DEPARTMENT OF MECHANICAL ENGINEERING

SCHEME OF INSTRUCTION AND SYLLABI
OF

M.E.

(Mechanical Engineering)

Specialization:

CAD/CAM

2013

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

Scheme of Instruction & Examination

M.E. (Mechanical Engineering) 4 Semesters (Full Time)

Sl. No	Subject	Periods per week		Duration (Hrs)	Max. Marks		Credits
		L/T	D/P		Univ. Exam	Sessional	
Semester - I							
1.	Core	4	--	3	75	25	3
2.	Core	4	--	3	75	25	3
3.	Core / Elective	4	--	3	75	25	3
4.	Core / Elective	4	--	3	75	25	3
5.	Core / Elective	4	--	3	75	25	3
6.	Elective	4	--	3	75	25	3
7.	Laboratory - I	--	3	--	--	50	2
8.	Seminar - I	--	3	--	--	50	2
	Total	**24**	**6**		**450**	**250**	**22**
Semester - II							
1.	Core	4	--	3	75	25	3
2.	Core	4	--	3	75	25	3
3.	Core / Elective	4	--	3	75	25	3
4.	Core / Elective	4	--	3	75	25	3
5.	Core / Elective	4	--	3	75	25	3
6.	Elective	4	--	3	75	25	3
7.	Laboratory - II	--	3	--	--	50	2
8.	Seminar - II	--	3	--	--	50	2
	Total	**24**	**6**		**450**	**250**	**22**
Semester – III							
1.	Project Seminar*	--	6	--	--	100**	4
Semester – IV							
1.	Dissertation	--	6	--	Viva - Voce (Grade ***)	--	16

Note: Six core subjects, Six elective subjects, Two Laboratory Courses and Two Seminars 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.

*** Excellent/Very Good/Good/Satisfactory/Unsatisfactory

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: Periods per week L/T	Scheme of Instruction: Periods per week D/P	Scheme of Examination: Duration in Hours	Max. Marks: Univ. Exam	Max. Marks: Sessionals	Credits
		CORE SUBJECTS						
1.	ME 501	Automation	4	--	3	75	25	3
2.	ME 502	Finite Element Techniques	4	--	3	75	25	3
3.	ME 503	Computer Aided Modeling and Design	4	--	3	75	25	3
4.	ME 504	Computer Integrated Manufacturing	4	--	3	75	25	3
5.	ME 505	Failure Analysis and Design	4	--	3	75	25	3
6.	ME 506	Computer Aided Mechanical Design and Analysis	4	--	3	75	25	3
		ELECTIVES						
1.	ME 511	Integrated Mechanical Design	4	--	3	75	25	3
2.	ME 512	Robotic Engineering	4	--	3	75	25	3
3.	ME 513	Programming Methodology and Data Structures	4	--	3	75	25	3
4.	ME 514	Optimization Techniques	4	--	3	75	25	3
5.	ME 515	Vibrations Analysis and Condition Monitoring	4	--	3	75	25	3
6.	ME 516	Engineering Research Methodology	4	--	3	75	25	3
7.	ME 517	Tribology In Design	4	--	3	75	25	3
8.	ME 518	Advanced Mechanics Of Materials	4	--	3	75	25	3
9.	ME 519	Mechanics of Composite Materials	4	--	3	75	25	3
10.	ME 520	Theory of Elasticity and Plasticity	4	--	3	75	25	3
11.	ME 521	Experimental Techniques and Data Analysis	4	--	3	75	25	3
12.	ME 522	Design for Manufacture	4	--	3	75	25	3
13.	ME 523	Data Base Management Systems	4	--	3	75	25	3
14.	ME 524	Fracture Mechanics	4	--	3	75	25	3
15.	ME 525	Design of Press Tools	4	--	3	75	25	3
16.	ME 526	Design of Dies	4	--	3	75	25	3
17.	ME 602	Computational Fluid Dynamics	4	--	3	75	25	3
18.	ME 527	Rapid Prototyping Principles & Applications	4	--	3	75	25	3
19.	ME 528	Flexible Manufacturing Systems	4	--	3	75	25	3
20.	ME 529	Non-Traditional Machining & Forming	4	--	3	75	25	3
21.	ME 530	Product Design and Process Planning	4	--	3	75	25	3
		DEPARTMENTAL REQUIREMENTS						
1.	ME 551	CAD/CAM Lab (Lab –I)	--	3	--	--	50	2
2.	ME 552	Computation Lab (Lab –II)	--	3	--	--	50	2
3.	ME 553	Seminar – I	--	3	--	--	50	2
4.	ME 554	Seminar – II	--	3	--	--	50	2
5.	ME 555	Dissertation & Project Seminar	--	6	--	--	--	4
6.	ME 556	Dissertation	--	6	--	Viva-Voce (*Grade)	--	16

*Excellent / Very Good / Good / Satisfactory / Unsatisfactory

<table>
<tr><td>CBIT</td><td colspan="9">Autonomous Regulation</td></tr>
<tr><td>Department</td><td>Mechanical Engineering</td><td colspan="4">Programme Code & Name</td><td colspan="4">M.E. (CAD/CAM)</td></tr>
<tr><td colspan="10">Semester-I</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">ME501</td><td></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>AUTOMATION</td><td>4</td><td>0</td><td>0</td><td>3</td><td>75</td><td>25</td><td>100</td></tr>
<tr><td>Objective (s)</td><td colspan="8">To learn & understand basic concepts of automation & its significance in manufacturing industries.
To understand Detroit type automation & flow lines.
To conceptualize & design assembly line balancing.
To learn about automated material handling systems
To design effective and appropriate testing & inspection systems.</td></tr>
<tr><td>Outcome(s)</td><td colspan="8">Ability to conceptualize and design automated flow lines.
Ability to implement line balancing concepts in production and assembly lines
Ability to understand and develop automated material handling system suitable for plant operations.
Ability to design, implement and use and appropriate automated inspection facility.</td></tr>
</table>

1	**UNIT – I**	**Total Hrs**	**7**

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	**UNIT – II**	**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	**UNIT – III**	**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	**UNIT – IV**	**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	**UNIT – V**	**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	**43**

Text book (s)	
1	Mikell P.Grover, Automation, Production Systems and Computer Integrated Manufacturing, Pearson Education Asia.
2	C.Ray Asfahl, Robots and manufacturing Sutomation, John Wiley and Sons New York.
Reference(s)	
1	N.Viswanadham and Y.Narahari, Performance Modeling of Automated Manufacturing Sytems, 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***								
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	
ME502	**FINITE ELEMENT TECHNIQUES**	4	0	0	3	75	25	100	
Objective (s)	Identify mathematical model for solution of common engineering problems Enable the students to formulate the design problems into FEA. Enable the students to perform engineering simulations using Finite Element Analysis software								
Outcome(s)	students are able to solve the different structures analytically and can extend these concepts to develop higher order elements suitable for structural, thermal and dynamic analysis								

1	**UNIT – I**	**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	**UNIT – II**	**Total Hrs**	**9**
Analysis of plane truss with number of unknowns not exceeding two at each node. Analysis of frames with two translations and a rotational degree of freedom at each node. Analysis of Beams: Element stiffness matrix for two noded, two degrees of freedom per node for beam element.			
3	**UNIT – III**	**Total Hrs**	**9**
. Finite element modeling of two dimensional stress analysis problems with constant strain triangles and 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	**UNIT – IV**	**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	**UNIT – V**	**Total Hrs**	**9**
Finite element formulation of three dimensional problems in stress analysis. Finite Element formulation of an incompressible fluid. Potential flow problems Bending of elastic plates. Introduction to non-linear problems and Finite Element analysis software.			
Total hours to be taught			**45**

Text book (s)	
1	Tirupathi R Chandrupatla and Ashok.D. Belegundu, Introduction of Finite Element in Engineering. Prentice Hall of India, 1997
2	Rao S.S.,The Finite Element Methods in Engineering, Pergamon Press, 1989.
Reference(s)	
1	Segerland. L.J., Applied Finite Element Analysis, Wiley Publication1984.
2	Reddy J.N., An Introduction to Finite Element Methods ,Mc Graw Hill Company, 1984

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	
ME503	**COMPUTER AIDED MODELING AND DESIGN**	4	0	0	3	75	25	100	
Objective (s)	Understand the basic and advanced concepts of computer aided design. Learn the application of CAD in geometric modeling. Understand the CAD Database, Data Exchange and Standards Introduce Geometric Modeling to the students to curve and surface modeling. Students will develop an understanding of the theory and construct the elements of curved surface representation. Explain solid modeling representation schemes and the Euler operators Understand and be able to perform two-dimensional and three-dimensional geometric transformations on two and three-dimensional objects, including Translation, Scaling, Rotation, Reflection, Shearing, Be able to combine the parameters for a sequence of transformations into a single composite 3x3 and 4x4matrix using homogeneous coordinates. Have an overview of advantages and disadvantages of modeling and analysis packages								
Outcome (s)	Upon completion of this course, the student will be able to: Ability to apply mathematics, and students learn some of the theory behind the CAD software they use in the laboratory. Solve engineering problems on the topics included in this theory - geometry manipulation, curve and surface representations and finite element analysis. Evaluate mathematical transformation, Design and model curves, surfaces and solids. Differentiate between the modeling techniques, Categorise and apply the principles of geometric modeling, Effectively employ solid modeling tools.								

1	**UNIT – I**	**Total Hrs**	**9**
Criteria for selection of CAD workstations, Shigle Design Process, Design criteria, Geometric modeling, entities, 2D & 3D Primitives. 2D & 3D Geometric Transformations: Translation, Scaling, Rotation, Reflection and Shearing, conlatenation. Graphics standards: GKS IGES, PDES.			
2	**UNIT – II**	**Total Hrs**	**9**
Wire frame modeling: Curves: Curve representation. Analytic curves – lines, Circles, Ellipse, Conis. Synthetic curves – Cubic, Bezier, B-Spline, NURBS.			**9**
3	**UNIT – III**	**Total Hrs**	**9**
Surface Modeling: Surface entities, Surface Representation. Analytic Surface – Plane Surface, Ruled Surface, Surface of Revolution, Tabulated Cyliner. Synthetic Surface-Cubic, Bezier, B-spline, Coons.			
4	**UNIT – IV**	**Total Hrs**	**9**
Solid Modeling Techniques: Graph Based Model, Boolean Models, Instances, Cell Decomposition & Spatial – Occupancy Enumeration, Boundary Representation (B-rep) & Constructive Solid Geometry (CSG)			
5	**UNIT – V**	**Total Hrs**	**9**
Advanced Modeling Concepts: Feature Based Modeling, Assembling Modeling, Behavioural Modeling, Conceptual Design & Top Down Design. Capabilities of Modeling & Analysis Packages such as solid works, Unigraghics, Ansys, Hypermesh. 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.

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<tr><td>Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Hours/ Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">ME504</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>COMPUTER INTEGRATED MANUFACTURING</td><td>4</td><td>0</td><td>0</td><td>3</td><td>75</td><td>25</td><td>100</td></tr>
<tr><td>Objective (s)</td><td colspan="8">To develop an understanding of the role of computer in manufacturing .To provide an in-depth understanding of control of manufacturing, automated material handling, storage and retrieval systems. To take up case studies on FMS and CIM systems.</td></tr>
<tr><td>Outcome (s)</td><td colspan="8">Ability to select the manufacturing process for the development of a product and store the details by database management systems. Ability to apply the concepts of lean manufacturing to product life cycle and process plan during the development of a product.</td></tr>
<tr><td colspan="5">1 UNIT – I</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="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.</td></tr>
<tr><td colspan="5">2 UNIT – II</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="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.</td></tr>
<tr><td colspan="5">3 UNIT – III</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="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.</td></tr>
<tr><td colspan="5">4 UNIT – IV</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="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.</td></tr>
<tr><td colspan="5">5 UNIT – V</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="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.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="9">Text book (s)</td></tr>
<tr><td>1</td><td colspan="8">S.Kant Vajpayee: Principles of Computer Integrated Manufacturing, Printice-Hall India.</td></tr>
<tr><td>2</td><td colspan="8">Nanua Singh: Systems Approach to Computer Integrated Design and Manufacturing- John Wiley</td></tr>
<tr><td colspan="9">References</td></tr>
<tr><td>1</td><td colspan="8">P.Radhakrishnan, S.Subramanyam: CAD/CAM/CIM, New Age International</td></tr>
<tr><td>2</td><td colspan="8">Alavudeen, Venkateshwaran: Computer Integrated Manufacturing, Printice-Hall India</td></tr>
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<tr><td colspan="9">Semester-I</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">ME 505</td><td></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>FAILURE ANALYSIS AND DESIGN</td><td>4</td><td>0</td><td>0</td><td>3</td><td>75</td><td>25</td><td>100</td></tr>
<tr><td>Objective (s)</td><td colspan="8">Failure analysis and design provides an introduction to the fundamentals of design and fracture including conceptual design, embodiment design and failure mode effect analysis. Under the basics of fracture, cylindrical configuration is analyzed (thick and thin cases) for buckling. Plate with thick and thin cases for static and dynamic loading is discussed. The course introduces standard design procedures and failure phenomenon.</td></tr>
<tr><td>Outcome (s)</td><td colspan="8">Design concepts along with fatigue, fracture and crack propagation concepts are reinforced through creative thinking methodologies and numericals.</td></tr>
</table>

1	**UNIT – I**	**Total Hrs**	**9**
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	**UNIT – II**	**Total Hrs**	**9**
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	**UNIT – III**	**Total Hrs**	**9**
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	**UNIT – IV**	**Total Hrs**	**9**
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	**UNIT – V**	**Total Hrs**	**9**
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			**45**

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

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<tr><td>Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Hours/ Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">ME 506</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>COMPUTER AIDED MECHANICAL DESIGN AND ANALYSIS</td><td>4</td><td>0</td><td>0</td><td>3</td><td>75</td><td>25</td><td>100</td></tr>
<tr><td>Objective (s)</td><td colspan="8">Ability to develop the necessary skills to understand and analyze stresses and strains in pressure vessels. To achieve fundamental understanding of the theory of bending of plates with various loading and boundary conditions. Understanding design principles of materials and structures using fracture mechanics approaches. Fully understand and appreciate the importance of vibrations in mechanical design and to understand the basic concepts of matrix algebra. Students able to understand procedures for Finite element methods.</td></tr>
<tr><td>Outcomes (s)</td><td colspan="8">Develop an ability to apply knowledge of mathematics, sciences and computations in solving engineering problems. Demonstrate the ability to identify, formulate and solve problems for a given application.) An ability to design a system or a component to meet the desired needs. Class Room Examination Score above 60% demonstrate accomplishment of this outcome. An ability to design, analyze and interpret the results. Be proficient in the use of software for analysis and design.</td></tr>
<tr><td colspan="5">1 UNIT-I</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Design of pressure Vessels: Introduction and constructional features of pressure vessels, stresses in pressure vessels, shrink fit stresses in built up cyliners, autofrettage of thick cylinders, thermal stresses and their significance.</td></tr>
<tr><td colspan="5">2 UNIT-II</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="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.</td></tr>
<tr><td colspan="5">3 UNIT-III</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="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.</td></tr>
<tr><td colspan="5">4 UNIT-IV</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="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.</td></tr>
<tr><td colspan="5">5 UNIT-V</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="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)</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="9">Text book (s)</td></tr>
<tr><td>1</td><td colspan="8">1. John, V. Harvey, Pressure Vessel Design: Nuclear and Chemical Applications, Affiliated East West Press Pvt. Ltd., 1969.</td></tr>
<tr><td>2</td><td colspan="8">2. Prasanth Kumar, Elements of Fracture Mechanics, Wheeler Publishing, New Delhi-1999.</td></tr>
<tr><td colspan="9">References</td></tr>
<tr><td>1</td><td colspan="8">V. Rammurti, Computer Aided Mechanical Design and Analysis, Tata Mc Graw Hill-1992</td></tr>
<tr><td>2</td><td colspan="8">3. Bathe, J., Finite Element Procedures, Prentice Hall of India-1996.</td></tr>
</table>

<table>
<tr><td>CBIT</td><td colspan="8">Autonomous Regulation</td></tr>
<tr><td>Department</td><td colspan="3">Mechanical Engineering</td><td colspan="2">Programme Code & Name</td><td colspan="3">M.E. CAD CAM</td></tr>
<tr><td colspan="9">Semester-I</td></tr>
<tr><td>Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Hours/ Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">ME511</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>INTEGRATED MECHANICAL DESIGN</td><td>4</td><td>0</td><td>0</td><td>3</td><td>75</td><td>25</td><td>100</td></tr>
<tr><td>Objective (s)</td><td colspan="8">To include the in –depth application of a scientific approach to design, the practice of a multi-disciplinary process, the practice of systems integration and the learning of typical values of design parameters.</td></tr>
<tr><td>Outcome (s)</td><td colspan="8">Choose suitable methods and tools for (a) the development of , (b) the modeling and simulation of, (c) the analysis of and (d) the choice of solution for an engineering problem in the mechanical engineering domain
Choose the models and analysis criteria following the specifications, and
Design a system based on specifications utilizing suitable tools.</td></tr>
</table>

1	**UNIT – I**	**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	**UNIT – II**	**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	**UNIT – III**	**Total Hrs**	**9**

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

4	**UNIT – IV**	**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.

REFERENCES

1. Norton 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, 2nd 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. P.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.

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<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 colspan="9">Semester-I</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></td><td></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>ME 512</td><td>ROBOTIC ENGINEERING</td><td>4</td><td>0</td><td>0</td><td>3</td><td>75</td><td>25</td><td>100</td></tr>
<tr><td>Objective (s)</td><td colspan="8">To educate mechanical engineers who are capable of solving multidisciplinary technical problems in a global work environment.
To produce individuals who contributed to contemporary engineering solutions with community involvement and aspire to lifelong learning.</td></tr>
<tr><td>Outcome (s)</td><td colspan="8">An ability to design a robotic system, component, or process to meet desired needs within realistic constraints, such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
An ability to function on multidisciplinary teams.</td></tr>
<tr><td>1</td><td colspan="4">UNIT-I</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="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.</td></tr>
<tr><td>2</td><td colspan="4">UNIT-II</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="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.</td></tr>
<tr><td>3</td><td colspan="4">UNIT-III</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="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.</td></tr>
<tr><td>4</td><td colspan="4">UNIT-IV</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="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</td></tr>
<tr><td>5</td><td colspan="4">UNIT-V</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="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</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="9">Text book (s)</td></tr>
<tr><td>1</td><td colspan="8">Nagrath and Mittal, “Robotics and Control”, Tata McGraw-Hill, 2003.</td></tr>
<tr><td>2</td><td colspan="8">Spong and Vidhyasagar, “Robot Dynamics and Control”, John Wiley and sons, 2008.</td></tr>
<tr><td colspan="9">References</td></tr>
<tr><td>1</td><td colspan="8">Fu. K.S, Gonzalez, R.C., Lee, C.S.G, Robotics, control, sensing, Vision and Intelligence, McGraw Hill International, 1987</td></tr>
<tr><td>2</td><td colspan="8">Steve LaValle, “Planning Algorithms”, Cambridge Univ. Press, New York, 2006.</td></tr>
<tr><td>3</td><td colspan="8">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.</td></tr>
</table>

CBIT	***Autonomous Regulation***								
Department	Mechanical Engineering	Programme Code & Name				M.E. (CAD/CAM)			
Semester-I									
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks			
		L	T	P	C	E	I	Total	
ME 513	**PROGRAMMING METHODOLOGY AND DATA STRUCTURES**	4	0	0	3	75	25	100	
Objective (s)	To improve logical thinking of the students. Encourage the student to use his own code to solve mechanical engineering Problems.								
Outcome (s)	Different types of data storage and their structures. Implementing the concepts with programming in 'C'								

1	**UNIT-I**	**Total Hrs**	**9**
Programming Methodology: Introduction, Algorithm, Data Flow Diagrams, Decision Tree, Decision Table and Life Cycles of Project Development.			
2	**UNIT-II**	**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	**UNIT-III**	**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	**UNIT-IV**	**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	**UNIT-V**	**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			**45**

Text book (s)	
1	1. G.Michael Schneider, Steven C.Bruell, "*Concepts in Data Structures and Software Development"*, Jaico Publishing House,2002
2	1. 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***									
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		
ME 514	**OPTIMIZATION TECHNIQUES**	4	0	0	3	75	25	100		
Objective (s)	Students should be aware of optimizing methods. Students should able to plan and executive the project									
Outcome (s)	Capable of applying optimization techniques in engineering applications. Ability to use linear & non linear programming techniques. Ability to develop schedule for projects and apply PERT & CPM techniques.									

1	**UNIT – I**	**Total Hrs**	**9**
Statement of Optimization Problem, Linear Programming: Simplex Method, Revised Simplex Method, Sensitivity Analysis, Parametric Programming, and Transportation Problem.			
2	**UNIT – II**	**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	**UNIT – III**	**Total Hrs**	**9**
Constrained Optimization Direct Methods: Lagrange Multipliers, Kuhn-Tucker conditions, Beal's method, Indirect Method: Penalty Function and Applications			
4	**UNIT – IV**	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	**UNIT – V**	Total Hrs	9
Sequencing and Scheduling, Project Scheduling by PERT-CPM; Probability and cost consideration in Projectscheduling; Queuing Theory, Single and multi server models; Queues with combined arrivals and departures;Queues with priorities for service.			
Total hours to be taught			**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

<table>
<tr><td>CBIT</td><td colspan="8">Autonomous Regulation</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 colspan="9">Semester-I</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">ME 515</td><td rowspan="2">VIBRATION ANALYSIS AND CONDITION MONITORING</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>4</td><td>0</td><td>0</td><td>3</td><td>75</td><td>25</td><td>100</td></tr>
<tr><td>Objective (s)</td><td colspan="8">Familiarization with the basics of vibration measurement and application of the same for condition monitoring of machinery.</td></tr>
<tr><td>Outcome (s)</td><td colspan="8">Understand the failure types, investigation and occurrences and causes of failure.
Understand Single degree and multi degree of freedom systems.
Understand Steady state and transient characteristics of vibration.
Simple harmonic motion, periodic motion. Peak to peak, RMS and average values.
Linear and logarithmic scales and phase angle.
Vibration measuring instruments: transducers, signal conditioning elements.
Display and recording elements. Vibration meters and analyzers.
Frequency analysis and filters.
Vibration limits and standards.
Contaminant analysis, SOAP and other contaminant monitoring techniques.
Special methods of vibration measurement: change in sound and ultrasonic method.
Shock pulse, kurtosis, acoustic emission monitoring.
Cepstrum analysis, modal analysis, critical speed analysis.
Shaft orbit position analysis.</td></tr>
</table>

1	**UNIT-I**	**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	**UNIT-II**	**Total Hrs**	**9**

UNIT-II

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	**UNIT-III**	**Total Hrs**	**9**

Vibration measuring instruments, vibration transducers, signal conditioning elements. Display and recording elements. Vibration meters and analyzers

4	**UNIT-IV**	**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	**UNIT-V**	**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	**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.

References

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.*

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<tr><td>CBIT</td><td colspan="9">Autonomous Regulation</td></tr>
<tr><td>Department</td><td>Mechanical Engineering</td><td colspan="4">Programme Code & Name</td><td colspan="4">M.E. Thermal Engineering</td></tr>
<tr><td colspan="10">Semester-I</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">ME 516</td><td></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>ENGINEERING RESEARCH METHODOLOGY</td><td>4</td><td>0</td><td>0</td><td>3</td><td>75</td><td>25</td><td>100</td></tr>
<tr><td>Objective (s)</td><td colspan="8">Students should able to understand designing of research methodology regarding data collection and its design including sample design Students should able to apply basic statistical tools to understand the data being collected and application of appropriate statistical methodology. Students should able to draw interpretations and conclusions from the statistical analysis.</td></tr>
<tr><td>Outcome (s)</td><td colspan="8">Students can apply suitable data collection and analysis techniques for given problem.
Students can analyze any practical problem by selecting suitable statistical techniques.</td></tr>
</table>

1	**UNIT – I**	**Total Hrs**	**9**

Introduction: Scope of research, objective/motivation, characteristics and prerequisites of research. Research needs in engineering, benefits to the society in general.

2	**UNIT – II**	**Total Hrs**	**9**

Review of Literature: Role of review, search for related literature, online search, and web-based search conducting a literature search. Evaluating, Organizing, and synthesizing the literature.

Identifying and describing the research. Finding the research Problem. Sources of research problem. Criteria/Characteristics of a Good research

3	**UNIT – III**	**Total Hrs**	**9**

The Nature and role of Data in Research. Linking Data and Research Methodology. Validity of Method. Planning for Data collection. Choosing a Research Approach. Use of Quantitative / Qualitative Research Design. Feasibility of Research Design. Establishing Research Criteria. Justification of Research Methodology. Research Proposal preparation. Characteristics of a proposal. Formatting a research proposal. Preparation of proposal. Importance of Interpretation of data and treatment of data.

4	**UNIT – IV**	**Total Hrs**	**9**

Exploring the data. Description and Analysis of Data. Role of Statistics for Data Analysis. Functions of Statistics, Estimates of. Population. Parameters. Parametric V/s Non Parametric methods. Descriptive Statistics, Points of Central tendency, Measures of Variability, Measures of relationship. Inferential Statistics-Estimation, Hypothesis Testing. Use of Statistical software.

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

5	**UNIT – V**	**Total Hrs**	**9**

Writing Format of the Research report. Style of writing report. References and Bibliography. Technical paper writing/Journal report

Total hours to be taught	45

Text book (s)

1	Paul D. Leedy and Jeanne E. Ormrod. “Practical Research: Planning and Design”, (8th Edition)
2	“A Hand Book of Education Research” - NCTE

Reference (s)

1	Sindhu, K.S. “ Methodology of Education Research” Sidhu
2	Kothari. C.R. “Research Methodology, Methods & Technique”:
3	Agarwal, Y.P. “Tests, Measurements and Research methods in Behavioral Statistical Methods”.
4	Box and Jenkins; “Time Series Analysis, Forecasting and Control”, Holden Day, Sanfrancisco
5	Holman, J.P. “Experimental Methods for Engineers”, McGraw Hill Int., New York.

CBIT	***Autonomous Regulation***								
Department	Mechanical Engineering		Programme Code & Name				M.E. CAD CAM		
Semester-I									
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks			
		L	T	P	C	E	I	Total	
ME517	**TRIBOLOGY IN DESIGN**	4	0	0	3	75	25	100	
Objective (s)	To impart knowledge in the friction , wear and lubrication aspects of machine components To understand the material properties which influence the tribological characteristics of surfaces. To understand the analytical behavior of different types bearings and design of bearings based on analytical /theoretical approach								
Outcomes	Ability to select material / surface properties based on the tribological requirements Methodology for deciding lubricants and lubrication regimes for different operating conditions Analysis ability of different types of bearings for given load/ speed conditions.								

1 **UNIT – I** **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 **UNIT – II** **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 **UNIT – III** **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 **UNIT – IV** **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 **UNIT – V** **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.

REFERENCES

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. S.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.

<table>
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<tr><td colspan="12">Semester-I</td></tr>
<tr><td>Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Hours/ Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">ME518</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>ADVANCED MECHANICS OF MATERIALS'</td><td>4</td><td>0</td><td>0</td><td>3</td><td>75</td><td>25</td><td>100</td></tr>
<tr><td>Objective (s)</td><td colspan="8">Understand the basic concepts of mechanics of materials and extend these for plates, curved members and non – circular sections.</td></tr>
<tr><td>Outcome (s)</td><td colspan="8">With the knowledge achieved through this subject, students will be able to apply these concepts of advanced mechanics of materials to various cross section that is subjected to various load where contact stresses are included in the structures.</td></tr>
<tr><td>1</td><td colspan="6">UNIT – I</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="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.</td></tr>
<tr><td>2</td><td colspan="6">UNIT – II</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Location of shear center for various thin sections - shear flows. Stresses and Deflections in beams subjected to unsymmetrical loading-kern of a section.</td></tr>
<tr><td>3</td><td colspan="6">UNIT – III</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="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</td></tr>
<tr><td>4</td><td colspan="6">UNIT – IV</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Torsion of rectangular cross section - St.Venants theory - elastic membrane analogy - Prandtl's stress function - torsional stress in hollow thin walled tubes.</td></tr>
<tr><td>5</td><td colspan="6">UNIT – V</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="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.</td></tr>
</table>

REFERENCES

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***		
Department	Mechanical Engineering	Programme Code & Name	M.E. (CAD/CAM)

Semester-I

Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	E	I	Total
ME 519	**MECHANICS OF COMPOSITE MATERIALS**	4	0	0	3	75	25	100

Objective (s)

An ability to identify the properties of fiber and matrix materials used in commercial composites, as well as some common manufacturing techniques.
An ability to predict the elastic properties of long fiber composites based on the constituent properties.
An ability to rotate stress, strain and stiffness tensors using ideas from matrix algebra.
A basic understanding of linear elasticity with emphasis on the difference between isotropic and anisotropic material behavior.
An ability to analyze a laminated plate in bending, including finding laminate properties from lamina properties.
An ability to predict the failure strength of a laminated composite plate.
Knowledge of issues in fracture of composites and environmental degradation of composites.
An exposure to recent developments in composites, including metal and ceramic matrix composites.
An ability to use the ideas developed in the analysis of composites towards using composites in industrial application.

Outcome (s)

At the end of the course, student should able to analyze the composite materials.
Should apply the knowledge gained to design and develop composite structures.

1	**UNIT-I**	**Total Hrs**	**9**

Introduction: Fibres, Matrix materials, interfaces, polymer matrix composites, metal matrix composites, ceramic matrix composites carbon fibre composites.

2	**UNIT-II**	**Total Hrs**	**9**

Micromechanics of Composites:
Mechanical properties: Prediction of Elastic constant, micromechanical approach, Halpin-Tsai equations, Transverse stresses. Thermal properties: Hygrothermal stresses, mechanics of load transfer from matrix to fibre.

3	**UNIT-III**	**Total Hrs**	**9**

Macromechanics of Composites:
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	**UNIT-IV**	**Total Hrs**	**9**

Strength, fracture, fatigue and design:
Tensile and compressive strength of unidirectional fibre composites, fracture modes in composites: Single and multiple fracture, 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	**UNIT-V**	**Total Hrs**	**9**

Analysis of plates and stress:
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	**45**

Text book (s)

1. Jones, R.M., *Mechanics of Composite Materials, Mc Graw Hill Co., 1967.*
2. Calcote, L.R., *The Analysis of Laminated Composite Structures,* Van Nostrand, 1969.

References

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***								
Department	Mechanical Engineering	Programme Code & Name				M.E. (CAD/CAM)			
Semester-I									
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks			
		L	T	P	C	E	I	Total	
ME 520	**THEORY OF ELASTICITY AND PLASTICITY**	4	0	0	3	75	25	100	
Objective (s)	Students should able to solve the problems selected to stress-strain tensors and an constitutive relations. Students should be able to apply suitable plasticity relations to solve the problems in various metal forming operations.								
Outcome (s)	Students can analyze a simple loading condition in practice and come out the state of stress induced in the member. Students can find force requirement in any forming operation such as forging, extrusion, wire drawing, rolling etc.								

1	**UNIT-I**	**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	**UNIT-II**	**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	**UNIT-III**	**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	**UNIT-IV**	**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	**UNIT-V**	**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			**45**

Text book (s)	
1	Timoshenko and Goodieer, *Theory of Elasticity*, Mcgraw Hill Publications 3rd Edition,
2	Madleson, *Theory of Plasticity,*
References	
1	J. Chakrabarty, *Theory of Plasticity, 2nd* edition, McGraw Hill Publications 1998
2	George E Dieter, *Mechanical Metallurgy,* McGraw Hill Publications 1988

CBIT	***Autonomous Regulation***							
Department	Mechanical Engineering	Programme Code & Name				M.E. (CAD/CAM)		
Semester-I								
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	E	I	Total
ME 521	**EXPERIMENTAL TECHNIQUES AND DATA ANALYSIS**	4	0	0	3	75	25	100
Objective (s)	To get acquainted with improving quality of product/ process by studying various parameters. To gain the knowledge regarding improvement of productivity							
Outcome (s)	Students can suggest suitable measurement technique for given a scenario. Students can able to apply suitable methodology for a given problem.							

1	**UNIT-I**	**Total Hrs**	**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.			
2	**UNIT-II**	**Total Hrs**	**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.			
3	**UNIT-III**	**Total Hrs**	**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.			
4	**UNIT-IV**	**Total Hrs**	**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.			
5	**UNIT-V**	**Total Hrs**	**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.			
Total hours to be taught			**45**

Text book (s)	
1	1. Holman, J.P.: *Experimental Methods for Engineers,* McGraw Hill Int., New York.
2	2. Venkatesh, V.C., and Chandrasekharan, *Experimental Methods in Metal Cutting*, Prentice Hall of India, Delhi.
References	
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.
	Tapan P. Bagchi, *Taguchi Methods Explained,* Prentice Hall of India, Delhi.

CBIT	***Autonomous Regulation***							
Department	Mechanical Engineering	Programme Code & Name			M.E. (CAD/CAM)			
Semester-I								
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	E	I	Total
ME 522	**DESIGN FOR MANUFACTURE**	4	0	0	3	75	25	100
Objective (s)	To provide understanding of manufacturing processes and design concepts To make the students understand the linkage required between design and manufacturing.							
Outcome (s)	Ability to design suitable manufacturing process .Capable of designing metallic & non metallic components							

1	**UNIT-I**	**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	**UNIT-II**	**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	**UNIT-III**	**Total Hrs**	**9**
Non Metallic Components Design: Thermosetting plastic, injection moulded and rotational moulded parts, blow moulded, welded plastic articles, ceramics.			
4	**UNIT-IV**	**Total Hrs**	**9**
Assembled Parts Design: Welded parts, arc, resistance, brazed and soldered parts, gear box assembly, bearing assembly.			
5	**UNIT-V**	**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			**45**

Text book (s)	
1	1. James G. Bralla, "*Hand book of product design for manufacturing*" McGraw Hill Co., 1986
2	2. K.G. Swift "*Knowledge based design for Manufacture*", Kogan page Limited, 1987.

CBIT	***Autonomous Regulation***							
Department	Mechanical Engineering	Programme Code & Name				M.E. (CAD/CAM)		
Semester-I								
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	E	I	Total
ME 523	**DATA BASE MANAGEMENT SYSTEMS**	4	0	0	3	75	25	100
Objective (s)	Knowledge of DBMS, both in terms of use and implementation/design Application of DBMS to various mechanical engineering processes.							
Outcome (s)	To get awareness of different types of databases How to use data base systems to mechanical engineering							

1	**UNIT-I**	**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.			
2	**UNIT-II**	**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.			
3	**UNIT-III**	**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.			
4	**UNIT-IV**	**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.			
5	**UNIT-V**	**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			**45**

Text book (s)	
1	1. Korth, H.F. Silbenhatz, A., *Database Concepts,* Mc Graw Hill, 1986.
2	2. Gio Wiederhold, *Database Design,* Mc Graw Hill, 1983.
References	
1	Whitney, I.M. Daniel, R.B. Pipes, *Experimental Mechanics of Fibre Reinforced Composite Materials,* Prentice Hall, 1984.
2	3. Jefferey O Ullman, *Principles of database systems.*
3	4. C.J. Date, *An Introduction to database systems,* Addison Wisely, 1980.
	5. Trembley and Soreson, *An Introduction to Data structures with applications,* Mc Graw Hills.

CBIT	***Autonomous Regulation***								
Department	Mechanical Engineering	Programme Code & Name				M.E. (CAD/CAM)			
Semester-I									
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks			
		L	T	P	C	E	I	Total	
ME 524	**FRACTURE MECHANICS**	4	0	0	3	75	25	100	
Objective (s)	The course introducer the concept of ductile and brittle fracture followed by fundamentals of elastic plastic fracture mechanics. As an extension, numericals are solved to understand fracture parameters such as strain energy release rate, fracture toughness, crack propagation rate.								
Outcome	Due to cabin pressurization and depressurization, aircraft structures are subjected to fatigue conditions and the concepts inherited through "Fracture Mechanics" can be applicable to solve real time problems.								

1	**UNIT-I**	**Total Hrs**	**9**
Introduction: Crack in a Structure – Griffth Criterion – Cleavage fracture – Ductile fracture – Fatigue Cracking. Service failure analysis.			
2	**UNIT-II**	**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	**UNIT-III**	**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	**UNIT-IV**	**Total Hrs**	**9**
Elastic Plastic Fracture Mechanics: Elastic plastic fracture concept – Crack tip opening displacement – J-integral technique; Determination of J-using FEM.			
5	**UNIT-V**	**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			**45**

Text book (s)	
1	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.
References	
1	2. Jean Cemative and Jean Louis Chboche Mechanics of Solid Materials, Cambridge University Press, Cambridge, 1987.

CBIT	***Autonomous Regulation***							
Department	Mechanical Engineering	Programme Code & Name			M.E. (CAD/CAM)			
Semester-I								
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	E	I	Total
ME 525	**DESIGN OF PRESS TOOLS**	4	0	0	3	75	25	100
Objective (s)	To make the students understand the basic concepts involved in designing press tools. To make students capable of designing various press tools which are safe, easy to operate, reliable and economical for manufacturing.							
Outcome (s)	The students will understand the basic concepts and principle involved in designing press tools, The students will be in a position to independently design various press tools which will cater to requirement of industry.							

1	**UNIT-I**	**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	**UNIT-II**	**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	**UNIT-III**	**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	**UNIT-IV**	**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	**UNIT-V**	**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			**45**

Text book (s)	
1	1. *Fundamentals of tool Design* – ASTME, Prentice Hall, New Delhi, 1987
2	2. *Die design Hand book* – AISME, Mc Graw Hills, New York, 1965
References	
1	3. Heinrich Makelt, *Mechanical Presses*, Edward Arnold, London, 1968.
2	4. Serope Kalpakjain, *Mechanical Processing in Materials*, 1967.
3	5. Javoronkov V.A and Chaturvedi. *R.C. Rolling of Metals*.
	6. Eary and Redds, *Shear Working of Metals*, Prentice Hall, New Delhi, 1969. 7. Honeyeeme R.W.K., *The plastic Deformation of metals*, Edward Arnold, London, 1968. 8. Kamenschikov, *Forging Practice*, Mir. Pub., Moscow, 1968. 9. *High Velocity Forming of metals,* ASME, Michigan, 1968. 10. Bhattacharya.A, *New Technology*, Institute of Engineers, Calcutta, 1973.

<table>
<tr><td>CBIT</td><td colspan="8">Autonomous Regulation</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 colspan="9">Semester-I</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">ME 526</td><td></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>DESIGN OF DIES</td><td>4</td><td>0</td><td>0</td><td>3</td><td>75</td><td>25</td><td>100</td></tr>
<tr><td>Objective (s)</td><td colspan="8">To make students understand the various steps and procedure involved in designing and manufacturing dies.
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">The students will understand the procedure involved in designing and manufacturing of dies.
The student will be in a position to independently design dies required for the industry.</td></tr>
</table>

1	**UNIT-I**	**Total Hrs**	**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.

2	**UNIT-II**	**Total Hrs**	**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.

3	**UNIT-III**	**Total Hrs**	**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.

4	**UNIT-IV**	**Total Hrs**	**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.

5	**UNIT-V**	**Total Hrs**	**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.

Total hours to be taught	**45**

Text book (s)

1	1. Rusinoff S.E., *Forging & Forming Metals*, Taraporewala, Bombay, 1952.
2	2. Dochlar H.H., *Die Casting Dies*, Mc Grawhill, 1951.

References

1	3. I.S. Standards, BSI., New Delhi.
2	4. Pye R.G.W., *Injection Mould Design*, Longman scientific & Technical Publishers, London, 1989.

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	
ME 602	**COMPUTATIONAL FLUID DYNAMICS**	4	0	0	3	75	25	100	
Objective (s)	To create the awareness of the importance of principles of fluid dynamics in engineering applications such as aerodynamic, heat transfer, turbo-machinery etc,.								
Outcome (s)	To enable to the students to visualize the characteristics of different flows. To interpret the results obtained by the commercial software.								

1	**UNIT – I**	**Total Hrs**	**9**
Continuity, Momentum and Energy equations, Navier Stokes equations, Reynolds and Favre averaged N – S equations. Differential equations for steady and unsteady state heat conduction. Differential equations for diffusion. Introduction to turbulence, Turbulence models-mixing length model, K-ε turbulence Model.			
2	**UNIT – II**	**Total Hrs**	**9**
Elliptic, parabolic and hyperbolic equations, Initial and boundary value problems. Concepts of Finite difference methods – forward, backward and central difference. Errors, Consistency, Stability analysis by von Neumann. Convergence criteria.			
3	**UNIT – III**	**Total Hrs**	**9**
Grid Generation- Types of grid O,H,C. Coordinate transformation, algebraic methods. Unstructured grid generation			
4	**UNIT – IV**	**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	**UNIT – V**	**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	Pradip Niyogi, Chakrabartty S.K, Laha M.K., 'Introduction to Computational Fluid Dynamics', Pearson Education, 2005.
2	Muralidhar K, Sundararajan T, 'Computational Fluid flow and Heat transfer', Narosa Publishing House, 2003**.**
Reference(s):	
3	John D Anderson, 'Computational Fluid Dynamics', Mc Graw Hill, Inc., 1995**.**
4	Patankar, S.V, 'Numerical Heat transfer and Fluid flow', Hemisphere Publishing Company, New York, 1980.
5	Chung, T J, 'Computational Fluid Dynamics, Cambridge University Press, 2002.

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<tr><td></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>ME 527</td><td>RAPID PROTOTYPING PRINCIPLES AND APPLICATIONS</td><td>4</td><td>0</td><td>0</td><td>3</td><td>75</td><td>25</td><td>100</td></tr>
<tr><td>Objective (s)</td><td colspan="8">To make students understand the basic concepts of various rapid prototyping technologies. To understand and apply criterion for selecting appropriate RPT technique for any given application.</td></tr>
<tr><td>Outcome (s)</td><td colspan="8">1. Describe various CAD issues for rapid prototyping and related operations for STL model manipulation, formulate and solve typical problems on reverse engineering for surface reconstruction from physical prototype models through digitizing and spline-based surface fitting.
2.explain and summarize the principles and key characteristics of RP technologies and commonly used RP systems: & explain and summarize typical rapid tooling processes for quick batch production of plastic and metal parts.</td></tr>
</table>

1	**UNIT-I**	**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	**UNIT-II**	**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	**UNIT-III**	**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	**UNIT-IV**	**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 3 D doctor.

5	**UNIT-V**	**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	**45**

Text book (s)

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

References

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

CBIT	***Autonomous Regulation***								
Department	Mechanical Engineering	Programme Code & Name				M.E. (CAD/CAM)			
Semester-I									
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks			
ME 528		L	T	P	C	E	I	Total	
	FLEXIBLE MANUFACTURING SYSTEMS	4	0	0	3	75	25	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 crediting the subject, the implementation of FMS is understood by the student. Students can independently develop the sequence of operations that are to be performed for manufacturing of a product and understand the functioning of programmable logical controller.								

1	**UNIT-I**	**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	**UNIT-II**	**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	**UNIT-III**	**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	**UNIT-IV**	**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	**UNIT-V**	**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	**45**

Text book (s)

1	1. Parrish, D.J., '*Flexible Manufacturing*', - Butter Worths – Heinemann, Oxford, 1993.
2	2. Groover, M.P., '*Automation, Production Systems and CIM*', - Prentice Hall India, 1989.
	References
1	3. Kusiak, A., '*Intelligent Manufacturing Systems*', - Prentice Hall, 1990.
2	4. Considine,D.M., & Considine,G.D., '*Standard Handbook of Industrial Automation*',-Chapman & Hall, 1986
3	5. Ranky, P.G., '*Design and Operation of FMS*', - IFS Publishers, UK, 1988

CBIT	***Autonomous Regulation***								
Department	Mechanical Engineering	Programme Code & Name				M.E. (CAD/CAM)			
Semester-I									
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks			
		L	T	P	C	E	I	Total	
ME 529	**NON-TRADITIONAL MACHINING AND FORMING**	4	0	0	3	75	25	100	
Objective (s)	To make the students understand the need and the applications of nontraditional machining processes. Students should able to choose the NTM processes for particular applications								
Outcome (s)	Students can select economical and feasible process for given an application. Students can compare different processes for given application based on metal removal rate and surface finish requirements.								

1	**UNIT-I**	**Total Hrs**	**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.

2	**UNIT-II**	**Total Hrs**	**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

3	**UNIT-III**	**Total Hrs**	**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.

4	**UNIT-IV**	**Total Hrs**	**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
Ion Beam Machining: Introduction-Mechanism of metal removal and associated equipment-process characteristics applications

5	**UNIT-V**	**Total Hrs**	**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.

Total hours to be taught	**45**

Text book (s)	
1	1. New Technology Institution of Engineers - Bhattacharya - India
2	2. Production Technology - HMT - Tata Mc Graw Hill - ISBN-10;

References	
1	7. Modern Manufacturing Method - Adithan - New Age International (p) Limited –
2	8. Modern Machining Processes - P.K. Mishra - Narosa Publishing House, New Delhi - 1997.

<table>
<tr><td>CBIT</td><td colspan="8">Autonomous Regulation</td></tr>
<tr><td>Department</td><td>Mechanical Engineering</td><td colspan="3">Programme Code & Name</td><td colspan="4">M.E. (CAD/CAM)</td></tr>
<tr><td colspan="9">Semester-I</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">ME 530</td><td rowspan="2">PRODUCT DESIGN AND PROCESS PLANNING</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>4</td><td>0</td><td>0</td><td>3</td><td>75</td><td>25</td><td>100</td></tr>
<tr><td>Objective (s)</td><td colspan="8">To enable students gain knowledge about procedure of designing and manufacturing new products.
To understand agronomical principles and make use of computers as tool in making an effective designing and manufacturing products.</td></tr>
<tr><td>Outcome (s)</td><td colspan="8">Apply coherent and advance knowledge of product design engineering in diverse contexts and applications using critical thinking and judgment. Safely apply a range of production skill and processes to make the product design, by managing time, and utilize the resources effectively and efficiently.
Apply new and emerging technology, material and processes and their influence on product design.
Design a product using suitable materials with the intention of improving acpects of the products aesthetics, functionality, quality.</td></tr>
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<table>
<tr><td>1</td><td>UNIT-I</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="4">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.</td></tr>
<tr><td>2</td><td>UNIT-II</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="4">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.</td></tr>
<tr><td>3</td><td>UNIT-III</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="4">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.</td></tr>
<tr><td>4</td><td>UNIT-IV</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="4">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.</td></tr>
<tr><td>5</td><td>UNIT-V</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="4">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.</td></tr>
<tr><td colspan="3">Total hours to be taught</td><td>45</td></tr>
<tr><td colspan="4">Text book (s)</td></tr>
<tr><td>1</td><td colspan="3">1. Niebel, B.W., and Draper, A.B., Product design and process Engineering, Mc Graw Hill – Kogalkusha Ltd., Tokyo, 1974.</td></tr>
<tr><td>2</td><td colspan="3">2. Chitale, A.K, and Gupta, R.C., Product Design and Manufacturing, Prentice Hall of India Pvt. Ltd., New Delhi, 2004.</td></tr>
<tr><td colspan="4">References</td></tr>
<tr><td>1</td><td colspan="3">3. Mahajan, M. Industrial Engineering and Production Management, Dhanpath Rai & Co., 2000.</td></tr>
</table>

ME 551

CAD/CAM LABORATORY

Instruction	3 periods/week
Sessional	50 Marks

Objectives:

1. Be able to produce CAD drawings which communicate the appropriate manufacturing details, standards, and specifications.
2. Have the ability to effectively communicate with others using oral, written, and graphical methods and procedures.
3. Be able to function effectively on teams or on group projects and assume leadership roles when appropriate.
4. Perform in a professional and ethical manner and maintain currency in technological advancements.

Outcomes:

1. Solve design and manufacturing problems using sound engineering principles and practices.
2. Produce CAD drawings which communicate the appropriate manufacturing details, standards, and specifications.
3. Effectively communicate with others using verbal, written, and graphical methods and procedures.
4. Function effectively on teams or on group projects, and assume leadership roles when appropriate.
5. Perform in a professional and ethical manner and maintain currency in technological advancements.
6. Info management (computer & research skills appropriate to degree level and type).
7. Written and oral communication (appropriate to degree level and type).
8. Critical thinking (problem solving, reasoning skills appropriate to degree level and type).

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
8. Assembly operations - part modifications, adding another assembly features – display.

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

ME 5552

COMPUTATIONAL LABORATORY

Instruction	3 periods / week
Sessional	50 Marks

Objective: Computation lab introduces various elements that are used to model real time structures that find application in daily life. The course will cover a wide range of elements starting from link, beam, plane, solid and shell elements for structural, thermal and vibration analysis. Link element is used to represent transmission tower. Columns and bridges use beam elements. To model plane stress and plane strain cases in a plate, plane, solid and shell elements are selected. The later part of the course will deal with the analysis of solidification of casting, thermal analysis and explicit dynamics. All these simulations are carried out in ANSYS.

Outcomes: The inputs in this lab can be extended to complicated structures that find application in automobile and aerospace industry

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 of two bodies.
15. Drop test of a container (Explicit Dynamics).