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.

DESIGNING YOUR FUTURE

Estd. 2000

M.E-CAD/CAM

Curriculum/Syllabus

Regulation-2019

MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

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

Rasipuram - 637 408, Namakkal Dt, Tamil Nadu.

Ph. No.: 04287-220837

Email: principal@mec.edu.in.

Programme Code & Name: ME & ME-CAD/CAM

MUTHAYAMMAL ENGINEERING COLLEGE

RASIPURAM

M.E. CAD/CAM

GROUPING OF COURSES

1. Foundation Course(FC)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1	19CMA01	Advanced Numerical Methods	FC	4	3	1	0	4
2	19CMA02	Applied Mathematics	FC	4	3	1	0	4
3	19CMA03	Applied Probability and Statistics	FC	4	3	1	0	4
4	19CMA04	Design of Experiments and Research Methodology	FC	3	3	0	0	3

2. Professional Core(PC)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1	19CMB01	Computer Aided Design	PC	3	3	0	0	3
2	19CMB02	Competitive Manufacturing Systems	PC	3	3	0	0	3
3	19CMB03	Design for Manufacture and Assembly	PC	3	3	0	0	3
4	19CMB04	CNC Machines and Robotics	PC	3	3	0	0	3
5	19CMB05	Advanced Strength of Materials	PC	3	2	1	0	3
6	19CMB06	Finite Element Analysis and Applications	PC	3	3	0	0	3
7	19CMB07	Integrated Product and Process Development	PC	3	3	0	0	3
8	19CMB08	Industrial Safety Management	PC	3	3	0	0	3
9	19CMB09	Applied Materials Engineering	PC	3	3	0	0	3
10	19CMB10	Computational Fluid Dynamics	PC	3	2	1	0	3
11	19CMB11	Data communications in CAD/CAM	PC	3	3	0	0	3
12	19CMB12	Mechanisms Design and Simulation	PC	3	3	0	0	3
13	19CMP01	Computer Aided Design Laboratory	PC	3	0	0	3	1

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14	19CMP02	CNC Machines and Robotics Laboratory	PC	3	0	0	3	1
15	19CMP03	Finite Element Analysis and Applications Laboratory	PC	3	0	0	3	1

3. Professional Electives(PE)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1	19CMC01	Optimization Techniques in Design	PE	3	2	1	0	3
2	19CMC02	Advanced Tool Design	PE	3	2	1	0	3
3	19CMC03	Computer Control in Process Planning	PE	3	2	1	0	3
4	19CMC04	Reliability in Engineering Systems	PE	3	2	1	0	3
5	19CMC05	Tribology in Composite Materials Design	PE	3	2	1	0	3
6	19CMC06	Design of Material Handling Equipments	PE	3	3	0	0	3
7	19CMC07	Mechatronics Applications in Manufacturing	PE	3	3	0	0	3
8	19CMC08	Modeling and Analysis of Manufacturing Systems	PC	3	3	0	0	3
9	19CMC09	Productivity Management and Re-Engineering	PE	3	3	0	0	3
10	19CMC10	Design and Manufacturing of Composite Materials	PE	3	3	0	0	3
11	19CMC11	Integrated Mechanical Design	PE	3	3	0	0	3
12	19CMC12	Additive Manufacturing	PE	3	3	0	0	3
13	19CMC13	Geometric Modeling	PE	3	3	0	0	3

4. Employability Enhancement Courses

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1.	19CMD01	Project Work Phase -I	EEC	12	0	0	12	6
2.	19CMD02	Project work Phase -II	EEC	24	0	0	24	12
3.	19CMD03	Seminar	EEC	3	0	0	3	1
4.	19CMD04	Design & Analysis Project	EEC	3	0	0	3	1

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Programme Code & Name: ME & ME-CAD/CAM

CREDITS

S.No	Subject Area	CREDITS AS PER SEMESTER				Total Credit
		I	II	III	IV	
1	FC	4	-	-	-	4
2	PC	17	10	-	-	27
3	PE	-	6	9	-	15
4	SDC	-	2	6	12	20
Total		21	18	15	12	66

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Department	Mechanical
Programme	M.E CAD/CAM

SEMESTER - I

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	19CMA02	Applied Mathematics	3	1	0	4	4
2.	19CMB01	Computer Aided Design	3	0	0	3	3
3.	19CMB02	Competitive Manufacturing Systems	3	0	0	3	3
4.	19CMB03	Design for Manufacture and Assembly	3	0	0	3	3
5.	19CMB04	CNC Machines and Robotics	3	0	0	3	3
6.	19CMB05	Advanced Strength of Materials	2	1	0	3	3
PRACTICALS							
1	19CMP01	Computer Aided Design Laboratory	0	0	3	1	3
2	19CMP02	CNC Machines and Robotics Laboratory	0	0	3	1	3
		TotalCredits				**21**	

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Department	Mechanical
Programme	M.E CAD/CAM

SEMESTER - II

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	19CMB06	Finite Element Analysis and Applications	3	0	0	3	3
2.	19CMB07	Integrated Product and Process Development	3	0	0	3	3
3.	19CMB08	Industrial Safety Management	3	0	0	3	3
4.	19CMC**	Elective I	2	1	0	3	3
5.	19CMC**	Elective II	3	0	0	3	3
PRACTICALS							
6.	19CMB06	Finite Element Analysis and Applications Laboratory	0	0	3	1	3
7.	19CMD04	Design & Analysis Project	0	0	3	1	3
	19CMD03	Seminar	0	0	3	1	3

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Total Credits	**18**	

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SEMESTER - III

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
THEORY							
1.	19CMC**	Elective III	2	1	0	3	3
2.	19CMC**	Elective IV	3	0	0	3	3
3.	19CMC**	Elective V	3	0	0	3	3
PRACTICALS							
4	19CMD01	Project Work Phase I	0	0	12	6	12
Total Credits						15	

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Programme	M.E CAD/CAM

SEMESTER - IV

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Contact Hours
			L	T	P	C	
PRACTICALS							
1.	16CMD02	Project Work Phase II	0	0	24	12	12
Total Credits						12	

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19CMA01 ADVANCED NUMERICAL METHODS

L T P C
3 1 0 4

COURSE OBJECTIVES

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

COURSE OUTCOMES

1. Demonstrate understanding and implementation of numerical solution algorithms applied to solve algebraicequations
2. Be familiar with numerical solutions of ordinary differential equation and partial differential equations.
3. Be competent with finite difference method and finite elementmethod.
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 numericalmethods
5. The students will have a clear perception of the power of numerical Techniques. This will also serve as a precursor for futureresearch.
6. Students would be able to demonstrate the applications of numerical techniques to problems drawn from industry, management and other engineeringfields.

UNIT I: ALGEBRAIC EQUATIONS 9+3

Systems of linear equations: Gauss Elimination method, pivoting techniques, Thomas algorithm for tridiagonal system – 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+3

RungeKutta Meth ods 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+3

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 aboveschemes.

UNIT IV: FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS 9+3

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+3

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

TOTAL: P: 45 + T: 15 = 60

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, 2nd Edition	New Age Publishers	2016
2.	S. K. Gupta	Numerical Methods for Engineers, 3rd 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, 6th 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

19CMA02 **APPLIED MATHEMATICS** **L T P C**
3 1 0 3

COURSE OBJECTIVES

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

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 problemsolutions
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 onevariable
5. The knowledge gained on this course helps the students to do engineeringoptimization.
6. Demonstrate an understanding of the basic concepts of Fourier seriesanalysis

UNIT I:MATRIX THEORY **9+3**

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

UNIT II: CALCULUS OF VARIATIONS 9+3

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

UNIT III: ONE DIMENSIONAL RANDOM VARIABLES 9+3

Randomvariables-Probabilityfunction–moments–momentgeneratingfunctionsandtheirproperties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a RandomVariable.

UNIT IV:LINEAR PROGRAMMING 9+3

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

UNIT V: FOURIER SERIES AND EIGEN VALUE PROBLEMS 9+3

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: 15 = 60

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, 4th Edition	New Age International Publishers	2016
2.	Stark. H., and Woods. J.W.	Probability and Random Processes with Applications to Signal Processing, 4th Edition	Pearson Education, Asia	2014
3.	HamdyATaha	Operations Research, 9th 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, 2nd Edition	McGraw Hill	2011

19CMA03 APPLIED PROBABILITY AND STATISTICS **L T P C**
3 1 0 4

COURSE OBJECTIVES

- To introduce the basic concepts of one dimensional and two dimensional RandomVariables.
- To gain knowledge in the application of family of random variables in real lifesituations
- To provide information about Correlation andRegression
- Learn about maximum likelihood estimation, unbiased estimation and least squaremethods.
- To understand concepts of testing ofhypothesis
- To enable the students to use the concepts of multivariate normal distribution and principle componentsanalysis.

COURSE OUTCOMES

1. 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 engineeringapplications.
2. Associate random variables by designing joint distributions and correlate the random variables
3. Perform and interpret correlation and regression analysis and develop correlation models to predict changes in processes and products for linear and non-linearrelationships
4. Provides knowledge to apply testing of hypothesis to real lifeproblems.
5. Be familiar with multivariateanalysis.
6. The student will able to acquire the basic concepts of Probability and Statistical techniques for solving mathematical problems which will be useful in solving Engineeringproblems

UNIT I: ONE DIMENSIONAL RANDOM VARIABLES **9+3**

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

UNIT II: TWO DIMENSIONAL RANDOM VARIABLES **9+3**

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

UNIT III:ESTIMATION THEORY **9+3**

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

UNIT IV: TESTING OF HYPOTHESES **9+3**

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: MULTI VARIATE ANALYSIS **9+3**

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

TOTAL: L: 45 +T: 15=60

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), 6th Edition	John Wiley & Sons, Inc.	2016
2.	Richard A. Johnson and Dean W. Wichern,	Applied Multivariate Statistical Analysis, 6th 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 Theoryand Problems of Probability, Random Variables and RandomProcesses	Tata McGraw Hill Edition, New Delhi	2014
5.	Walpole. R.E., Myers.R.H., Myers.S.L., and Ye. K.,,	Probability and Statisticsfor Engineers and Scientists, 8thEdition	Pearson Education, Asia	2013

19CMA04 DESIGN OF EXPERIMENTS AND RESEARCH METHODOLOGY

L T P C
3 0 0 3

COURSE OBJECTIVES

- To introduce different researchmethods
- To understand different testing methods ofhypotheses
- To understand the terminology in design ofexperiments
- To illustrate the interaction between different inputdata
- To familiarize the statistical approach in experimental dataanalysis
- To design different experimentaldesign

COURSE OUTCOMES

1. Understand the fundamentals of researchmethodology.
2. Illustrate the different testing methods inresearch
3. Develop different design ofexperiments
4. Comprehend the interaction between inputdata
5. Identify and construct various statisticalapproach
6. Construct experimental design and providerecommendation

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 makerecommendations.

TOTAL: L: 45+ T: 0 = 45

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	C.R.Kothari, GauravGarg	Research methods and techniques	3rd 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)	6th 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. GlinerGeorge A. Morgan, and Nancy L.Leech	Research methods in applied settings: an integrated approach to design and analysis	Taylor & Francis	2016

19CMB01 COMPUTER AIDED DESIGN

L T P C
3 0 0 3

COURSE OBJECTIVES

- To impartthe fundamental theory of the computergraphics.
- To understand the computer application and design for curves and surfacemodeling.
- To familiarize the basic fundamental of NURBS and solidmodeling.
- To understand the algorithms of shading, coloring in visualrealism.
- To impart knowledge on the various aspects of modeling of assemblyparts.
- To understand the various analyses in product dataexchange

COURSE OUTCOMES

1. Explain the primitives in computer graphics, 2D and 3Dtransformations
2. Explain different types of curves in surface modeling
3. Discuss the various types of curves in solidmodeling.
4. Explain the algorithms and principles of creation of prismatic and loftedparts
5. Examine the mechanism involved in assemblymodeling.
6. Understand and analysis the product dataexchange.

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 bi cubic 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 solidmodeling.

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

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

19CMB02 COMPETITIVE MANUFACTURING SYSTEMS

L T PC
3 0 0 3

COURSE OBJECTIVES

- To emphasize the knowledge on quality improvement andautomation
- To know how to create highest caliber products quickly andinexpensively.
- To know the principles of flexible manufacturingsystems.
- To understand the modern methods required for manufacturing competitiveenvironment.
- To comprehend the necessity of customer focusedmanufacturing.
- To understand the factors to consider for the qualitymanufacturing.

COURSE OUTCOMES

1. Understand the principles of manufacturing in a competitiveenvironment.
2. Understand and explain group technology and flexiblemanufacturing
3. Explain the hierarchy of computercontrol
4. Explainthesoftwarerequiredforsimulationanddatabaseforflexiblemanufacturing systems.
5. Understand and explain the principles and methods of leanmanufacturing.
6. Explain the elements involved in Just in timeprocess.

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 DATA BASE 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.

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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) - Leanculture.

UNIT V: JUST IN TIME 9

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 MostPowerful 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

19CMB03 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 andmachining.
- To understand the factors influencing the manufacturingprocesses.
- To comprehend the factors influencing the designing of cast and machinedcomponents.
- To understand the basic procedure of design for assembly andenvironments.
- To familiarize the tools required in various manufacturingprocesses..

COURSE OUTCOMES

1. Understand the basic principles formanufacturability.
2. Understand and explain the factors influencing the form designsystems
3. Demonstrate the design considerations required for machinedcomponents
4. Comprehend and explain the design consideration for castcomponents.
5. Demonstrate the need for designing forenvironment
6. Explain life cycleassessment.

UNIT I: BASICS OF DESIGNING PRINCIPLES **9**

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 andstandards.

TOTAL: L: 45= 45

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Kevien Otto and Kristin Wood	Product Design	Pearson Publication	2011
2	Boothroyd, G, Heartz 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

19CMB04 CNC MACHINES AND ROBOTICS

L T P C
3 0 0 3

COURSE OBJECTIVES

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

COURSE OUTCOMES

1. Understand and explain the CNC lathe and millingmachines
2. Identify and explain the types of feedback and control systems in CNCmachines
3. Construct and experiment various part programming of CNC lathe andmilling
4. Apply and practice basic principles of roboticdesign.
5. Understand and write programs for various robot motioncontrols.
6. Understand and explain robot working principles for variousapplications.

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 itsassembly.

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 automotiveindustry

TOTAL: L: 45 = 45

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 CNCmachines	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

19CMB05 ADVANCED STRENGTH OF MATERIALS

L T P C
2 1 0 3

COURSE OBJECTIVES

- To understand the basic concepts of stress, strain, displacement andtransformations
- To be able to estimate strength and predict failure ofmaterials
- To able to find the shear stress and shear straincentre.
- 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 andbending
- Tounderstandstressfunctions,andunderstandstressesinplatesandshells,thickcircular cylinders and discs, contact stresses and stressconcentration.

COURSE OUTCOMES

1. Understand the basic concepts of elasticity and stress strainrelationship
2. Locate the shear centre and understand the shear flows for varioussections.
3. Solve stress related problems in curved flexible members andplates
4. Examine the torsion forces in non- circularsections
5. Analyze the stress in rotatingmembers
6. Analyze the contact stresses and explain the methods of computingthem.

UNITI: ELASTICITY **9**

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 **9**

Location of shear center for various sections - Shear flows - Stresses and deflections in beams subjected to unsymmetrical loading - Kern of asection.

UNIT III: CURVED FLEXIBLE MEMBERS AND STRESSES IN PLATES **9**

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 **9**

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 **9**

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: 15=45

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. Baskarand 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

19CMB06 FINITE ELEMENT ANALYSIS AND APPLICATIONS

L T PC
3 0 0 3

COURSE OBJECTIVES

- To obtain an understanding of the fundamental theory of the FEAmethod.
- To understand the application and use of the FE method for heat transferproblems.
- To understand the use of the basic finite elements for structural applications using truss, beam, frame, and planeelements.
- To be able to use the basic finite elements for structural applications using plane stress, plane strainproblems.
- To understand the overview of application packages such as ANSYS andDEFORM.
- To be a able to develop code for one dimensional analysis andvalidation.

COURSE OUTCOMES

1. Apply the procedure involved to solve a structural problem using Finite Element Methods.
2. Develop the element stiffness matrices using differentapproach.
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 hexahedralelements.
5. Develop FEA/FEM general pre and post processingsolutions.
6. Develop code for one dimensional analysis andvalidation.

UNITI: INTRODUCTION 9

Basics of FEM - Initial value and boundary value problems - weighted residual Galerkin and Raleigh Ritzmethods-reviewofVariationalcalculus-Integrationbyparts-BasicsofVariationformulation.

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 axis 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

REFERENCE BOOKS:

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

19CMB07 INTEGRATED PRODUCT AND PROCESS DEVELOPMENT

L T PC
3 0 0 3

COURSE OBJECTIVES

- To emphasize the need for integrated product developmentprocess
- To understand the significance of customer role in productdevelopment
- To be able to generate concepts and testthem.
- To know to design for industry requirement and establish the bestarchitecture
- To understand the factors influencing the productdevelopment.
- To understand the basics and need ofprototyping.

COURSE OUTCOMES

1. Understand the basic principles of productdevelopment
2. Identify and demonstrate the concept generation, selection and testingprocess
3. Demonstrate the establishment of productarchitecture
4. Apply various tools in industrial designprocess
5. Explain the elements involved in design formanufacturability.
6. Explain the principles involved inprototyping.

UNIT I: BASIC CONCEPTS OFP RODUCT 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 TestingMethodologies.

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

19CMB08 INDUSTRIAL SAFETY MANAGEMENT

L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand the modern safetyconcepts.
- To be able to understand the role of employee in safetymeasures
- To provide a structured management approach to control safety risks in variousoperations.
- To be able to integrate health & safety measures into alltasks.
- To understand the techniques involved in accidentprevention
- To know safety, health, welfare andlaws.

COURSE OUTCOMES

1. Explain the modern safety concepts and safety managementfunctions.
2. Acquire, articulate and apply specialized knowledge relevant to operationalsafety.
3. Demonstrate the safety measures in various types of workingplaces.
4. Explain the causes and costs ofaccidents
5. Illustrate the methods of accidentprevention.
6. Comprehend various laws and welfare activities related to safety andhealth.

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:OPERATIONALSAFETY **9**

Hot metal Operation - Boiler, pressure vessels - heat treatment shop - gas furnace operation – electroplating-hotbendingpipes-Safetyinweldingandcutting.Cold-metalOperation-Safetyin

Machine shop - Cold bending and chamfering of pipes - metal cutting - shot blasting, grinding, painting - Power press and othermachines.

UNIT III:SAFETYMEASURES **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 ofmajor

UNIT IV:ACCIDENTPREVENTION **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

19CMB09 APPLIED MATERIALS ENGINEERING

L T PC
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 ofmaterials.
- To provide the knowledge on material properties, material cost and factors to be considered while selecting materials for variousapplications.
- To study various cases in material selection for differentapplications.
- To educate the material processing concepts and various process induceddefects.
- To familiarize the modern materials and heat treatment ofmaterials.

COURSE OUTCOMES

1. Familiarize the fundamentals of material behaviour
2. Explain the various strengthening mechanisms ofmaterials
3. Comprehend fracture mechanism and discover the material failuredefects
4. Select the suitable material for differentapplications

5. Propose the suitable process for materials and analyze the process induceddefects
6. Explain the characteristics of modernmaterials

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 failureanalysis.

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 , Nanomaterials.

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
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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19CMC10 COMPUTATIONAL FLUID DYNAMICS

L T PC
2 1 0 3

COURSE OBJECTIVES

- Toemphasizetheknowledgeonboundaryconditions,finitedifferencemethod,and numericalerrors
- 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 ofone dimensional and two dimensional convection problems.
- To understand the basics of analysis byFEM
- To understand the algebraic models and heat transfer using standardcodes

COURSE OUTCOMES

1. Understand the principles of governing differential equation and finite differencemethod.
2. Understand and explain heat conduction in various dimensionalmethod
3. Explain the equations for Incompressible fluid flow by differenceapproach.
4. Understand and explain the principles of convection heattransfer
5. Explain the FEM analysis of conduction and incompressibleflow
6. Explain the fundamentals involved in turbulencemodels

UNIT I: GOVERNING DIFFERENTIAL EQUATION AND FINITE DIFFERENCE METHOD 9

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 IndependenceTest.

UNIT II: CONDUCTION HEAT TRANSFER 9

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

UNIT III: INCOMPRESSIBLE FLUID FLOW 9

Governing Equations, Stream Function -Verticity 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 TRANSFERAND FEM 9

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 MODELS 9

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: 15 = 45

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REFERENCE BOOKS:

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

19CMB11 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 operatingsystems.
- To familiarize the functions ofcompiler.
- To provide the knowledge on data communication, networking, transmissions of communications systems
- To educate the different types of networkingstructure.
- To familiarize the Internet services andProtocols

COURSE OUTCOMES

1. Explain the basic functions, operations and languages of digital computersand microprocessors
2. Describe various operatingsystems.
3. Describe the functioning of acompiler.
4. Illustrate various networking and communicationmodels
5. Choose suitable networkstructure
6. Explain the internet services andProtocols

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-assemblylanguage–assembler.RegistersALUandBusSystems-timingandcontrol

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.

UNITV: 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 3rd Edition	2012.
5	Morris Mano. M	Computer System Architecture",	Prentice Hall of India	2013

19CMB12 MECHANISMS DESIGN AND SIMULATION

L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand the layout of linkages and kinematic analysis of variouslinks.
- To impart the knowledge of kinematics simulations of variousmechanisms.
- To learn the Path Curvature Theory used inmechanisms.
- To study the synthesis analysis of four barmechanisms.
- To comprehend synthesis of cam mechanisms

- To understand coupler curve basedmechanisms.

COURSE OUTCOMES

1. Comprehend the basics of mechanismdesign
2. Determine and analyze the kinematics attributes of variouslinks.
3. Illustrate the path curvature theory and itsapplications
4. Design four bar based mechanisms of real timeapplications.
5. Analyze the cam mechanisms of real timeapplications
6. Describe the coupler curve basedmechanisms

UNITI: 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 - CaseStudy-Kinematicanalysisofspatialmechanisms-simulationmechanismsusingsoftwarepackage.

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	3rd Edition, John Wiley-Sons	2016
2	David H. Myszka,	Machines & Mechanisms: Applied Kinematic Analysis	Pearson Education, 4th revised edition	2011
3	J. J. Uicker, G. R. Pennock and J.E. Shigley	Theory of Machines and Mechanisms	Oxford University Press, NY, IInd Edition	2014
4	Robert L. Nortron	Kinematics and Design of Machinery	McGraw Hill Higher Education, 2nd 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

19CMB01 COMPUTER AIDED DESIGN LABORATORY

L T P C
0 0 3 1

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

7. Explain the primitives in computer graphics, 2D and 3Dtransformations
8. Explain different types of curves in surface modeling
9. Discuss the various types of curves in solid modeling.
10. Explain the algorithms and principles of creation of prismatic and lofted parts
11. Examine the mechanism involved in assembly modeling.
12. Understand and analysis the product data exchange.

TOTAL: P: 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

19CMB04 CNC MACHINES AND ROBOTICS LABORATORY

L T P C
3 0 0 3

COURSE OBJECTIVES

- 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

7. Understand and explain the CNC lathe and milling machines
8. Identify and explain the types of feedback and control systems in CNC machines
9. Construct and experiment various part programming of CNC lathe and milling
10. Apply and practice basic principles of robotic design.
11. Understand and write programs for various robot motion controls.
12. Understand and explain robot working principles for various applications.

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

19CMB06 FINITE ELEMENT ANALYSIS AND APPLICATIONS LABORATORY

L T P C
3 0 0 3

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 a able to develop code for one dimensional analysis and validation.

COURSE OUTCOMES

7. Apply the procedure involved to solve a structural problem using Finite Element Methods.
8. Develop the element stiffness matrices using different approach.
9. Develop the global and natural co-ordinates, shape functions for one and two dimensional elements
10. Analyze a 2D problem using line, triangular, Axisymmetry, quadrilateral element, Tetrahedral and hexa hedral elements.
11. Develop FEA/FEM general pre and post processing solutions.
12. Develop code for one dimensional analysis and validation.

TOTAL: P: 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

19CMC01 OPTIMIZATION TECHNIQUES IN DESIGN

L T P C
2 1 0 3

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 optimizationtechniques.
- To solve problems on design ofexperiments.
- To familiarize the selecting algorithms for solving multi-objective and non-traditional optimizationproblems.

COURSE OUTCOMES

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

UNITI: INTRODUCTION **9**

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 **9**

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 searchmethod.

UNIT III: MULTI VARIABLE AND CONSTRAINED OPTIMIZATION TECHNIQUES **9**

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 **9**

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 **9**

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: 15= 45

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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. Tirupathiand 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

19CMC02 ADVANCED TOOL DESIGN

L T P C
2 1 0 3

COURSE OBJECTIVES

- To introduce design process oftools.
- To develop solutions for the design oftools.
- To develop skills to reduce the overall cost to manufacture a product by making acceptable parts at the lowestcost.
- To understand the basics of designing jigs andfixtures.
- To familiarize the methods to increase the production rate by designing tools to produce parts as quickly aspossible.
- To design tools that produce parts with the requiredprecision.

COURSE OUTCOMES

1. Familiarize the cutting tools, tool holders and cuttingfluids.
2. Comprehend and design cutting toolsystems.
3. Understand the design consideration of jigs andfixtures.
4. Design jigs and fixtures for variousoperations.
5. Design and draft press tooldies.
6. Design and analyze tools for CNC machinetools.

UNIT I: INTRODUCTION TO TOOL DESIGN 9

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 heattreatment

UNIT II: DESIGN OF CUTTING TOOLS SYSTEMS 9

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 9

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 - Drillbushings - 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 ForceCalculations

UNIT IV: DESIGN OF PRESS TOOL DIES 9

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 9

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: 15=45

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 PvtLtd,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

19CMC03 COMPUTER CONTROL IN PROCESS PLANNING

L T P C
2 1 0 3

COURSE OBJECTIVES

- To impart knowledge about the basics of processplanning.
- To impart knowledge on conventional tolerances used in partdesign.
- To comprehend various group technology codingsystems.

- To understand the basic concept of process engineering and various process planningapproaches.
- To familiarize the various systems and tools required for computer aided processplanning.
- To provide the knowledge about structure and operations of integrated process planningsystems

COURSE OUTCOMES

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

UNIT I: BASIC PRINCIPLES OF PROCESS PLANNING **9**

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

UNIT II: PART DESIGN REPRESENTATION **9**

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 MICLASSsystem.

UNIT III: PROCESS ENGINEERING AND PROCESS PLANNING **9**

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

UNIT IV: COMPUTER AIDED PROCESS PLANNING SYSTEMS **9**

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 **9**

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

TOTAL: L: 30+ T: 15 = 45

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
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

19CMC04 RELIABILITY IN ENGINEERING SYSTEMS

L T PC
2 1 0 3

COURSE OBJECTIVES

- To provide the knowledge about reliability concept andfunctions
- To impart knowledge on failure dataanalysis
- To understand the process of reliabilityassessment
- To educate the reliability monitoringmethods
- To understand reliability improvement ofsystems.

COURSE OUTCOMES

1. Explain the reliability concept andfunctions
2. Comprehend the method of failure dataanalysis
3. Elaborate about reliabilityassessment
4. Formulate the reliability monitoringsystems
5. Analyze the downtime ofsystems
6. Improve the reliability of thesystem.

UNIT I:RELIABILITY CONCEPT 9

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 9

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 9

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 9

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

UNIT V:RELIABILITY MPROVEMENT 9

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

TOTAL: L: 30+ T: 15 = 45

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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19CMC05 TRIBOLOGY IN COMPOSITE MATERIALS DESIGN

L T P C
2 1 0 3

COURSE OBJECTIVES

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

COURSE OUTCOMES

1. Summarize the basic principles of friction, wear andlubrication.
2. Recall measurements of friction and wear for different operatingconditions
3. Characterize the properties of .compositematerials
4. Describe various methods of composite materialsfabrication.
5. Identify the various testing facilities of differentcomposites.
6. Interpret the tribological problems and diagnose them

UNIT I: FRICTION, WEAR& LUBRICATION **9**

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

UNIT II:TRIBOLOGICAL MEASUREMENTS **9**

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 **9**

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 **9**

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 **9**

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: 15 = 45

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

19CMC06 DESIGN OF MATERIAL HANDLING EQUIPMENTS

L T PC
3 0 0 3

COURSE OBJECTIVES

- To impart knowledge on operating principles of various material handling systems and their limitations.
- Tounderstandthedesignproceduresofvariousmaterialshandlingequipmentusedin industry.
- To enhance the knowledge on drives of hoistinggear.
- To understand the working principle ofconveyors
- To understand the working principle ofelevators
- To design and perform the selection of various material handlingequipments

COURSE OUTCOMES

1. Understand the basics of Material Handlingequipments
2. Demonstrate the principles involved in design ofHoists
3. Understand and explain the drives of hoistinggear.
4. Demonstrate the working principle conveyors
5. Demonstrate the working principle ofelevators
6. Describe various material handling equipments used inindustry.

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 conetypes.

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.

UNITIV:CONVEYORS **9**

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

UNITV: 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

19CMC07 MECHATRONICS APPLICATIONS IN MANUFACTURING

L T P C
3 0 0 3

COURSE OBJECTIVES

- To provide the knowledge about measurement systems and Mechatronicsdesign.
- To impart knowledge on various types of sensors andtransducers
- To understand the difference between microprocessors andmicrocontrollers
- To provide the knowledge on programming and interfacing ofmicroprocessors
- To illustrate various programmable logiccontrollers
- To familiarize the design of various mechatronicssystems

COURSE OUTCOMES

1. Explain the basic principles of traditional and mechatronicssystems.
2. Comprehend the suitable sensor and transducers for variousapplications
3. Elaborate on architecture ofmicroprocessors.
4. Describe the interfacing of variousconverters..
5. Design the programmable logiccontrollers
6. Choose the suitable design for Mechatronicssystems

UNITI: 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 - Servosystems.

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 Introductionto Mechatronics	Prentice-Hall	2000
5	Ghosh, P.K. and Sridhar, P.R	0000 to 8085, Introduction to Microprocessors for Engineers and Scientists	Second Edition, PrenticeHall	2004

19CMC08 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 manufacturingsystems
- To describe the various concepts of controlling the manufacturingsystems.
- To familiarize the concepts of controlling manufacturing processes and evolution analysis in Manufacturing.
- To understand the queuing models in manufacturingsystem.
- To understand the basic procedure used in the QueuingNetworks
- To familiarize the representational power and Stochastic Petri Nets in manufacturingsystem.

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 manufacturingsystems.
3. Understand and explain the analysis of manufacturingprocesses
4. Demonstrate the queuing methods and itsanalysis
5. Comprehend and explain the consideration for QueuingNetworks
6. Explain the elements involved in the PetriNETS

UNIT I: MANUFACTURING SYSTEMS & CONTROL **9**

Manufacturing Systems - Modeling - Role of performance modeling - 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 managementsystem.

UNIT II:MANUFACTURING PROCESSES **9**

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 inmanufacturing.

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 Newellnetworks

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 andModeling ofManufacturingSystems	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, Barış Tan	Handbook of StochasticModels and Analysis ofManufacturing System	Springer Science & Business Media	2013
5	S. Joshi, Jeffrey Smith S	Computer control of flexiblemanufacturing systems	pringer Science & Business Media	2012

19CMC09 PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- Toimpartknowledgeonproductivitymodelsandorganizationaltransformations.
- To describe the measurement ofproductivity.
- To study the organizationaltransformation
- To impart knowledge reengineering process improvementtools.
- To gather knowledge in reengineering tools andimplementation
- To understand the supply chainmanagement.

COURSE OUTCOMES

1. Understand the basic concepts ofproductivity
2. Demonstrate the productivity models
3. Demonstrate the principles involved in organizationaltransformation.
4. Explain various re-engineering process improvementmodels.
5. Describe the various re-engineeringtools.
6. Enumerate the principles of supply chainmanagement.

UNITI: 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 andtechniques.

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, NewDelhi,	2008
2	R C Mishra and K Pathak	Maintenance Engineering andManagement	PHI	2005
3	D J Sumant	Productivity engineering and management	TMH, New Delhi	2006
4	J AEdosomwan	Organizational transformation andprocess 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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19CMC10 DESIGN AND MANUFACTURING OF COMPOSITE MATERIALS

L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand the basics of compositematerials.
- To describe various types of matrix materials andreinforcements.
- To understand the methods of manufacturing compositematerials.
- To comprehend the principles of mechanics of compositelaminates
- To demonstrate the testing methods of compositematerials
- To familiarize the recent trends in compositematerials

COURSE OUTCOMES

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

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 oxidationprocess

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 behavior of particulate reinforced composites.

UNIT V: RECENT TRENDS IN COMPOSITEMATERIALS 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	ManeelDe kkerInc,	2007

19CMC11 INTEGRATED MECHANICAL DESIGN

L T P C
3 0 0 3

COURSE OBJECTIVES

- To familiarize the fundamentals in the design process with steady and variablestresses
- To design shafts to satisfy functional and strengthrequirements.
- To describe the principles of gear and gearboxes.
- To describe characteristics shared by clutches andbrakes.
- To learn to use standard practices and standard data and design springs, levers &flywheels.
- To learn to use catalogues and standard conveyingequipments.

COURSE OUTCOMES

1. Understand the design fundamentals in mechanicaldesign.
2. Analyze steady and variable stresses inshafts.
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 designthem.
5. Acquire and demonstrate competency in integrateddesign.
6. Understand and explain the principles and types of conveyingequipments.

UNIT I: FUNDAMENTALS AND DESIGN OF SHAFTS **9**

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 pneumaticconveyors.

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	KalaikathirAchchagam, Coimbatore	2003
2.	Lingaiah. K. and NarayanaIyengar	Machine Design Data Hand Book	Vol. 1 & 2, Suma Publishers, Bangalore.	1994

19CMC12 ADDITIVE MANUFACTURING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To provide an exhaustive knowledge of various rapid prototypingtechniques
- To understand various rapid prototypingsystems
- 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 industrialapplications.
- To make familiar in reverse engineering and cadmodeling
- To make familiar about materials and process parameters in prototypedevelopment.

COURSE OUTCOMES

- Classify different prototypingtechniques.
- Describe various rapid prototypingsystems
- Understand file conversion technique of file formats for rapid prototypesystems.
- Select the suitable additive manufacturing process for respectiveapplications.
- Describe reverse engineering in rapidprototyping.
- Describe the properties of various materials used inprototyping

UNITI: 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 RAPIDPROTOTYPINGSYSTEMS **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 RAPIDPROTOTYPINGSYSTEMS **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 ANDCADMODELING **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- Casestudies.

UNIT V:MATERIALSPROPERTIES **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 WorkingPrinciple.

TOTAL: L:45 = 45

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Ian Gibson, DavidW.Rosen	Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing	Springer	2015
2	AmitBandyopadhyay ,Susmita Bose	Additive Manufacturing	Taylor &Francis Group	2016
3	Liou, L.W. and Liou, F.W	Rapid Prototyping and Engineering applications: Atool box for prototypedevelopment"	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

19CMC13 GEOMETRIC MODELING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To understand the mathematical representation of curves
- To interpret the mathematical representation of surfaces
- To interpret the mathematical representation of surfaces
- To comprehend visual realization.
- To familiarize computer animation

COURSE OUTCOMES

- Develop the mathematical model of curves and surface.
- Develop the mathematical representation of surface.
- Develop the mathematical model of solid based on the design application.
- Develop visual realization algorithm.

- Design the animation of product.

UNIT I: TYPES AND MATHEMATICAL REPRESENTATION OF CURVES 9

Introduction, Wireframe models, parametric representation of curves(analytic synthetic),curve Manipulation, design examples.

UNIT II: MATHEMATICAL REPRESENTATION OF SURFACES 9

Surface models, parametric representation, surface manipulation, design applications.

UNIT III: MATHEMATICAL REPRESENTATION OF SOLIDS 9

Fundamentals of solid modeling, Boundary representation, constructive solid geometry, sweep Representation, analytic solid modelers, design applications.

UNIT IV: VISUAL REALISATION 9

Model cleanup, hidden line removal, hidden surface removal, shading, and colouring.

UNIT V: COMPUTER ANIMATION *

Computer animation, animation systems types and techniques, design applications, Computer Graphics Standard.

TOTAL: L:45 = 45

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	David Solomon	Computer Graphics and Geometric Modeling	Springer	2015
2.	Michael EMortenson	Geometric Modeling	JohnWiley&Sons Inc.,SecondEdition	2010

19CMD01 PROJECT WORK PHASE -I

L T P C
0 0 12 6

COURSE OBJECTIVES

- To achieve integrated mechanical design of a product through parts design, assembly and preparation of manufacturing drawings

COURSE OUTCOMES

- Choose an engineering problem in a current industrial scenario.
- Do intensive and related literature review
- Decide the working methodology of the project

Each student has to work under a project supervisor. Based on the current industrial scenario, any relevant problem should be selected for the project with the consultation of the supervisor. Literature review should be done related to the problem considered. The working methodology of the project work for the phase II should be decided. These activities should be registered in a report and submitted by the student which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report, jointly by external and internal examiners.

TOTAL: P:90 = 90

19CMD02 **PROJECT WORK PHASE -II** **L T P C**
0 0 24 12

COURSE OBJECTIVES

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.

COURSE OUTCOMES

- Apply knowledge and demonstrate to manage project in multi-disciplinary.
- Design and conduct experiments to interpret data pertaining to engineering problems
- Apply contextual knowledge to assess social, health and cultural issues and endue to professional engineering practice.
- Prepare documentation and presentation for engineering activities for society
- Perform effectivelyas leader in multi-disciplinary terms.

Based on the work methodology decided in the Phase I, the project is further developed. Necessary modeling and analysis is done using required software. The project is fabricated. The analytical results and the experimental results are validated. Three reviews will be conducted periodically by a committee constituted by the Head of the Department. A project report to be prepared by the students along with which the project has to be submitted for the final viva voce examination

TOTAL: P:450 = 450

19CMD03 **SEMINAR** **L T P C**
0 0 4 1

COURSE OBJECTIVES

- To encourage the students to comprehend the knowledge acquired from various premeier journals through periodic exercise.
- To gain ability to understand and comprehend any given problem related to mechanical engineering field

COURSE OUTCOMES

- Recall the basic principles of previous semester courses.
- Comprehend and analyze problems associated with mechanical engineering
- Make an oral presentation

The students have to recall the principles and fundamental of the courses studied in their previous semesters. Along with that knowledge and that acquired from reading various premier journals of their choice, the students have to make an oral presentation. Weekly examination will be conducted and evaluated. The average of the marks obtained in the tests will be considered for the end semester evaluation.

TOTAL: P:30 = 30

19CMD04 **DESIGN AND ANALYSIS PROJECT** **L T P C**
0 0 4 1

COURSE OBJECTIVES

- To give an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by them.

COURSE OUTCOMES

- Use of design principles and develop conceptual and engineering design of any components.
- Ability to fabricate any components using different manufacturing tools.

The students have to work individually under a project supervisor. The device/ system/component(s) to be designed and /analysed may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the student and the model, will be reviewed and

evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners.

TOTAL: P:60 = 60

Chairman-Board of Studies
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