 & 2, Suma Publishers, Bangalore.	1994

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1. <http://nptel.ac.in/courses/103106108/Lecture%2024.pdf>
2. <https://youtu.be/QfhIea6KzZA>


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3. http://nptel.ac.in/courses/IIT-MADRAS/Machine_Design_II/pdf/2_1.pdf
4. <https://www.youtube.com/watch?v=ZldkigrDplc>
5. <https://www.youtube.com/watch?v=dKfriV8H9-8>

16CMC12ADDITIVE MANUFACTURING

L T P C
3 0 0 3

COURSE OBJECTIVES

- To provide an exhaustive knowledge of various rapid prototyping techniques
- To understand various rapid prototyping systems
- To educate the emerging trends and applications of Additive Manufacturing (AM) technology.
- To educate fundamental and advanced knowledge in the field of the associated aerospace, architecture, art, medical and industrial applications.
- To make familiar in reverse engineering and cad modeling
- To make familiar about materials and process parameters in prototype development.

COURSE OUTCOMES

- Classify different prototyping techniques.
- Describe various rapid prototyping systems
- Understand file conversion technique of file formats for rapid prototype systems.
- Select the suitable additive manufacturing process for respective applications.
- Describe reverse engineering in rapid prototyping.
- Describe the properties of various materials used in prototyping

UNIT I: INTRODUCTION

9

Need - Development of AM systems - AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling - RP to AM -Classification of AM processes – Benefits- Applications.

UNIT II: LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS

9

Stereo lithography Apparatus SLA Principle, Part building processes, Photo polymerization of SL resins, Part quality, Recoating issues, Materials. Solid Ground Curing, Fused Deposition Modeling and Laminated Object Manufacturing Working Principle - Process parameters and Materials.

UNIT III: POWDER BASED AND OTHER RAPID PROTOTYPING SYSTEMS

9

Selective Laser Sintering Principle, Process Variables, Indirect and direct SLS - Powder structures, Materials, Post processing, Surface deviation and Accuracy - Three dimensional Printing Principle, Physics of 3DP, Types, Process capabilities, Solid, Liquid and Powder based 3DP systems.

UNIT IV: REVERSE ENGINEERING AND CAD MODELING

9

Basic concept - Digitization techniques - Model reconstruction - Data Processing for Rapid Prototyping - CAD model preparation, Data requirements - Geometric modeling techniques - Wire frame, surface and solid modeling - data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for AM- Case studies.

UNIT V: MATERIALS PROPERTIES

9

Role of materials - Viscous flow - Photo polymerization - Sintering - Infiltration - Materials for AM Processes - Mechanical Properties of AM Parts - Material properties, Colour, Dimensional accuracy, Stability, Surface finish, Machinability, Environmental resistance, Operational properties of products developed Direct Metal Deposition, Ballistic Particle Manufacturing, Electron Beam Melting and Laser Engineered Net Shaping Working Principle.

TOTAL: L:45 = 45

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Ian Gibson, David W. Rosen	Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing	Springer	2015
2	Amit Bandyopadhyay, Susmita Bose	Additive Manufacturing	Taylor & Francis Group	2016
3	Liou, L.W. and Liou, F.W	Rapid Prototyping and Engineering applications: A tool box for prototype development"	CRC Press	2011
4	Kamrani, A.K. and Nasr, E.A	Rapid Prototyping: Theory and practice	Springer	2006
5	Chua, C.K., Leong K.F. and Lim C.S	Rapid prototyping: Principles and applications	World Scientific Publishers	2010

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1. nptel.ac.in/courses/112107143/1
2. <http://www.public.iastate.edu/courses/.html>
3. [https://books.google.co.in/books/about/Rapid Prototyping](https://books.google.co.in/books/about/Rapid_Prototyping)
4. <https://www.youtube.com/watch?v=PDLOmoQj4H0>
5. <https://www.youtube.com/watch?v=i6Px6RSL9Ac>


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