DEPARTMENT OF
MECHANICAL ENGINEERING

SCHEME OF INSTRUCTION AND SYLLABI
OF

M.E.

(Mechanical Engineering)

Specialization:

CAD/CAM

2016-17 – CBCS

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
(Autonomous)
Affiliated to Osmania University
Hyderabad – 500 075, Telangana, INDIA

CHAITANYA BHARATHI INSTIUTE OF TECHNOLOGY

(AUTONOMOUS)-CBCS

Gandipet, Hyderabad – 500 075

INSTITUTE

Vision

To be a centre of excellence in technical education and research

Mission

To address the emerging needs through quality technical education and advanced research

DEPARTMENT

Vision

To be a Pace Setter in the field of mechanical Engineering by providing conducive environment for understanding and applying its principles to cater the needs of Society

Mission

To impart quality & innovative technical education to the students of mechanical engineering for their professional achievements in consultancy, R&D and to become successful entrepreneur enabling them to serve the society in general and the industry in particular

CHAITANYA BHARATHI INSTIUTE OF TECHNOLOGY

(AUTONOMOUS)

Gandipet, Hyderabad – 500 075

MECHANICAL ENGINEERING

Programme: M.E (CAD/CAM)

Programme Educational Objectives:

1. Will become professional contributors in the industry related to the area of CAD/CAM
2. Will excel in research & development and consultancy
3. Will become entrepreneurs in CAD/CAM industry.

POs describe what students are expected to know or be able to do by the time of graduation from the program.

1. To demonstrate knowledge in core subjects of CAD/CAM with mathematical & numerical orientation.
2. To exhibit proficiency in usage of software packages of solid modeling, meshing and analysis.
3. To understand advanced technologies in the area of Manufacturing & Automation in Manufacturing
4. To posses the necessary skills to prepare the project proposals by referring technical papers in various reputed journals, pertaining to CAD/CAM.
5. To Understand the concepts and principles of Engineering Research Methodology and apply the same for designing and conducting experiments related to the area of CAD/CAM.
6. To acquire leadership qualities by organizing and participating in various events.

Note: PEOS are expected to achieve after 2 years of graduation

Scheme of Instruction & Examination
M.E. (CAD/CAM) – Mechanical Engineering - 4 Semesters (Full Time)

Semester - I

Sl. No	Subject	No. of Hrs. per week		Duration (Hrs)	Marks for		Total Marks	Credits
		Lecture	T/P/S		Internal Assessment	End Exam		
1.	Core	3	1	4	30	70	100	4
2.	Core	3	1	4	30	70	100	4
3.	Core	3	1	4	30	70	100	4
4.	Elective	3	--	3	30	70	100	3
5.	Elective	3	--	3	30	70	100	3
6.	Elective	3	--	3	30	70	100	3
7.	Laboratory	--	3	3	50	--	50	2
8.	Seminar - I	--	3	3	50	--	50	2
9.	Soft Skills	--	--	--	--	--	--	--
	Total	**18**	**09**		**340**	**360**	**700**	**25**

Semester - II

Sl. No	Subject	No. of Hrs. per week		Duration (Hrs)	Marks for		Total Marks	Credits
		Lecture	T/P/S		Internal Assessment	End Exam		
1.	Core	3	1		30	70	100	4
2.	Core	3	1		30	70	100	4
3.	Core	3	1		30	70	100	4
4.	Elective	3	--		30	70	100	3
5.	Elective	3	--		30	70	100	3
6.	Elective	3	--		30	70	100	3
7.	Laboratory - II	--	3		50	--	50	2
8.	Seminar - II	--	3		50	--	50	2
9.	Mini Project	--	2		50	--	50	1
	Total	**18**	**11**		**390**	**360**	**750**	**26**

Semester - III

Sl. No	Subject	Marks for		Total Marks	Credits
		Internal Assessment	End Exam		
1	Project Seminar* (i)Problem formulation and submission of synopsis within 8 weeks from the commencement of 3rd Semester. (50 Marks) (ii) Preliminary work on Project implementation. (50 Marks)	**100**	**--**	**100**	**6**
	Total	**100**		**100**	**6**

Semester - IV

Sl. No	Subject	Marks for		Total Marks	Credits
		Internal Assessment	End Exam		
1	Project Work	**100**	**100**	**200**	**12**

Note: Six core subjects, Six elective subjects, Two Laboratory Courses and Two Seminars, Mini Project and Soft Skills should normally be completed by the end of semester II.

* Project seminar presentation on the topic of Dissertation only, 50 marks awarded by the project guide and 50 marks by the internal committee

Credit requirements for the award of degree, lower limit and upper limit of credits for registration by a student in a semester Credit Requirement for the award of M.E/M. Tech. Degree is 69

With effect from the academic year 2016- 2017

Scheme of Instruction & Examination Post Graduate course in Mechanical Engineering

with specialization in **CAD/CAM**

Course duration: 4 Semesters (Full – Time)

Sl. No	Syllabus Ref.No.	Subject	Scheme of Instruction Hours per week		Scheme of Examination			Credits
					Duration in Hours	Max. Marks		
			L	T/P		End Exam	Internal Assessment	
		CORE SUBJECTS						
1.	16MEC101	Automation	3	1	4	70	30	4
2.	16MEC102	Computer Aided Modeling and Design	3	1	4	70	30	4
3.	16MEC103	Computer Integrated Manufacturing	3	1	4	70	30	4
4.	16MEC104	Computer Aided Mechanical Design and Analysis	3	1	4	70	30	4
5.	16MEC105	Finite Element Techniques	3	1	4	70	30	4
6.	16MEC205	Computational Fluid Dynamics	3	1	4	70	30	4
		ELECTIVES						
1	16MEE101	Failure Analysis and Design	3	--	3	70	30	3
2.	16MEE102	Integrated Mechanical Design	3	--	3	70	30	3
3.	16MEE103	Robotic Engineering	3	--	3	70	30	3
4.	16MEE104	Programming Methodology and Data Structures	3	--	3	70	30	3
5.	16MEE105	Optimization Techniques	3	--	3	70	40	3
6.	16MEE106	Vibrations Analysis and Condition Monitoring	3	--	3	70	30	3
7.	16MEE107	Engineering Research Methodology	3	--	3	70	30	3
8.	16MEE108	Tribology In Design	3	--	3	70	30	3
9.	16MEE109	Advanced Mechanics of Materials	3	--	3	70	30	3
10.	16MEE110	Mechanics of Composite Materials	3	--	3	70	30	3
11.	16MEE111	Theory of Elasticity and Plasticity	3	--	3	70	30	3
12.	16MEE112	Experimental Techniques and Data Analysis	3	--	3	70	30	3
13.	16MEE113	Design for Manufacture	3	--	3	70	30	3
14.	16MEE114	Data Base Management Systems	3	--	3	70	30	3
15.	16MEE115	Fracture Mechanics	3	--	3	70	30	3
16.	16MEE116	Design of Press Tools	3	--	3	70	30	3
17.	16MEE117	Design of Dies	3	--	3	70	30	3
18.	16MEE118	Rapid Prototyping Principles & Applications	3	--	3	70	30	3
19.	16MEE119	Flexible Manufacturing Systems	3	--	3	70	30	3
20.	16MEE120	Non-Traditional Machining & Forming	3	--	3	70	30	3
21	16MEE121	Product Design and Process Planning	3	--	3	70	30	3
		DEPARTMENTAL REQUIREMENTS						
1.	16MEC106	CAD/CAM Lab (Lab –I)	--	3	--	--	50	2
2.	16MEC107	Computation Lab (Lab –II)	--	3	--	--	50	2
3.	16MEC108	Seminar – I	--	3	--	--	50	2
4.	16MEC109	Seminar – II	--	3	--	--	50	2
5	16MEC110	Mini Project		2	--	--	50	1
6	16MEC111	Project Seminar	--	6	--	--	100	6
7	16MEC112	Project work	--	6	--	100	100	12

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEC 101	**AUTOMATION**	L	T	P	C	E	I	Total
		3	1	0	4	70	30	100

Objective (s)

Student will

1. To learn & understand basic concepts of automation & its significance in manufacturing industries
2. To understand Detroit type automation & flow lines.
3. To conceptualize & design assembly line balancing
4. To learn about automated material handling systems
5. To understand different automated storage/retrieval system
6. To design effective and appropriate testing & inspection systems

Outcome (s)

1. Ability to conceptualize and design automated flow lines
2. Ability to implement line balancing concepts in production and assembly lines
3. Ability to understand and develop automated material handling system suitable for plant operations
4. Ability to design, implement and use and appropriate automated inspection facility
5. Ability to understand and develop automated material handling system suitable for plant operations
6. Ability to design, implement and use and appropriate automated inspection facility

1.	**Total Hrs**	**9**

Introduction: Definition of automation, Types of production, Functions of Manufacturing, Organization and Information Processing in Manufacturing, Production concepts and Mathematical Models, Automation Strategies, Production Economics: Methods of Evaluating Investment Alternatives, Costs in Manufacturing, Break-Even Analysis, Unit cost of production, Cost of Manufacturing Lead time and Work-in-process.

2.	**Total Hrs**	**9**

Detroit-Type Automation: Automated Flow lines, Methods of Workpart Transport, Transfer Mechanism, Buffer Storage, Control Functions, Automation for Machining Operations, Design and Fabrication Considerations. *Analysis of Automated Flow Lines*: General Terminology and Analysis, Analysis of Transfer Lines Without Storage, Partial Automation, Automated Flow Lines with Storage Buffers, Computer Simulation of Automated Flow Lines

3.	**Total Hrs**	**9**

Assembly Systems and Line Balancing: The Assembly Process, Assembly Systems, Manual Assembly Lines, The Line Balancing Problem, Methods of Line Balancing, Computerized Line Balancing Methods, Other ways to improve the Line Balancing, Flexible Manual Assembly Lines. *Automated Assembly Systems:* Design for Automated Assembly, Types of Automated Assembly Systems, Part Feeding Devices, Analysis of Multi-station Assembly Machines, Analysis of a Single Station Assembly Machine

4.	**Total Hrs**	**9**

Automated Materials Handling: The material handling function, Types of Material Handling Equipment, Analysis for Material Handling Systems, Design of the System, Conveyor Systems, Automated Guided Vehicle Systems. *Automated Storage Systems:* Storage System Performance, Automated Storage/Retrieval Systems, Carousel Storage Systems, Work-in-process Storage, Interfacing Handling and Storage with Manufacturing

5.	**Total Hrs**	**9**

Automated Inspection and Testing: Inspection and testing, Statistical Quality Control, Automated Inspection Principles and Methods, Sensor Technologies for Automated Inspection, Coordinate Measuring Machines, Other Contact Inspection Methods, Machine Vision, Other optical Inspection Methods. *Modeling Automated Manufacturing Systems:* Role of Performance Modeling, Performance Measures, Performance Modeling Tools: Simulation Models, Analytical Models. *The Future Automated Factory:* Trends in Manufacturing, The Future Automated Factory, Human Workers in the Future Automated Factory, The social impact

Total hours to be taught		**45**

Text book (s)

1 Mikell P.Grover, Automation, Production Systems and Computer Integrated Manufacturing, Pearson Education Asia.

2. C.Ray Asfahl, Robots and manufacturing Automation, John Wiley and Sons New York.

References:

1. N.Viswanadham and Y.Narahari, Performance Modeling of Automated Manufacturing Systems, Printice Hall India Pvt. Ltd.,
2. Stephen J. Derby, Design of Automatic Machinary, Special Indian Edition, Marcel Decker, New York Yesdee publishing Pvt. Ltd, Chennai.

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEC 102	**COMPUTER AIDED MODELING AND DESIGN**	L	T	P	C	E	I	Total
		3	1	0	4	70	30	100

Objective (s)

Student will Understand the

1. Understand the basics of computer aided design
2. To impart knowledge on design process
3. Recognize and explain the uses of wireframe and surface entities
4. Understand and apply various Geometric transformations
5. Understand various advanced modeling concepts

Outcome (s)

Students are able to

1. apply design concepts in design , analysis and can visualize the models through the graphics standards
2. implement Various transformations on geometric models for manipulation
3. recognize various wireframe entities and model them
4. apply surface modeling techniques for the generating various parts and implement
5. differentiate various solid modeling techniques
6. apply various advanced modeling concepts and calculate the interference between mating objects

1.	**Total Hrs**	**9**

Criteria for selection of cad workstations, Shigle design process, Design criteria, Geometric modeling , Entities, 2d and 3d primitives, Computer Aided Design , Iterative Design ,CAD process
Geometric Transformations: 2d Translation, Scaling, Rotation, Reflection and shearing, Homogeneous Coordinates , Rotation and Scaling about arbitrary points , 3D transformations
Windowing - View ports -Clipping transformations
Graphics standards: GKS , IGES , PDES and their relevance

2.	**Total Hrs**	**9**

Analytic curves : Lines, Circles, Ellipse, Conics.
Synthetic curves – Cubic, Bezier, B-Splines, NURBS. Curve Manipulations
Wireframe Modeling and its advantages and Limitations

3.	**Total Hrs**	**9**

Analytic Surfaces: Plane Surface, Ruled Surface, Surface of Revolution, Tabulated Cylinder.
Synthetic Surface - Cubic, Bezier, B-spline, Coons ,Surface Manipulations , Surface Modeling Techniques

4.	**Total Hrs**	**9**

Boundary Representation (B-rep) & Constructive Solid Geometry (CSG) Modeling

Graph Based Model, Boolean Models, Instances, Cell Decomposition & Spatial – Occupancy Enumeration

5.	**Total Hrs**	**9**

Feature Based Modeling, Assembly Modeling, Conceptual Design and Top down design, Parametric and Variational Modeling Feature recognition, Design by Features
Computer Aided Design of mechanical parts and Interference Detection by Motion analysis

Total hours to be taught		**45**

Text book (s)

1. Ibrahim Zeid, ―CAD/CAM, Theory and Practice‖, Mc Graw Hill, 1998
2. Foley, Van Dam, Feiner and Hughes, ―Computer Graphics Principles and Practice‖, 2nd Ed., Addison Wesley, 2000

Reference (s)

1. E. Micheal, ―Geometric Modelling‖, John Wiley & Sons, 1995
2. Hill Jr, F.S., ―Computer Graphics using open GL‖, Pearson Education, 2003

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEC 103	**COMPUTER INTEGRATED MANUFACTURING**	L	T	P	C	E	I	Total
		3	1	0	4	70	30	100

Objective (s)

1. To identify the main elements in computer integrated manufacturing systems
2. To use computer in the area of manufacturing to reduce manual processing and linking computers to all the manufacturing machines and increase the productivity, reduce the unnecessary costs.
3. To study about computer aided planning, artificial intelligence and expert systems
4. To obtain an overview of computer technologies including computers, database and data collection, networks, machine control, as they apply to factory management and factory floor operation
5. To describe the integration of manufacturing activities into a complete system

Outcome (s)

Student are able to understand

1. the basic of CIM, Concurrent engineering, communication matrix, product development cycle, collaborative product development
2. to create the manufacturing database and store and retrieve data from database
3. the product design, design for manufacturability and design for assembly concepts, types of computer aided process planning
4. the CIM technologies such as cellular manufacturing, shop-floor control and flexible manufacturing systems
5. the importance of principles of networking, topology, network devices, selection of network technology, different models of CIM
6. to apply the concepts of lean manufacturing, agile & web based manufacturing to product life cycle and process plan during the development of a product.

1. **Total Hrs** **9**

The meaning of Manufacturing Types of Manufacturing: Basic Concepts of CIM: CIM Definition, Elements of CIM, CIM wheel, concept or technology, Evolution of CIM, Benefits of CIM, Needs of CIM: Hardware and software. Fundamentals of Communication: Communications Matrix. Product Development Cycle, Concurrent Engineering: Definition, Sequential Engineering Versus Concurrent Engineering, Benefits of Concurrent Engineering, Characteristics of concurrent Engineering, Framework for integration of Life-cycle phases in CE, Concurrent Engineering Techniques, Integrated Product Development(IPD), Product Life-Cycle Management (PLM), Collaborative Product Development

2. **Total Hrs** **9**

Introduction, Manufacturing Data: Types, sources; Database Terminology, Database requirements, Database models, Database Management System, DBMS Architecture, Query Language, Structural Query Language (SQL): Basic structure, Data definition Language (Create, Alter, Drop, Truncate, View), Data Manipulation Language (store, retrieve, update, delete). Illustration of Creating and Manipulating a Manufacturing Database. SQL as a Knowledge Base Query Language. Features of commercial DBMS: Oracle, MySQL, SQL Access, Sybase, DB2. Product Data Management (PDM), Advantages of PDM.

3. **Total Hrs** **9**

Product Design: Needs of the market, Design and Engineering, The design Process, Design for Manufacturability (DFM): Component Design, Design for Assembly. Computer-Aided Process Planning: Basic Steps in developing a process plan, Variant and Generative Process Planning, Feature Recognition in Computer-Aided Process Planning. Material Requirements Planning (MRP), Manufacturing Resource Planning (MRP –II), Cellular Manufacturing: Design of Cellular Manufacturing Systems, Cell Formation Approaches: Machine–Component Group Analysis, Similarity Coefficients-Based Approaches. Evaluation of Cell Design. Shop-floor Control: Data Logging and Acquisition, Automated Data Collection, Programmable Logic Controllers, Sensor Technology. Flexible Manufacturing Systems: Physical Components of an FMS. Types of Flexibility, Layout Considerations: Linear Single Machine Layout, Circular Machine Layout, Cluster Machine Layout, Loop Layout; Operational Problems of FMS. FMS benefits

4. **Total Hrs** **9**

Introduction to Networking, Principles of Networking, Network Terminology, Types of Networks: LAN, MAN, WAN; Selection of Network Technology: Communication medium, Network Topology, Medium access control Methods, Signaling methods; Network Architectures and Protocols: OSI Model, MAP & TOP, TCP/IP, Network Interconnection and Devices, Network Performance. Framework for Enterprise-wide Integration.

CIM Models: ESPRIT-CIM OSA Model, NIST-AMRF Model, Siemens Model of CIM, Digital Equipment Corporation Model, IBM Concept of CIM

5.	**Total Hrs**	**9**
Lean Manufacturing: Definition, Principles of Lean Manufacturing, Characteristics of Lean Manufacturing, Value of Product, Continuous Improvement, Focus on Waste, Relationship of Waste to Profit, Four Functions of Lean Production, Performance Measures, The Supply Chain, Benefits of Lean Manufacturing. Introduction to Agile and Web Based Manufacturing systems.		
Total hours to be taught		**45**
Text book (s)		
1. S.Kant Vajpayee: Principles of Computer Integrated Manufacturing, Printice-Hall India 2. Singh: Systems Approach to Computer Integrated Design and Manufacturing- John Wiley		
Reference (s) 1. P.Radhakrishnan, S.Subramanyam: CAD/CAM/CIM, New Age International 2. Alavudeen, Venkateshwaran: Computer Integrated Manufacturing, Printice-Hall India		

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEC 104	**COMPUTER AIDED MECHANICAL DESIGN AND ANALYSIS**	L	T	P	C	E	I	Total
		3	1	0	4	70	30	100

Objective (s)

1. To develop the necessary skills to understand and analyze problems in pressure vessels
2. To achieve fundamental understanding of the theory of bending of flat plates with various loading and boundary conditions
3. To Understand design principles of a component and structures using fracture mechanics approaches
4. To enable the importance of vibrations in mechanical design and to understand the basic concepts of matrix algebra
5. To understand the different mode extraction methods in vibrations
6. To understand the fundamental concepts various algorithms used for dynamic analysis

Outcome (s)

1. Ability to apply knowledge of mathematics, sciences and computations in solving the stresses & strains in pressure vessels
2. Demonstrate the ability to identify, formulate and solve problems for a given flat plate bending applications
3. An ability to design a system or a component to meet the desired needs of fracture mechanics
4. Students are able to understand and solve various Eigen value and Eigen vectors
5. Students will understand different mode extraction methods to calculate frequencies
6. Student will understand numerical methods in solving multi degree freedom dynamic analysis problems

1.	**Total Hrs**	**9**

Design of pressure Vessels: Introduction and constructional features of pressure vessels, stresses in pressure vessels, shrink fit stresses in built up cylinders, auto frettage of thick cylinders, thermal stresses and their significance.

2.	**Total Hrs**	**9**

Stresses in flat plates: Introduction, Bending of plate in one direction, Bending of plate in two perpendicular directions, Thermal stresses in plates, Bending of circular plates of constant thickness, Bending of uniformly loaded plates of constant thickness

3.	**Total Hrs**	**9**

Fracture Mechanics: Introduction, Modes of fracture failure Griffith Analysis, Energy release rate, Energy release rate of DCB specimen; Stress Intensity Factor: SIF's for edge and centre line crack, Fracture toughness, Elastic plastic analysis through J-integral method: Relevance and scope, Definition of J-integral, Path independence, stress strain relation, Strain Energy Release Rate Vs J-integral

4.	**Total Hrs**	**9**

Eigen Value Problems: Properties of Eigen values and Eigen Vectors, Torsional, Longitudinal vibration, lateral vibration, Sturm sequence. Subspace iteration and Lanczo's method, Component mode synthesis, Eigen value problems applied to stepped beams and bars

5.	**Total Hrs**	**9**

Dynamic Analysis: Direct integration method, Central difference method, Wilson-θ method, Newmark method, Mode superposition, Single degree of freedom system response, Multi degree of freedom system response, Rayleigh damping, Condition for stability.
(Note: The related algorithms and codes to be practiced by students)

Total hours to be taught		**45**

Text book (s)

1. John, V. Harvey, Pressure Vessel Design: Nuclear and Chemical Applications, Affiliated East West Press Pvt. Ltd., 1969
2. Prasanth Kumar, Elements of Fracture Mechanics, Wheeler Publishing, New Delhi-1999

Reference (s)

1. Rammurti, Computer Aided Mechanical Design and Analysis, Tata Mc Graw Hill-1992
2. Bathe, J., Finite Element Procedures, Prentice Hall of India-1996.

BIT	Autonomous Regulation	Semester-1		AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name		M.E. CAD/CAM & Thermal Engineering		
Course Code	Course Name	Hours/ Week		Credit	Maximum Marks	

Course Code	Course Name	L	T	P	C	E	I	Total
16MEC 105	**FINITE ELEMENT TECHNIQUES**	3	1	0	4	70	30	100

Objective (s)

1. Identify mathematical model for solution of common engineering problems
2. Enable the students to formulate the design problems into FEA
3. Enable the students to perform engineering simulations using Finite Element Analysis software

Outcome (s)

Students are able to

1. implement finite element formulations to axial and quadratic elements and solve problems with hand calculations numerically
2. formulate numerically the truss, beam and frame elements and solve for deflection, strains and stresses
3. formulate numerically the plane and axisymmetric triangular elements and quadrilateral elements then solve for deflections, strains and stresses in structural mechanics problems
4. apply FE formulations to heat transfer of 1D and 2D elements and solve for temperature and heat flux in slabs, walls and plates
5. apply FE formulations to dynamic analysis of 1D and 2D elements and solve for eigen values and eigen vectors in bars and beams
6. apply FE formulations to 3D solids, plates and for non linear problems

1. FIELD PROBLMES AND MODELING — **Total Hrs 9**

Introduction to Finite Element Method of solving field problems. Stress and Equilibrium. Boundary conditions. Strain-Displacement relations. Stress-strain relations.

One Dimensional Problem: Finite element modeling. Local, natural and global coordinates and shape functions. Potential Energy approach: Assembly of Global stiffness matrix and load vector. Finite element equations, treatment of boundary conditions. Quadratic shape functions

2. ANALYSIS OF TRUSSES AND FRAMES — **Total Hrs 9**

Analysis of plane truss with number of unknowns not exceeding two at each node.

Analysis of Beams: Element stiffness matrix for two noded, two degrees of freedom per node for beam element. Analysis of frames with two translations and a rotational degree of freedom at each node

3. TWO DIMENSIONAL STRESS ANALYSIS — **Total Hrs 9**

Finite element modeling of two dimensional stress analysis problems with constant strain triangles treatment of boundary conditions. Two dimensional four noded isoparametric elements treatment of boundary conditions. Two dimensional four noded isoparametric elements and numerical integration. Finite element modeling of Axisymmentric solids subjected of axisymmetric loading with triangular elements.

Convergence requirements and geometric isotropy

4. HEAT TRANSFER PROBLEMS AND DYNAMIC ANALYSIS — **Total Hrs 9**

Steady state heat transfer analysis: One dimensional analysis of a fin and two dimensional, conduction analysis of thin plate, Time dependent field problems: Application to one dimensional heat flow in a rod.

Dynamic analysis: Formulation of finite element modeling of Eigen value problem for a stepped bar and beam. Evaluation of Eigen values and Eigen vectors, Analysis of a uniform shaft subjected to torsion using Finite Element Analysis.

5. THREE DIMENSIONAL PROBLEMS IN SRESS ANALYSIS — **Total Hrs 9**

Finite element formulation of three dimensional problems in stress analysis,

Bending of elastic plates: Thin and Thick plate formulations, Introduction to non-linear problems and Finite Element analysis software's

Total hours to be taught		

Text book (s)

1. Tirupathi R Chandrupatla and Ashok.D. Belegundu, Introduction of Finite Element in Engineering. Prentice Hall of India, 2004
2. Rao S.S.,The Finite Element Methods in Engineering, 2nd Edn Pergamon Press, 2001.
3. David.V.Hutton, " Fundamentals of Finite Element Analysis", Tata McGraw Hill,2003

References:

1. Robert Cook , "Concepts and applications of finite element analysis", 4e, John Wiley and sons,2009
2. Reddy J.N., An Introduction to Finite Element Methods ,Mc Graw Hill Company, 1984
3. K..J Bathe, Finite element procedures, 2nd Edn,Prentice Hall of India,2007
4. Logan, D. L. (2011). First course in finite element method, (5th Ed.). Mason, OH: SouthWestern, Cengage Learning.

CBIT	Autonomous Regulation		
Department	Mechanical Engineering	Programme Code & Name	M.E. Thermal Engineering

Semester-I

Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	E	I	Total
16MEC 205	**COMPUTATIONAL FLUID DYNAMICS**	3	1	0	4	70	30	100

Objective (s)	1. To understand the basic equations and concept of CFD. 2. To make the students to learn concept of PDEs and finite difference methods. 3. To study various types of grid generation and errors in numerical solution. 4. To learn the Crank-Nihcolson, Implicit and Explicit methods 5. To prepare the students with Jacobi, Gauss Seidel and ADI methods 6. To enkindle the students importance of FVM
Outcome (s)	Students will be able to 1. derive CFD governing equations and turbulence models. 2. apply elliptical, parabolic and hyperbolic PDEs and forward, backward and center difference methods . 3. understand errors, stability, consistency and develop O,H and C grid generated models. 4. evaluate the use of Crank-Nihcolson, Implicit and Explicit methods. 5. analyze problem by Jacobi, Gauss Seidel and ADI methods. 6. solve conduction and convection problems using FVM

1	**BASIC EQUATIONS IN FLUID DYNAMICS**	**Total Hrs**	**9**
Continuity, Momentum and Energy equations, Navier Stokes equations, Reynolds and Favre averaged N – S equations. Introduction to turbulence, Turbulence models-mixing length model, K-ε turbulence Model.			
2	**CLASSIFICATION OF PDEs**	**Total Hrs**	**9**
Elliptic, parabolic and hyperbolic equations, Initial and boundary conditions. Concepts of Finite difference methods – forward, backward and central difference.			
3	**GRID GENERATION**	**Total Hrs**	**9**
Grid Generation- Types of grid O,H,C. Coordinate transformation, Unstructured grid generation, Errors, Consistency, Stability analysis by von Neumann. Convergence criteria.			
4	**FINITE DIFFERENCE SOLUTIONS**	**Total Hrs**	**9**
Finite difference solutions-Parabolic PDEs – Euler, Crank Nicholson, Implicit methods, Elliptic PDEs – Jacobi, Gauss Seidel, ADI, methods. FD- solution for Viscous incompressible flow using Stream function – Vorticity method & MAC method			
5	**FINITE VOLUME METHOD**	**Total Hrs**	**9**
Introduction to Finite volume method. Finite volume formulations for diffusion equation, convection diffusion equation. Solution algorithm for pressure velocity coupling in steady flows. Use of Staggered grids SIMPLE Algorithm.			
	Total hours to be taught	**45**	

Text book (s)	
1	John D Anderson, ‘Computational Fluid Dynamics’, Mc Graw Hill, Inc., 2015**.**
2	H.K.Versteeg - 2015, Malala Shekara, Introduction to “ Finite Volume Method” Pearson
3	Muralidhar K, Sundararajan T, ‘Computational Fluid flow and Heat transfer’, Narosa Publishing House, 2003
4	Patankar, S.V, ‘Numerical Heat transfer and Fluid flow’, Hemisphere Publishing Company, New York,1980

BIT	Autonomous Regulation	Semester-1			AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name			M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week		Credit	Maximum Marks		
		L	T	P	C	E	I	Total
16MEE101	**FAILURE ANALYSIS AND DESIGN**	3	1	0	4	70	30	100

Objective (s)

1. To understand importance of design and its morphology
2. To understand buckling phenomenon due to combined external pressure and axial loading

Outcome (s)

Graduate will be able to understand

1. design methodology and various aspects involved in design process
2. different creative and inventive problem solving techniques
3. different types of design process, concepts of reliable and safe design
4. concept of buckling of cylinders under various loading conditions
5. the fundamentals of fracture, fracture types and concepts of fatigue crack growth, fatigue life prediction and various stress theories of failure vessels
6. basic crack propagation concept, concepts of crack propagation under combined loading, fracture toughness of weld metals.

1.	**Total Hrs**	**10**

Importance of design- The design process-Considerations of Good Design – Morphology of Design – Organization for design– Computer Aided Engineering –Concurrent Engineering – Product and process cycles –Market Identification – Competition Bench marking. Identification of customer needs- customer requirements- Product Design Specifications- Human Factors in Design – Ergonomics and Aesthetics

2.	**Total Hrs**	**10**

Creativity and Problem Solving –Creativity methods-Theory of Inventive Problem Solving(TRIZ)– Conceptual decomposition-Generating design concepts-Axiomatic Design – Evaluation methods-Embodiment Design-Product Architecture-Configuration Design- Parametric Design. Role of models in design-Mathematical Modeling – Simulation – Design for Reliability –Introduction to Robust Design-Failure mode Effect Analysis

3.	**Total Hrs**	**10**

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

4.	**Total Hrs**	**10**

Failure analysis and determination of stress patterns from plastic Flow observations – Dynamic loading– Fracture types in tension—Fatigue crack growth– Fatigue life prediction- Cumulative fatigue damage-Stress theory of failure vessels-Thermal stress fatigue

5.	**Total Hrs**	**10**

Introduction –Through cracks emanating from holes – Corner cracks at holes – Cracks approaching holes-Combined loading-Fatigue crack growth binder- Mixed mode loading-Fracture toughness of weld metals-Service failure analysis

Total hours to be taught		

Text book (s)

1. Dieter, George E., —Engineering Design - A Materials and Processing Approach‖, McGraw Hill, International Editions, Singapore, 2000.
2. Pahl, G, and Beitz, W.,‖ Engineering Design‖, Springer – Verlag, NY. 1984

References:

1. David Broek, ‖Elementary Engineering Fracture Mechanics —, Fifthoff and Noerdhoff International Publisher, 1978
2. Preshant Kumar, —Elements of Fracture Mechanics‖, Wheeler Publishing, 1999
3. John F. Harvey, Theory and Design of Pressure Vessels, CBS Publishers and Distributors, 1987
4. Henry H. Bedner, —Pressure Vessels, Design Hand Book, CBS publishers and Distributors, , 1987

CBIT	Autonomous Regulation	Semester-1			AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name			M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week		Credit	Maximum Marks		
16MEE 102	**INTEGRATED MECHANICAL DESIGN**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)	1. To know the importance of limits, fits and tolerances in design of machine and mechanical components 2. To learn design criteria of machine components according to standards and Theories of failures 3. To learn application of principles to design different gears and gear boxes. 4. To provide the design concepts of machine tools, automobiles and mechanical handling equipments for dynamics and thermal aspects. 5. To provide the students the knowledge of design of Mechanical handling equipments like power plants and Construction fields
Outcome (s)	1. Be able to know the importance of limits ,fits and tolerances and Testing standards for design and manufacturing 2. Be able to do the complete design and analysis of shafts, bearings and casings by considering design and machining allowances according to standards and requirements. 3. Be able to do the design and analysis of Different gears and gear boxes. 4. Be able to do the design of brakes of machine tools, automobiles and mechanical handling equipments for dynamics and thermal aspects. 5. Be able to design of Mechanical handling equipments.

1.	**Total Hrs**	**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.		
2.	**Total Hrs**	**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		
3.	**Total Hrs**	**9**
Dynamics and thermal aspects of vehicle braking – Integrated design of brakes for machine tools, automobiles and mechanical handling equipments		
4.	**Total Hrs**	**9**
Integrated Design of systems consisting of shaft, bearings, springs, motor, gears, belt, rope, chain, pulleys, Cam & Follower, flywheel etc. Example - Design of Elevators, Escalators, Gear Box, Valve gear Mechanisms, Machine Tools		
Total hours to be taught		

Text book (s)

1. L. R., ―Machine Design – An Integrated Approach‖ Pearson Education, 2005
2. Newcomb, T.P. and Spur, R.T., ―Automobile Brakes and Braking Systems‖, Chapman and Hall, 2^{nd} Edition,1975.
3. Maitra G.M., ―Hand Book of Gear Design‖, Tata McGraw Hill, 1985
4. Shigley, J.E., ―Mechanical Engineering Design‖, McGraw Hill, 1986
5. Prasad. L. V., ―Machine Design‖, Tata McGraw Hill, New Delhi, 1992
6. Alexandrov, M., Materials Handling Equipments, MIR Publishers, 1981
7. Boltzharol, A., Materials Handling Handbook, The Ronald Press Company, 1958

Approved Data Books:

1. .S.G. Tech., ―Design Data Book‖, Kalaikathir Achchagam, Coimbatore, 2003.
2. Lingaiah. K. and Narayana Iyengar, ―Machine Design Data Hand Book‖, Vol. 1 & 2, Suma 1983

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 102		L	T	P	C	E	I	Total
	ROBOTIC ENGINEERING	3	0	0	3	70	30	100
Objective (s)	- To be familiar with the brief history of robot and applications. - To give the student familiarities with the kinematics of robots. - To give knowledge about robot end effectors and their design. - To give knowledge about various Sensors and their applications in robots.							
Outcome (s)	1. Students will be equipped with the brief history of robot configuration , subsystems,applicatios. 2. Students will have good knowledge about robot end effectors and their design concepts. 3. Understand different orientations of robot 4. Students will be familiarized with the kinematic motions of robot and 5. Able to solve the static and dynamic analysis of Planar robots 6. Students will be equipped with the principles of various Sensors, their applications in robots and concept of robot vision							

1.	**Total Hrs**	**9**
Brief History, Types of robots, Overview of robot subsystems, resolution, repeatability and accuracy, Degrees of freedom of robots, Robot configurations and concept of workspace, Mechanisms and transmission, End effectors and Different types of grippers, vacuum and other methods of gripping. Pneumatic, hydraulic and electrical actuators, applications of robots, specifications of different industrial robots.		
2.	**Total Hrs**	**9**
Rotation matrices, Euler angle and RPY representation, Homogeneous transformation matrices, Denavit-Hartenberg notation, representation of absolute position and orientation in terms of joint parameters, direct kinematics.		
3.	**Total Hrs**	**9**
Inverse Kinematics, inverse orientation, inverse locations, Singularities, Jacobian, Trajectory Planning: joint interpolation, task space interpolation, executing user specified tasks, sensor based motion planning: The Bug Algorithm, The Tangent Bug Algorithm, The Incremental Voronoi Graph.		
4.	**Total Hrs**	**9**
Static force analysis of RP type and RR type planar robots, Dynamic analysis using Lagrangean and Newton-Euler formulations of RR and RP type planar robots, , Independent joint control, PD and PID feedback, actuator models, nonlinearity of manipulator models, force feedback, hybrid control		
5.	**Total Hrs**	**9**
Sensors and controllers: Internal and external sensors, position, velocity and acceleration sensors, proximity sensors, force sensors, laser range finder Robot vision: image processing fundamentals for robotic applications, image acquisition and preprocessing. Segmentation and region characterization object recognition by image matching and based on features		
Total hours to be taught		

Text book (s)

1. Nagrath and Mittal, ―Robotics and Control‖, Tata McGraw-Hill, 2003
2. Spong and Vidhyasagar, ―Robot Dynamics and Control‖, John Wiley and sons, 2008

References:

1. Fu. K.S, Gonzalez, R.C., Lee, C.S.G, Robotics, control, sensing, Vision and Intelligence, McGraw Hill International, 1987
2. Steve LaValle, ―Planning Algorithms‖, Cambridge Univ. Press, New York, 2006
3. Howie Choset, Kevin Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki and Sebastian Thurn, ―Principles of Robot Motion: Theory, Algorithms, and Implementations‖ , Prentice Hall of India, 2005

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 103	**PROGRAMMING METHODOLOGY AND DATA STRUCTURES**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100
Objective (s)	• To improve logical thinking of the students. • To encourage the student to use their own code to solve mechanical engineering Problems.							
Outcome (s)	1. Different types of data storage and their structures 2. Implementing the concepts with programming in 'C' 3. Apply different sorting techniques in Mechanical engineering Applications 4. Classify the different Data Structures 5. differentiate between Linked lists,stacks and queues 6. Understand the concept of Trees and their traversals							

1.	**Total Hrs**	**9**
Programming Methodology: Introduction, Algorithm, Data Flow Diagrams, Decision Tree, Decision Table and Life Cycles of Project Development.		
2.	**Total Hrs**	**9**
Programming in 'C': Data types & Memory size, Expressions, Statements, Operators, Control flows, Arrays, Pointers, Structures, Functions, Dynamic Memory Allocation and Simple programs in Mechanical Engineering.		
3.	**Total Hrs**	**9**
Sorting and Searching Techniques: Selection sort, Quick sort, Radix sort, Heap sort. Linear search, Binary search trees and Applications in Mechanical Engineering		
4.	**Total Hrs**	**9**
Data Structures: Classification of Data Structures, Definitions of Linked Lists, Double Linked Lists, Stacks and Queues. Operations and Implementations of Stack, Queues and Linked List. General and Mechanical Engineering Applications		
5.	**Total Hrs**	**9**
Advanced Data Structures: Tree, Basic Terminology, Binary Trees, Operations on Binary tree, Tree traversals, Graph, Graph representation Adjacency matrix, Adjacency Lists and Applications		
Total hours to be taught		

Text book (s)

1. G.Michael Schneider, Steven C.Bruell, —*Concepts in Data Structures and Software Development"*, Jaico Publishing House,2002
2. Kernighan B.W, Ritchie D.M, —*The C Programming Language"*, 2nd Edition, Prentice-Hall of India, 2003

References:

1. Kruse RL, Bruce RL, Cloris Lt, —*Data Structures and Program Design in C",* PHI, 1991
2. Hyer, M.W., *Stress Analysis of Fibre Reinforced Composite Materials,* Mc Graw Hill Co., 1998.
3. Trembly and Sorenson, —*An Introduction to Data Structures with application",* McGraw Hill, 1984

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 104	**OPTIMIZATION TECHNIQUES**	L	T	P	C	E	I	Total
		3	1	0	4	70	30	100

Objective (s)

1. To Understand the need of the optimization methods.
2. To introduce the fundamental concepts of Optimization Techniques
3. To provide students with the modeling skills necessary to describe and formulate optimization problems
4. To make the learners aware of the importance of optimizations in real scenarios
5. To provide the concepts of various classical and modern methods of for constrained and unconstrained problems in both single and multivariable
6. Get a broad picture of the various applications of optimization methods used in engineering.

Outcome (s)

1. Formulate and solve Linear programming problem
2. Apply different techniques to solve Non Linear programming problem
3. Implement constrained optimization techniques
4. Analyze dynamic programming and integer programming problems
5. Develop schedule for projects and apply PERT/CPM techniques
6. Apply Queuing theory to real life situations

1. LINEAR AND TRASPORTATION PROBLEMS	**Total Hrs**	**9**
Statement of Optimization Problem, Linear Programming: Simplex Method, Revised Simplex Method, Sensitivity Analysis, Parametric Programming, and Transportation Problem		
2. NON-LINEAR PROBLEMS	**Total Hrs**	**9**
Nonlinear Programming: Approach, Convergence and Scaling of Design variables; Unconstrained Optimization Direct Search Methods: Random Search, Univariate, Simplex Method; Indirect Search Methods: Steepest Descent, Conjugate Gradient, Newton, Quasi Newton, DFP Methods;		
3. NON-LINEAR PROGRAMMING	**Total Hrs**	**9**
Constrained Optimization Direct Methods: Lagrange Multipliers, Kuhn-Tucker, conditions, Beal's method, Indirect Method: Penalty Function and Applications		
4. DYNAMIC PROGRAMMING	**Total Hrs**	**9**
Introduction to Dynamic Programming; Concept of Sub optimization and the principle of optimality; Linear and Continuous Dynamic Programming with Applications; Introduction to Integer Programming; Cutting Plane Method; Branch and Bound method; Introduction to Genetic Algorithms, particle swarm optimization		
5. PROJECT SCHEDULING	**Total Hrs**	**9**
Sequencing and Scheduling, Project Scheduling by PERT-CPM; Probability and cost consideration in Project scheduling; Queuing Theory, Single and multi server models; Queues with combined arrivals and departures; Queues with priorities for service		
Total hours to be taught	**Total Hrs**	**45**

Text book (s)

1. Rao,S.S. Engineering "Optimization Theory and Practice", New Age Int. Pub., 3rd Ed., 1996.
2. Haug,E.J.and Arora, J.S., "Applied Optimal Design", Wiley Inter Science Publication, NY, 1979.

Reference(s)

1. Douglas J. Willde, "Globally Optimal Design", Jhon Wiley & Sons, New York, 1978
2. Johnson Ray C., "Optimum Design of Mechanical Elements", John Wiley & Sons, 1981.
3. S.D. Sharma, S.D. "Operations Research", Khanna Publications, 2001.
4. David Goldberg, "Genetic Algorithms", pearson publications, 2006.
5. Maurice cleric, "Particle Swarm Optimization", ISTE Publications, 2006
6. Prem Kumar Gupta, "Operations Research", S Chand publications, 2008

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE105	**VIBRATION ANALYSIS AND CONDITION MONITORING**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)	• To familiarization with the basics of vibration measurements • To apply the vibration principles for condition monitoring of machinery
Outcome (s)	1. Understand the Causes of Vibration and its effect on structures 2. Understand Single degree and multi degree of freedom systems of steady state and transient characteristics of vibration, simple harmonic motion, periodic motion, peak to Peak,RMS and average values. 3. Vibration measuring instruments, display and recording to elements, frequency analysis and filters, Vibration limits and standards 4. Know and be able to explain the aim and the basics of CM; 5. Be aware of some methods and procedures applied for general CM; 6. Appreciate and understand the basic idea behind vibration-based structural health monitoring and vibration- based condition monitoring, know the general stages of CM;

1.	**Total Hrs**	**9**
Causes and effects of vibration. Vibrations of Single Degree, Two Degree and Multi Degree of freedom systems. Steady state and transient characteristics of vibration		
2.	**Total Hrs**	**9**
Introduction to Condition Monitoring, Failure types, investigation and occurrences, Causes of failure, Characteristics of vibration – SHM, Periodic motion, Displacement, Velocity and acceleration Peak to peak & RMS, linear and logarithmic scales and phase angle		
3.	**Total Hrs**	**9**
Vibration measuring instruments, vibration transducers, signal conditioning elements. Display and recording elements. Vibration meters and analyzers		
4.	**Total Hrs**	**9**
Condition Monitoring through vibration analysis. Frequency analysis, Filters, Vibration signature of active systems, vibration limits and standards. Contaminant analysis, SOAP and other contaminant monitoring techniques		
5.	**Total Hrs**	**9**
Special vibration measuring techniques - Change in sound method, Ultrasonic measurement method, Shock pulse measurement, Kurtosis, Acoustic emission monitoring, Cepstrum analysis, Modal analysis, critical speed analysis, Shaft –orbit & position analysis		
Total hours to be taught	**Total Hrs**	**45**

Text book (s)

1. Collacott, R.A.,*Mechanical Fault Diagnosis and Condition Monitoring,* Chapman & Hall, London,1982
2. John S. Mitchell, *Introduction to Machinery Analysis and Monitoring,* Penn Well Books, Penn Well Publishing Company, Tulsa, Oklahoma, 1993.

Reference(s)

1. Nakra, B.C. Yadava, G.S. and Thuested, L.,*Vibration Measurement and Analysis, National Productivity Council, New Delhi, 1989*
2. Pox and Zenkins, *Time Series Analysis*
3. A.H. Search, *Vibration and Time Series Analysis*

CBIT	***Autonomous Regulation***									
Department	Mechanical Engineering		Programme Code & Name			M.E. CAD/CAM & Thermal Engineering				
Semester-I										
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks				
		L	T	P	C	E	I	Total		
16MEE 107	**ENGINEERING RESEARCH METHODOLOGY**	3	0	0	3	70	30	100		

Objective (s)	1. To motivate the students to choose research as career. 2. To make the students to formulate the research problem. 3. To identify various sources for literature review and data collection. 4. To prepare the research design 5. To equip the students with good methods to analyze the collected data 6. To write a report and interpret the results
Outcome (s)	Students will be able to 1. define research problem 2. review and asses the quality of literature from various sources. 3. understand and develop various research designs. 4. collect the data by various methods: observation, interview, questionnaires. 5. analyze problem by statistical techniques: ANOVA, F-test, Chi-square 6. improve the style and format of writing a report for technical paper/ Journal report

1	**Research Methodology:**	**Total Hrs**	**9**

Research Methodology: Objectives and Motivation of Research, Types of Research, Research Approaches, Significance of Research, Research Methods verses Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general.
Defining the Research Problem: Selection of Research Problem, Necessity of Defining the Problem, Technique involved in Defining a Problem

2	**Literature Survey**:	**Total Hrs**	**9**

Literature Survey: Importance and purpose of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet.
Literature Review: Need of Review, Guidelines for Review, Record of Research Review

3	**Research Design:**	**Total Hrs**	**9**

Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Steps in sample design, types of sample designs.

4	**Data Collection:**	**Total Hrs**	**9**

Data Collection: Methods of data collection, importance of Parametric test, testing of proportions, testing of variance of two normal population, and Non Parametric test, relation between Spearman's r's and Kendall's W
Data Analysis: Tests for significance: Chi-square, ANOVA, F-test.

5	**Interpretation and report writing:**	**Total Hrs**	**9**

Interpretation and report writing: Meaning of interpretation, layout of research report, Types of reports, Mechanics of writing a report.
Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal

Text Book (s):

1. C.R Kothari, Research Methodology, Methods & Technique; New Age International Publishers, 2004
2. R. Ganesan, Research Methodology for Engineers, MJP Publishers, 2011

References:

3. Y.P. Agarwal, Statistical Methods: Concepts, Application and Computation, Sterling Publs., Pvt., Ltd., New Delhi, 2004
4. Vijay Upagade and Aravind Shende, Research Methodology, S. Chand & Company Ltd., New Delhi, 2009
5. P. Ramdass and A. Wilson Aruni, Research and Writing across the Disciplines, MJP Publishers

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 108	**TRIBOLOGY IN DESIGN**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

1. To impart knowledge in the friction , wear and lubrication aspects of machine components
2. To understand the material properties which influence the tribological characteristics of surfaces

Outcome (s)

After the completion of the course, student will be able to :

1. Have a knowledge of surface topography and can model a rough engineering surface
2. Understand friction and wear aspects of machine
3. decide upon lubricants and lubrication regimes for different operating conditions
4. Understand Hertz contact and rough surface contact
5. Ability to select material / surface properties based on the tribological requirements
6. Analysis ability of different types of bearings for given load/ speed conditions.

1.	**Total Hrs**	**9**

Topography of Surfaces – Surface features -Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction –Rolling Friction-Friction properties of metallic and non-metallic materials – friction in extreme conditions –Thermal considerations in sliding contact

2.	**Total Hrs**	**9**

Types of wear – Mechanism of various types of wear – Laws of wear –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.

3.	**Total Hrs**	**9**

Lubricants and their physical properties- Viscosity and other properties of oils –Additives-and selection of Lubricants- Lubricants standards ISO,SAE,AGMA, BIS standards – Lubrication Regimes –Solid Lubrication-Dry and marginally lubricated contacts- Boundary Lubrication- Hydrodynamic lubrication –– Elasto and plasto hydrodynamic - Magneto hydrodynamic lubrication – Hydro static lubrication – Gas lubrication

4.	**Total Hrs**	**9**

Reynolds Equation,-Assumptions and limitations-One and two dimensional Reynolds Equation-Reynolds and Sommerfeld boundary conditions- Pressure wave, flow, load capacity and friction calculations in Hydrodynamic bearings-Long and short bearings-Pad bearings and Journal bearings- Squeeze film effects-Thermal considerations-Hydrostatic lubrication of Pad bearing-Pressure , flow , load and friction calculations-Stiffness considerations- Various types of flow restrictors in hydrostatic bearings

5.	**Total Hrs**	**9**

Rolling contacts of Elastic solids**-** contact stresses – Hertzian stress equation- Spherical and cylindrical contacts-Contact Fatigue life- Oil film effects- Elasto Hydrodynamic lubrication Theory-Soft and hard EHL-Reynolds equation for elasto hydrodynamic lubrication- - Film shape within and outside contact zones-Film thickness and friction calculation- Rolling bearings- Stresses and deflections-Traction drives

Total hours to be taught	**Total Hrs**	**45**

Text book (s)

Reference(s)

1. Rabinowicz.E, ―Friction and Wear of materials‖, John Willey &Sons ,UK,1995
2. Cameron, A. ―Basic Lubrication Theory‖, Ellis Herward Ltd., UK, 1981
3. Halling, J. (Editor) – ―Principles of Tribology ―, Macmillian – 1984
4. Williams J.A. ― Engineering Tribology‖, Oxford Univ. Press, 1994
5. .K.Basu, S.N.Sengupta & B.B.Ahuja ,‖Fundamentals of Tribology‖, Prentice – Hall of India Pvt. Ltd., New Delhi, 2005
6. G.W.Stachowiak & A.W .Batchelor, Engineering Tribology, Butterworth-Heinemann,UK, 2005

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 109	**ADVANCED MECHANICS OF MATERIALS**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

1. To understand the various stresses and deflections in beams
2. To understand the stress-strain relations and failure theories

Outcome (s)

Students will be able to

1. understand the analysis and deformation, stress-strain relations, failure theories
2. analyze and design the columns
3. determine the stresses due to asymmetric bending
4. locate the shear centre of thin-walled sections.
5. Determine the stresses in curved beams
6. calculate the residual stresses in members under torsion/bending analyze the torsion of noncircular cross-sections.

	Total Hrs	
1.	**Total Hrs**	**9**

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

	Total Hrs	
2.	**Total Hrs**	**9**

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

	Total Hrs	
3.	**Total Hrs**	**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. Solution of rectangular

	Total Hrs	
4.	**Total Hrs**	**9**

Torsion of rectangular cross section - St.Venants theory - elastic membrane analogy - Prandtl's stress function - torsional stress in hollow thin walled tub

	Total Hrs	
5.	**Total Hrs**	**9**

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

Total hours to be taught	**Total Hrs**	**45**

Text book (s)

Reference(s)

1. Arthur P Boresi, Richard J. Schmidt, —Advanced mechanics of materials‖,John Wiley, 2002
2. Timoshenko and Goodier, "Theory of Elasticity", McGraw Hill
3. Robert D. Cook, Warren C. Young, "Advanced Mechanics of Materials", Mc-millan pub. Co., 1985
4. Srinath. L.S., —Advanced Mechanics of solids‖, Tata McGraw Hill, 1992
5. G H Ryder Strength of Materials Macmillan, India Ltd, 2007
6. Allan F. Bower, —Applied Mechanics of Solids‖, CRC press – Special Indian Edition -2012, 2010
7. K. Baskar and T.K. Varadan, —Theory of Isotropic/Orthotropic Elasticity‖, Ane Books Pvt. Ltd., New Delhi, 2009

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 110	**MECHANICS OF COMPOSITE MATERIALS**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

1. An ability to identify the properties of fiber and matrix materials used in commercial composites, as well as some common manufacturing techniques.
2. An ability to predict the elastic properties of fiber composites based on the constituent properties.
3. An ability to analyze a laminated plate in bending, including finding laminate properties from lamina properties.
4. An ability to predict the failure strength of a laminated composite plate

.

Outcome (s)

1. Classify the composites, types of reinforcements, matrices and phases.
2. Recognize the fundamentals of orthotropic materials and mechanics of materials in micro and macro level.
3. Understand different fabrication methods of composites.
4. Demonstrate the fundamentals of directional stresses and strains. Transformation of stress and strain.
5. Understand the failure of composites including fracture.
6. Analyze different types of composite structures using plate and shell theory

1.	**Total Hrs**	**9**
Introduction: Fibres, Matrix materials, interfaces, polymer matrix composites, metal matrix composites, ceramic matrix composites and carbon carbon composites.		
2.	**Total Hrs**	**9**
Micromechanics of lamina and mechanical properties: Prediction of Elastic constants, micromechanical approach, Halpin-Tsai equations. Thermal properties, Hygro properties, mechanics of load transfer from matrix to fibre		
3.	**Total Hrs**	**9**
Macro-mechanics of lamina: Elastic constants of a lamina, relations between engineering constants and reduced stiffness and compliances. Variation of lamina properties with orientation, analysis of laminated composites, stresses and strains with orientation, inter-laminar stresses and edge effects. Simplified composite beam solutions. Bending of laminated beams		
4.	**Total Hrs**	**9**
Strength, fracture, fatigue and design: Tensile and compressive strength of unidirectional fibre composites, fracture modes in composites: single and multiple fractures, de-bonding, fibre pullout and de-lamination failure, fatigue of laminate composites. Effect of variability of fibre strength. Strength of an orthotropic lamina: Max stress theory, max strain criteria, maximum work (Tsai-Hill) criterion, quadratic interaction criteria. Designing with composite materials		
5.	**Total Hrs**	**9**
Analysis of laminated plates and shells: Plate equilibrium equations, Bending of composite plates, Levy and Navier solution for plates of composite materials. Analysis of composite cylindrical shells under axially symmetric loads.		
Total hours to be taught	**Total Hrs**	**45**

Text book (s)

1. Jones, R.M., *Mechanics of Composite Materials, Mc Graw Hill Co., 1967*
2. B.D.Agarwal et.al, *Analysis and performance of fiber composites*,3rd edition, Wiley sons., 2013
3. Ever J Barbero, *Introduction to composite materials design*, Taylor &Francis, 1999.

Reference(s)

1. Whitney, I.M. Daniel, R.B. Pipes, *Experimental Mechanics of Fibre Reinforced Composite Materials,* Prentice Hall, 1984
2. Hyer, M.W., *Stress Analysis of Fibre Reinforced Composite Materials,* Mc Graw Hill Co., 1998
3. Carl. T. Herakovich, *Mechanics of Fibrous Composites,* John Wiley Sons Inc., 1998.

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 111	**THEORY OF ELASTICITY AND PLASTICITY**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

Students should able to
1. solve the problems selected to stress-strain tensors and an constitutive relations
2. apply suitable plasticity relations to solve the problems in various metal forming operations

Outcome (s)

Students can
1. demonstrate the understanding of fundamentals stress and its concepts.
2. understanding of concepts of strain
3. solve the problems related to stress & strain and also their relations in isotropic materials
4. to apply the constitutive equations, compatibility equation and equilibrium equations for problem solving
5. apply plasticity relations for simple problems
6. can choose and apply plasticity analysis methods

1.	**Total Hrs**	**9**

Basic Concepts of Stress : Definition, State of Stress at a point, Stress tensor, invariants of stress tensor, principle stresses, stress ellipsoid, derivation for maximum shear stress and planes of maximum shear stress, octahedral shear stress, Deviatoric and Hydrostatic components of stress, Invariance of Deviatoric stress tensor, plane stress

2.	**Total Hrs**	**9**

Basic concepts of Strain : Deformation tensor, Strain tensor and rotation tensor; invariants of strain tensor, principle strains, derivation for maximum shear strain and planes of maximum shear strain, octahedral shear strain, Deviatoric and Hydrostatic components of strain tensor, Invariance of Deviatoric strain tensor, plane strain.

3.	**Total Hrs**	**9**

Generalized Hooke‘s Law : Stress-strain relationships for an isotropic body for three dimensional stress space, for plane stress and plane strain conditions, differential equations of equilibrium, compatibility equations, Material (D) matrix for Orthotropic Materials

4.	**Total Hrs**	**9**

True stress and true strain, von-Mise‘s and Tresca yield criteria, Haigh–Westergard stress space representation of von - Mise‘s and Tresca yield criteria, effective stress and effective strain, St. Venants theory of plastic flow, Prandtle–Reuss and Levy–Mise‘s constitutive equations of plastic flow, Strain
hardening and work hardening theories, work of plastic deformation.

5.	**Total Hrs**	**9**

Analysis methods: Slab method, Slip line field method, uniform deformation energy method, upper and lower bound solutions. Application of Slab method to forging, wire drawing, extrusion and rolling processes

Total hours to be taught	**Total Hrs**	**45**

Text book (s)

1. Timoshenko and Goodieer, *Theory of Elasticity*, Mcgraw Hill Publications 3^{rd} Edition
2. Madleson, *Theory of Plasticity*

Reference(s)

1. J. Chakrabarty, *Theory of Plasticity, 2^{nd}* edition, McGraw Hill Publications 1998
2. George E Dieter, *Mechanical Metallurgy,* McGraw Hill Publications 1988

<table>
<tr><td>CBIT</td><td>Autonomous Regulation</td><td colspan="4">Semester-1</td><td colspan="3">AY - 2006-17</td></tr>
<tr><td>Department</td><td>Mechanical Engineering</td><td colspan="4">Programme Code & Name</td><td colspan="3">M.E. CAD/CAM</td></tr>
<tr><td>Course Code</td><td>Course Name</td><td colspan="3">Hours/ Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">16MEE 112</td><td rowspan="2">EXPERIMENTAL TECHNIQUES AND DATA ANALYSIS</td><td>L</td><td>T</td><td>P</td><td>C</td><td>E</td><td>I</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>70</td><td>30</td><td>100</td></tr>
<tr><td>Objective (s)</td><td colspan="8">1. To get acquainted with improving quality of product/process by studying various parameters
2. To gain the knowledge regarding improvement of productivity</td></tr>
<tr><td>Outcome (s)</td><td colspan="8">1. Show the general principle of measurement
2. Classify and apply different transducers for converting cutting forces into suitable signals
3. State the design requirements of tool-force dynamometers
4. Understand various surface measurement aspects
5. Able to apply Taguchi methods for different optimization problems</td></tr>
<tr><td colspan="7">1.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Measurement of Cutting Forces: Strain gauge and piezoelectric transducers and their characteristics. Dynamometer construction, Bridge circuits. Instrumentation and calibration. Displacement and strain measurements by photoelasticity. Holography, interferometer, Moir techniques, strain gauge rosettes</td></tr>
<tr><td colspan="7">2.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Temperature Measurement: Circuits and instrumentation for different transducers viz, bimetallic, expanding fluid, electrical resistance, thermister, thermocouples, pyrometers
Flow Measurement : Transducers for flow measurements of Non-compressible and compressible fluids. Obstruction and drag methods. Vortex shredding flow meters. Ultrasonic, Laser Dopler and Hotwire anemometer. Flow visualization techniques, Shadow graphs, Schlieren photography. Interferometer</td></tr>
<tr><td colspan="7">3.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Metallurgical Studies: Optical and electron microscopy, X-Ray diffraction, Bragg‘s Law and its application for studying crystal structure and residual stresses, Electron spectroscopy, electron microprobe, Surface Measurements: Micro hardness, roughness, accuracy of dimensions and forms. 3-D co-ordinate, measuring machines</td></tr>
<tr><td colspan="7">4.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Experiment design & data analysis: Statistical methods, Randomised block design, Latin and orthogonal squares, factorial design. Replication and randomization.
Data Analysis: Deterministic and random data, uncertainty analysis, tests for significance: Chi-square, student‘s _t‘ test. Regression modeling, direct and interaction effects. ANOVA, F-test. Time Series analysis, Autocorrelation and autoregressive modeling</td></tr>
<tr><td colspan="7">5.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Taguchi Methods: Experiment design and planning with Orthogonal arrays and linear graphs. Additive cause effect model. Optimization of response level. Identification of Design and noise factors
Performance evaluation and Optimization by signal to noise ratios. Concept of loss function and its application.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td>Total Hrs</td><td>45</td></tr>
<tr><td colspan="9">Text book (s)</td></tr>
<tr><td colspan="9">1. Holman, J.P.: Experimental Methods for Engineers, McGraw Hill Int., New York
2. Venkatesh, V.C., and Chandrasekharan, Experimental Methods in Metal Cutting, Prentice Hall of India, Delhi</td></tr>
<tr><td colspan="9">Reference(s)</td></tr>
<tr><td colspan="9">1. Davis, O.V.; The Design and Analysis of Industrial Experiments, Longman, London
2. Box and Jenkins; Time Series analysis, Forecasting and control, Holden Day, Sanfrancisco
3. Dove and Adams, Experimental stress analysis and motion measurement, Prentice Hall of India, Delhi
4. Tapan P. Bagchi, Taguchi Methods Explained, Prentice Hall of India, Delhi</td></tr>
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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 113	**DESIGN FOR MANUFACTURE**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100
Objective (s)	1. To provide understanding of manufacturing processes and design concepts 2. To make the students understand the linkage required between design and manufacturing							
Outcome (s)	Student will able to 1. understand constraints of manufacturing processes that limit design possibilities with respect to cycle time, material handling, and other factory costs 2. design suitable manufacturing process capable of designing metallic components 3. design suitable manufacturing process capable of designing non-metallic components 4. design welded assembly, gear box assembly etc. 5. design suitable manufacturing process capable of designing the bolted, screwed, flanged connections etc. 6. prepare a project or report applying DFM principles per an example from industry							

1.	**Total Hrs**	**9**
Introduction: General design principles for manufacturability, strength and mechanical factors, mechanisms selection, evaluation method, geometrical tolerances, tolerance control and utilization. Economic Use of Raw Materials: Ferrous steel, hot rolled steel, cold finished steel, stainless steel, non ferrous materials aluminium, copper, brass, non metallic materials, plastics, rubber and composites		
2.	**Total Hrs**	**9**
Metallic Components Design: Metal extrusion, metal stamping, fine blanking, four slide parts, spring and wire forms, spun metal parts, cold headed parts, extruded parts, tube and section bends, rolled formed parts, power metal parts, forging electro forming parts, specialized forming methods, turned parts, machined round holes, drilled parts, milled parts.		
3.	**Total Hrs**	**9**
Non Metallic Components Design: Thermosetting plastic, injection moulded and rotational moulded parts, blow moulded, welded plastic articles, ceramics		
4.	**Total Hrs**	**9**
Assembled Parts Design: Welded parts, arc, resistance, brazed and soldered parts, gear box assembly, bearing assembly		
5.	**Total Hrs**	**9**
Assembled Parts Design: Retension, bolted connection, screwed connections, flanged connections, centred connections, press fitted connections, surface finishing, plated parts, heat treated parts, NC machining, group technology, low cost automation, computer aided manufacture, product design requirements. **Case Studies:** Identification of economical design and redesign for manufacture		
Total hours to be taught	**Total Hrs**	**45**
Text book (s)		
1. James G. Bralla, —*Hand book of product design for manufacturing*‖ McGraw Hill Co., 1986 2. K.G. Swift —*Knowledge based design for Manufacture*‖, Kogan page Limited, 1987.		

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 114	**DATA BASE MANAGEMENT SYSTEMS**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

1. To understand the different issues implementation of a database system.
2. To study the logical database designs, database modeling, relational network models
3. To understand data manipulation language to query and manage a database

Outcome (s)

After the completion of the course, the student will be able to :

1. Understand the basic concepts and applications of database systems.
2. Familiarized with commercial relational database system.
3. Demonstrate an understanding of the relational data model
4. Familiarized with indexing methods including B-tree, and hashing.
5. work successfully in a team by design and development of a database application
6. Understand the basics of query evaluation techniques and and query optimization

	Total Hrs	
1.	**Total Hrs**	**9**

Introduction and E.R. Model: Purpose of database systems, Data abstraction, Data models, Data independent DDL, DML, DBA. Entities and entity sets. Relationships and relationship sets Mapping constraints, Primary Keys E-R diagrams, reducing E-R Diagram to tables.

	Total Hrs	
2.	**Total Hrs**	**9**

Relational model and relational database design: Structure of relational database, former query languages, commercial query languages. Modifying the database views. Pitfalls in relational database design and normalization.

	Total Hrs	
3.	**Total Hrs**	**9**

Network data model and hierarchical data model: data structure diagram, the DBTCCODASYL. Model data retrieval Update and set processing facility, Three structure diagram, data retrieval and update facility, virtual records

	Total Hrs	
4.	**Total Hrs**	**9**

File and System Structure, Indexing and Hashing: Physical storage media – file organization, buffer management, Mapping relations, networks and hierarchies to files – Index – sequential files. Bi-tree indexed files

	Total Hrs	
5.	**Total Hrs**	**9**

Distributed database, security and integrity: Design, transparency and autonomy, query processing, recovery, concurrency control, deadlock handling and coordinator selection. Security and integrity, near database application

Total hours to be taught	**Total Hrs**	**45**

Text book (s)

1. Korth, H.F. Silbenhatz, A., *Database Concepts,* Mc Graw Hill, 1986
2. Gio Wiederhold, *Database Design,* Mc Graw Hill, 1983

Reference(s)

1. Jefferey O Ullman, *Principles of database systems*
2. C.J. Date, *An Introduction to database systems,* Addison Wisely, 1980.
3. Trembley and Soreson, *An Introduction to Data structures with applications,* Mc Graw Hills.

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 115	**FRACTURE MECHANICS**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

1. To introduce students to the concepts of materials fracture and failure analysis
2. To equip them with knowledge on how to design against catastrophic failures

Outcome (s)

At the completion of the course ,the student can:

1. Identify and explain the types of fractures of engineered materials and their characteristic features;
2. Understand the differences in the classification of fracture mechanics (LEFM and EPFM)• and how their corresponding parameters can be utilized to determine conditions under which engineering materials will be liable to fail catastrophically in service;
3. Understand and explain the mechanisms of fracture;
4. Appreciate the theoretical basis of the experimental techniques utilized for fracture
5. Develop expertise on the experimental techniques utilized for fracture and failure analysis
6. Learn simple LEFM testing methods for evaluating the fracture toughness of materials

1.	**Total Hrs**	**9**

Introduction: Crack in a Structure – Griffth Criterion – Cleavage fracture – Ductile fracture – Fatigue Cracking. Service failure analysis.

2.	**Total Hrs**	**9**

Elastic Crack: Elastic Crack tip stress field – Solution to crack problems. Effect of finite size stress intensity factor – Special cases – Irwin plastic zone correction. Actual shape of plastic zone – Plane stress – Plane strain.

3.	**Total Hrs**	**9**

Energy Principle: Energy release rate – Criterion for crack growth – Crack resistance curve – Principles of crack arrest – Crack arrest in practice

Fatigue Crack Growth: Fatigue crack growth test, stress intensity factor, factors affecting stress intensity factor – Variable amplitude service loading, retardation model

4.	**Total Hrs**	**9**

Elastic Plastic Fracture Mechanics: Elastic plastic fracture concept – Crack tip opening displacement – J-integral technique; Determination of J-using FEM

5.	**Total Hrs**	**9**

Application of Fracture Mechanics: Fracture design – Selection of materials – fatigue crack growth rate curve – Stress intensity factor range – Use of crack growth law

Total hours to be taught	**Total Hrs**	**45**

Text book (s)

1. David Broek – Elementary Engineering Fracture Mechanics: Sifth off an Noordhoff Internal Publishers – 1978.
2. Calcote, L.R., *The Analysis of Laminated Composite Structures,* Van Nostrand, 1969

Reference(s)

1. Jean Cemative and Jean Louis Chboche Mechanics of Solid Materials, Cambridge University Press Cambridge, 1987

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 116	**DESIGN OF PRESS TOOLS**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

1. To make the students understand the basic concepts involved in designing press tools
2. To make students capable of designing various press tools which are safe, easy to operate, reliable and economical for manufacturing.

Outcome (s)

Student will be able to

1. classify types of presses, characteristics and their principles.
2. understand the terminology in the design of Dies.
3. understand Elements of shearing dies
4. understand the basic concepts and principle involved in designing press tools.
5. ne in a position to independently design various press tools which will cater to requirement of industry
6. understand the different types of dies

1. — **Total Hrs 9**

Classification of Mechanical, Hydraulic, and pneumatic presses, Press Characteristics, safety devices in presses. Principles of stretch forming machines, principles of feeding and unloading equipment. Design principles of presses.

2. — **Total Hrs 9**

Design of Dies: Introduction terminology shearing dies- types of dies – analysis process shearing clearance – size and tolerances of die opening and punch – force, power, energy in shearing – loading center, shearing with inclined edges – strip layouts, economical stock – Utilization.

3. — **Total Hrs 9**

Elements of shearing dies – die plates – split dies, rules of development for split dies, inserts, types of punches, punch holders, punches – strippers – calculation of springs and rubber ejector, shedders, stops – pilots – stock guides – alignment system design for press tools

4. — **Total Hrs 9**

Compound dies, progressive dies, stock feeding devices – cam actuated die, horn dies (type, sub-press dies) – precision shearing dies, shaving dies, lamination dies – Bending dies, theory of bending development of blank, spring back, curling, flanging and press brake dies, bending on press brake

5. — **Total Hrs 9**

Drawing and forming Dies: Theory of drawing, blank development, strain factor, calculation of force, construction of drawing and drawing dies – Drawing of rectangular components (development, stages draw beeds) – Ironing (application of rubber and hydraulic system) – Defects in deep drawing – Modern Metal forming techniques – Discussion of various computer software for sheet metal design

Total hours to be taught — **Total Hrs 45**

Text book (s)

1. *Fundamentals of tool Design* – ASTME, Prentice Hall, New Delhi, 1987
2. *Die design Hand book* – AISME, Mc Graw Hills, New York, 1965

Reference(s)

1. Heinrich Makelt, *Mechanical Presses*, Edward Arnold, London, 1968
2. Serope Kalpakjain, *Mechanical Processing in Materials*, 1967
3. Javoronkov V.A and Chaturvedi. *R.C. Rolling of Metals*
4. Eary and Redds, *Shear Working of Metals*, Prentice Hall, New Delhi, 1969.
5. Honeyeeme R.W.K., *The plastic Deformation of metals*, Edward Arnold, London, 1968
6. Kamenschikov, *Forging Practice*, Mir. Pub., Moscow, 1968
7. *High Velocity Forming of metals,* ASME, Michigan, 1968
8. Bhattacharya.A, *New Technology*, Institute of Engineers, Calcutta, 1973

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<tr><td>Course Code</td><td>Course Name</td><td colspan="3">Hours/ Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">16MEE 117</td><td rowspan="2">DESIGN OF DIES</td><td>L</td><td>T</td><td>P</td><td>C</td><td>E</td><td>I</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>70</td><td>30</td><td>100</td></tr>
<tr><td>Objective (s)</td><td colspan="8">1. To make students understand the various steps and procedure involved in designing and manufacturing dies
2. To make students capable of solving complex geometric problems related to tool and die making</td></tr>
<tr><td>Outcome (s)</td><td colspan="8">Upon completion of the subject, students will be able to:

1. Apply contemporary design principles when designing advanced moulds and dies;
2. Assess the performance of a given tool design based on the design criteria;
3. Evaluate the effects of a given tool design on the quality of the work.
4. Describe the principles of clamping, drill jigs and computer aided jig design
5. Design fixtures for milling, boring, lathe, grinding, welding; identify fixtures and cutting tools for NC machine tools
6. Explain the principles of dies and moulds design</td></tr>
<tr><td colspan="7">1.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Design principles for dies of thermo-plastic and thermo-setting components. Impression core cavities, strength of cavities, guide pillars and bushes, ejection systems, cooling methods, bolster types. Split moulds, methods of actuating the splits, moulds of threaded components, internal & external under cuts, moulds with under – feed systems. Design principles and standards for Transfer and compression moulding dies.
Design of Tools: Mould for a spindle component with sleeve, pin ejection. Mould with splits Multi-cavity mould with stripper plate, inserts, ejectors.</td></tr>
<tr><td colspan="7">2.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Design of Dies for metal mould Castings, Die casting, Shell moulding.
Design of casting cavity, sprue, slug, fixed and movable cores, finger cam, core, pin, draft, ejector pins, ejector plate, gate, goose-neck, nozzle, over-flow, platen plunger, runner, slot, slide, vent, water line. Design of hot chamber, cold chamber machines, vertical, horizontal,, die locking machines, toggle and hydraulic systems, injection systems, rack and pinion, knockout pins and plates, hydraulic ejection, Other parts of die casting machines</td></tr>
<tr><td colspan="7">3.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Design of various types of dies – Single cavity, multi cavity, combination, unit dies. Alignment of dies with sprue. Design approach for die elements. Selection of materials and heat treatment for die casting dies and elements – die casting alloys – types of die casting alloys, Case studies on executed dies and design details. Finishing, Trimming, and inspection. Gravity die casting – Die design with cores and inserts – Bulk forming tools</td></tr>
<tr><td colspan="7">4.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Open die forging, Advantages of open die forging over closed die forging. Calculation of allowances and tolerances. Methods of open die forging. Design of dies. Closed die forging. Preparation of material for forging. Calculation of raw-stock, cutting off, heating in furnaces. Allowances and tolerances for closed die forging as per IS: 3469 1974</td></tr>
<tr><td colspan="7">5.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Die blocks for forging operations. Design of fuller impression, Roller impression, Bender impression, Blocker impression, Finisher impression. Swaging tools. Planning layout of multi impression dies. Flash and cutter calculations – additional operations on forging, piercing, and trimming dies, coining dies. Horizontal forging machines. Design of upsetting dies. Calculations on upsetting dies – Press forging reducer rollers. Forging equipment. Layout of forge shop. Roll forming, wire drawing forward & backward extrusion</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td>Total Hrs</td><td>45</td></tr>
<tr><td colspan="9">Text book (s)</td></tr>
<tr><td colspan="9">1. Rusinoff S.E., Forging & Forming Metals, Taraporewala, Bombay, 1952
2. Dochlar H.H., Die Casting Dies, Mc Grawhill, 1951</td></tr>
<tr><td colspan="9">Reference(s)</td></tr>
<tr><td colspan="9">1. I.S. Standards, BSI., New Delhi.
2. Pye R.G.W., Injection Mould Design, Longman scientific & Technical Publishers, London, 1989</td></tr>
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<tr><td>CBIT</td><td>Autonomous Regulation</td><td colspan="4">Semester-1</td><td colspan="3">AY - 2006-17</td></tr>
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<tr><td>Course Code</td><td>Course Name</td><td colspan="3">Hours/ Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">16MEE 118</td><td rowspan="2">RAPID PROTOTYPING PRINCIPLES AND APPLICATIONS</td><td>L</td><td>T</td><td>P</td><td>C</td><td>E</td><td>I</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>70</td><td>30</td><td>100</td></tr>
</table>

Objective (s)

1. To make students understand the basic concepts of various rapid prototyping technologies.
2. To understand and apply criterion for selecting appropriate RPT technique for any given application.

Outcome (s)

1. identify different process and key characteristics of RP technologies and commonly used RP systems
2. describe various CAD issues for rapid prototyping and related operations for STL model generation and manipulation
3. Explain and summarize typical rapid tooling processes for quick batch production of plastic and metal parts
4. critically explore technologies used for rapid prototyping in terms of their parameters, application, limitations, cost, materials, equipment, outcomes and implications
5. distinguish the types of Additive Manufacturing capabilities based on part geometry customer demands and CNC machine capabilities
6. identify different post processing techniques involved after rapid prototyping.

1. — **Total Hrs 9**

Introduction: Prototyping fundamentals, Historical development, Fundamentals of Rapid Prototyping, Advantages and Limitations of Rapid Prototyping, Commonly used Terms, Classification of RP process, Rapid Prototyping Process Chain: Fundamental Automated Processes, Process Chain

2. — **Total Hrs 9**

Liquid-based Rapid Prototyping Systems: Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies **Solid-based Rapid Prototyping Systems**: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies

3. — **Total Hrs 9**

Powder Based Rapid Prototyping Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs RT, Need for RT. Rapid Tooling Classification: Indirect Rapid Tooling Methods: Spray Metal Deposition, RTV Epoxy Tools, Ceramic tools, Investment Casting, Spin Casting, Die casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP

4. — **Total Hrs 9**

Rapid Prototyping Data Formats: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats.

Rapid Prototyping Software's: Features of various RP software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3D doctor

5. — **Total Hrs 9**

RP Applications: Application – Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. **RP Medical and Bioengineering Applications:** Planning and simulation of complex surgery, Customised Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visulization of Biomolecules

Total hours to be taught — **Total Hrs 45**

Text book (s)

1. Rapid prototyping: Principles and Applications - Chua C.K., Leong K.F. and LIM C.S, World Scientific publications , Third Edition, 2010
2. Rapid Manufacturing – D.T. Pham and S.S. Dimov, Springer , 2001

Reference(s)

1. Wholers Report 2000 – Terry Wohlers, Wohlers Associates, 2000
2. Rapid Prototyping & Manufacturing – Paul F.Jacobs, ASME Press, 1996

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 119	**Flexible Manufacturing Systems**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

The course covers the significance of manufacturing systems over numerical control machining methods. The fundamentals of flexible manufacturing system are clearly stated from the design concepts that include usage of operation cycle description, robot automatic guided vehicle, chip removal, washing station, fixturing etc

Outcome (s)

Upon completion of the subject, student will be able to

1. the understand the elements of flexible manufacturing system
2. Students can independently develop the sequence of operations that are to be performed for manufacturing of a product
3. understand the functioning of programmable logical controller
4. understand Automated storage and retrieval systems
5. understand the concept of just in time manufacturing
6. understand the FMS design concept

1. — **Total Hrs 9**

Evolution of Manufacturing Systems: FMS definition and description, General FMS considerations, Manufacturing cells, Cellular versus Flexible Manufacturing.
Systems Planning: Objective, introduction planning, preparation guidelines, the project team, supplier selection, system description and sizing, facility preparation planning, FMS layouts. Human resources: staff considerations, team work, communication and involvement, the supervisors role, personnel selection, job classifications, employee training

2. — **Total Hrs 9**

Manufacturing's Driving Force: Definition, description and characteristics. Just in-time manufacturing, definition and description, benefits and relationship to FMS, implementation cornerstones, quality and quantity application principles. Single manufacture Cell – design scheduling of jobs on single manufacturing cells.
Group Technology: Concepts, classification and coding, benefits and relationship to FMS, design of group technology using rank order clustering technique

3. — **Total Hrs 9**

FMS Design – Using Bottleneck, Extended bottleneck models, Processing and Quality Assurance: Turning centres, Machining centre, construction and operations performed, axes, programming, and format information, work-holding and work-changing equipment, automated features and capabilities, cleaning and deburring – station types and operation description, importance to automated manufacturing, coordinate measuring machines, types, construction and general function, operation cycle description, importance to flexible cells and systems

4. — **Total Hrs 9**

Automated movement and storage systems–AGVs, Robots, automated storage and retrieval systems, storage space design, queuing carousels and automatic work changers, coolant and chip Disposal and recovery systems, auxiliary support equipment, cutting tools and tool Management – introduction, getting control of cutting tools, Tool Management, tool strategies, data transfer, tool monitoring and fault detection, guidelines, work holding considerations, General fixturing, Modular fixturing. FMS and the relationship with workstations – Manual, automated and transfer lines design aspects

5. — **Total Hrs 9**

FMS: computer Hardware, Software, Communications networks and Nanotechnology – general functions, and manufacturing usages, hardware configuration, programmable logic controllers, cell controllers, communications networks. FMS implementation

Total hours to be taught — **Total Hrs 45**

Text book (s)

1. Parrish, D.J., _*Flexible Manufacturing*', - Butter Worths – Heinemann, Oxford, 1993
2. Groover, M.P., _*Automation, Production Systems and CIM*', - Prentice Hall India, 1989

Reference(s)

1. Kusiak, A., _*Intelligent Manufacturing Systems*', - Prentice Hall, 1990
2. Considine,D.M., & Considine,G.D., _*Standard Handbook of Industrial Automation*',-Chapman & Hall, 1986
3. Ranky, P.G., _*Design and Operation of FMS*', - IFS Publishers, UK, 1988

<table>
<tr><td>CBIT</td><td>Autonomous Regulation</td><td colspan="4">Semester-1</td><td colspan="3">AY - 2006-17</td></tr>
<tr><td>Department</td><td>Mechanical Engineering</td><td colspan="4">Programme Code & Name</td><td colspan="3">M.E. CAD/CAM</td></tr>
<tr><td>Course Code</td><td>Course Name</td><td colspan="3">Hours/ Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">16MEE 120</td><td rowspan="2">NON-TRADITIONAL MACHINING AND FORMING</td><td>L</td><td>T</td><td>P</td><td>C</td><td>E</td><td>I</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>70</td><td>30</td><td>100</td></tr>
<tr><td>Objective (s)</td><td colspan="8">1. To make the students understand the need and the applications of nontraditional machining processes.
2. To choose the NTM processes for particular applications</td></tr>
<tr><td>Outcome (s)</td><td colspan="8">Students can understand,
1.the importance ,principles of various Non-traditional processes
2.the processes of Thermal Metal Removal
3.the parameters and chemistry of Electro chemical process
4.the principles of Plasma Arc machining
5.the principles of laser Beam and Electron Beam machining
6.to make the comparison of conventional and high velocity forming methods</td></tr>
<tr><td colspan="7">1.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Introduction: Need for non-traditional machining processes. Processes selection, classification, comparative study of different processes.
Mechanical Process: Ultrasonic Machining-Definition-Mechanism of metal elements of the process- Tool feed mechanism. Theories of mechanics of causing effect of parameter applications.
Abrasive Jet Machining: Principles - parameters of the process, applications, advantages and disadvantages.
Water Jet Machining (WJM): Schematic diagram, equipment used, advantages and applications</td></tr>
<tr><td colspan="7">2.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Thermal Metal Removal Process: Electric discharge machining Principle and operation – mechanism of meta removal, basic EDM circuitry-spark erosion. Analysis of relaxation type of circuit material removal rate in relaxation circuits- critical resistance parameters in Ro Circuit-Die electric fluids- Electrodes for surface finish. Applications. Wire EDM principle and operation. Wire materials, wire tension and its parameters. Applications</td></tr>
<tr><td colspan="7">3.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Electro Chemical and Chemical Processes: Electro chemical machining (ECM) Classification ECM process-principle of ECM Chemistry of the ECM parameters of the processes-determination of the metal removal rate - dynamics of ECM process-Hydrodynamics of ECM process-polarization. Tool Design-advantages and disadvantages - applications. Electro Chemical Grinding-Electro Chemical holding Electrochemical deburring.
Plasma Arc Machining: Introduction-Plasma-Generation of Plasma and equipment Mechanism of metals removal, PAN parameters-process characteristics - type of torches applications</td></tr>
<tr><td colspan="7">4.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Electron Beam Machining (EBM): Introduction-Equipment for production of Electron beam - Theory of electron beam machining Thermal & Non thermal types characteristics – applications.
Laser Beam Machining (LBM): Introduction-principle of generation of lasers Equipment and Machining procedure-Types of Lasers-Process characteristics-advantages and limitations-applications</td></tr>
<tr><td colspan="7">5.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">High Velocity Forming Process: introduction - development of specific process selection-comparison of conventional and high velocity forming methods - Types of high velocity forming methods- explosion forming process-elector hydraulics forming magnetic pulse forming. Electro-Magnetic Forming. Rubber Pad Forming: Principle of the process, process details, process variants - Guerin, wheelon, Marforming and Hydro forming processes and applications</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td>Total Hrs</td><td>45</td></tr>
<tr><td colspan="9">Text book (s)</td></tr>
<tr><td colspan="9">1. New Technology Institution of Engineers - Bhattacharya – India
2. Production Technology - HMT - Tata Mc Graw Hill - ISBN-10</td></tr>
<tr><td colspan="9">Reference(s)</td></tr>
<tr><td colspan="9">1. Modern Manufacturing Method - Adithan - New Age International (p) Limited
2. Modern Machining Processes - P.K. Mishra - Narosa Publishing House, New Delhi - 1997.</td></tr>
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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 121	**PRODUCT DESIGN AND PROCESS PLANNING**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100
Objective (s)	1. To impart the concepts about design and manufacturing engineering 2. To understand the ergonomic considerations to manufacture a product							
Outcome (s)	1. Imparting basic foundation and advanced concepts about Design and Manufacturing Engineering. 2. Root cause analysis of a design engineering problem through basic and engineering sciences. 3. Understanding and learning of Manufacturing issues. 4. Imparting research activities through curriculum. 5. Solving complex design engineering problems. and apply latest engineering tools with advanced software knowledge . 6 .Mechanical engineering solutions to green and sustainable development							

1.	**Total Hrs**	**9**

Product design and process design functions, selection of a right product, essential factors of product design, Morphology of design, sources of new ideas for products, evaluation of new product ideas Product innovation procedure-Flow chart. Qualifications of product design Engineer. Criteria for success/failure of a product. Value of appearance, colours and Laws of appearance

2.	**Total Hrs**	**9**

Product reliability, Mortality Curve, Reliability systems, Manufacturing reliability and quality control. Patents: Definitions, classes of patents, applying for patents. Trademarks and copyrights. Cost and quality sensitivity of products, Elements of cost of a product, costing methods, cost reduction and cost control activities. Economic analysis, Break even analysis Charts. Value engineering in product design, creativity aspects and techniques. Procedures of value analysis – cost reduction, material and process selection.

3.	**Total Hrs**	**9**

Various manufacturing processes, degree of accuracy and finish obtainable, process capability studies. Methods of improving tolerances. Basic product design rules for Casting, Forging, Machining, Sheet metal and Welding. Physical properties of engineering materials and their importance on products. Selection of plastics, rubber and ceramics for product design

4.	**Total Hrs**	**9**

Industrial ergonomics: Man-machine considerations, ease of maintenance. Ergonomic considerations in product design-Anthropometry, Design of controls, man-machine information exchange. Process sheet detail and their importance, Advanced techniques for higher productivity. Just-in-time and Kanban System. Modern approaches to product design; quality function development, Rapid prototyping

5.	**Total Hrs**	**9**

Role of computer in product design and management of manufacturing, creation of manufacturing data base, Computer Integrated Manufacturing, communication network, production flow analysis, Group Technology, Computer Aided product design and process. Planning. Integrating product design, manufacture and production control

Total hours to be taught	**Total Hrs**	**45**

Text book (s)

1 Niebel, B.W., and Draper, A.B., Product design and process Engineering, Mc Graw Hill – Kogalkusha Ltd., Tokyo, 1974.
2 Chitale, A.K, and Gupta, R.C., Product Design and Manufacturing, Prentice Hall of India Pvt. Ltd., New Delhi, 2004

Reference(s)

1. Mahajan, M. Industrial Engineering and Production Management, Dhanpath Rai & Co., 2000

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEC 106	**CAD/CAM LABORATORY**	L	T	P	C	E	I	Total
		0	0	3	2		50	50

Objective(s):

1. To produce CAD drawings which communicate the appropriate manufacturing details, standards, and specifications..
2. To effectively communicate with others using oral, written, and graphical methods and procedures..
3. To function effectively on teams or on group projects and assume leadership roles when appropriate..
4 To introduce STUDENTS to the basic tools of computer-aided design (CAD) and computer-aided manufacturing (CAM)
5 To understand the basic analytical fundamentals that are used to create and manipulate geometric models in a computer program
6 To prepare the student to be an effective user of a CAD/CAM system.

Outcome(s): After the completion of the course, students will be able to

1. use parametric CAD software for geometric modeling of mechanical designs
2. visualize of machine components and assemblies before their actual fabrication through modeling, animation, shading, rendering, lighting and coloring
3. apply of CAD computational analysis tools to engineering design.
4. create a complete CAD documentation for an engineering design.
5. model complex shapes including freeform curves and surfacesExplain the basic concepts of CNC programming and machining
6. implement CNC programs for milling and turning machining operations

List of Exercises:

CAD

1. Understanding of various CAD commands and creating simple objects.
2. Understanding of holes, cuts and model tree relations.
3. Creation shafts, rounds, chamfers and slots.
4. Sketch Tools & Datum planes.
5. Creation of objects by revolved features, patterns and copies, sweeps and blends.
6. Creation of engineering drawing details such as dimensioning, sectional views, adding esthetics.
7. Assembling of part models using constraints with bill of materials.
8. Assembly operations - part modifications, adding another assembly features – display.
9. Mass properties and tolerance analysis.

CAM

1. Understanding of CNC Machines and CNC Programming and Creation of 2-D contour Pockets, Slots
2. Drills and Facing, 2-D high Speed blend
3. Surface Roughing for Bottle die
4. Surface finishing for Phone die
5. Manufacturing of Crane Hook
6. Manufacturing of Connecting Rod
7. Manufacturing of Turbine Blade
8. 3-D Machining using ball nose cutters

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEC 107	**COMPUTATIONAL LABORATORY**	L	T	P	C	E	I	Total
		0	0	3	2		50	50

Objective(s)

1. To understand how and why finite element technique works
2. To learn the selection of the element type for a defined problem.
3. To use ANSYS package to solve engineering problems for a variety of application
4. To learn to use finite element analysis in design
5. To know various fields of engineering where these tools can be effectively used to improve the output of a product
6. To impart the fundamental knowledge on using various analytical tools like ANSYS Engineering Simulation.

Outcome(s):

Students will be able to:

1. Use the tools like ANSYS in solving real time problems and day to day problems.
2. Apply the Finite Element Method for the calculation stresses, strains and deformations in any component
3. critically evaluate the model results in comparison to simplified analytical solutions
4. Versatility in using these tools for any engineering and real time applications.
5. Gain knowledge on utilizing these tools for a better project in their curriculum
6. Face industry with confidence in using these tools in their respective jobs

List of Experiments:

1. Introduction to Finite Element Analysis Software.
2. Static analysis of a corner bracket.
3. Statically indeterminate reaction force analysis.
4. Determination of Beam stresses and Deflection.
5. Bending analysis of a Tee-shaped beam.
6. Analysis of cylindrical shell under pressure.
7. Bending of a circular plate using axisymmetric shell element.
8. Stress analysis in a long cylinder.
9. Solidification of a casting.
10. Transient Heat transfer in an infinite slab.
11. Transient Thermal stress in a cylinder.
12. Vibration analysis of a simply supported beam.
13. Natural frequency of a motor generator.
14. Thermal – structural contact analysis of two bodies.
15. Drop test of a container (Explicit Dynamics).

16MEC 110

MINIPROJECT GUIDELINES

Instruction	2 Hrs / week
Sessional	50 Marks
Credits	01

Objectives:

First year ME students will each do a 14-week mini project, each generally comprising about one week of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment (see assessment information below). Each student will be allotted to a Faculty supervisor for mentoring.

Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original. Mini projects should have inter disciplinary/ industry relevance. The students can select a mathematical modeling based/Experimental investigations or Numerical modeling. All the investigations are clearly stated and documented with the reasons/explanations. All the projects should contain A clear statement of the research objectives, background of work, Literature review, techniques used, prospective deliverables, benefit from this [line of] research, Detailed discussion on results, Conclusions and references.

Outcomes:

Students are able to
1. Formulate a specific problem and give solution
2. Develop model/models either theoretical/practical/numerical form
3. Solve, interpret/correlate the results and discussions
4. Conclude the results obtained and write the documentation in standard format

Assessment:

1. 50 % of marks for a scientific report on the project.
   Regarding the formatting and structure, the report should be written as a journal article using the style file of a journal appropriate for the field of the research (which journal format is most appropriate should be agreed between student and supervisor). If the journal you selected has a page limit, it can be ignored but the report should not exceed 8000 words (common sense should be used if there are a lot of equations).

   Regarding content, the report should be understandable by your fellow students, so the introduction and literature review could be a bit more detailed than in a research paper. The results and discussions are in elaborate form and at end conclusions and include references.

2. 50 % of marks for an oral presentation which will take place at the end of the semester and evaluation by a committee consist of Supervisor, one senior faculty and Head of the department or his nominee.
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