B.E Semester: VI Mechanical Engineering

Subject Name: Computer Aided Design

A. Course Objective

- To present a problem oriented in depth knowledge of Computer Aided Design and Optimization.
- To address the underlying concepts, methods and application of CAD.

B. Teaching / Examination Scheme

SUBJECT		Teaching Scheme				Total Credit	Evaluation Scheme					Total Marks
		L	T	P	Total		THEORY		IE	CIA	PR. / VIVO	
CODE	NAME	Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	
ME603	Computer Aided Design	4	0	2	6	5	3	70	30	20	30	150

C. Detailed Syllabus

1. PRINCIPLES OF COMPUTER GRAPHICS: Introduction, graphic primitives, point plotting, lines, Bresenham's circle algorithm, ellipse, transformation in graphics, coordinate systems, view port, 2D and 3D transformation, hidden surface removal, reflection, shading and generation of characters.
2. CAD TOOLS: Definition of CAD Tools, Types of system, CAD/CAM system evaluation criteria, brief treatment of input and output devices. Graphics standard, functional areas of CAD, Modeling and viewing, software documentation, efficient use of CAD software.
3. GEOMETRIC MODELLING: Types of mathematical representation of curves, wire frame models wire frame entities parametric representation of synthetic curves her mite cubic splines Bezier curves B-splines rational curves
4. SURFACE MODELING: Mathematical representation surfaces, Surface model, Surface entities surface representation, parametric representation of surfaces, plane surface, rules surface, surface of revolution, Tabulated Cylinder.
5. PARAMETRIC REPRESENTATION OF SYNTHETIC SURFACES: Hermite Bicubic surface, Bezier surface, B- Spline surface, COONs surface, Blending surface Sculptured surface, Surface manipulation — Displaying, Segmentation, Trimming, Intersection, Transformations (both 2D and 3D).
6. GEOMETRICMODELLING-3D: Solid modeling, Solid Representation, Boundary, Representation (13-rep), Constructive Solid Geometry (CSG). CAD/CAM Exchange: Evaluation of data — exchange format, IGES data representations and structure, STEP Architecture, implementation, ACIS & DXF. Design Applications: Mechanical tolerances, Mass property calculations, Finite Element Modeling and Analysis and Mechanical Assembly.
7. OPTIMIZATION: General Characteristics of mechanical elements, adequate and optimum design, principles of optimization, formulation of objective function, design constraints, classification of optimization problems. Single and multivariable optimization techniques, Technique of unconstrained minimization Golden section, Random, Pattern and Gradient search methods, Engineering applications, structural-design application axial and transverse loaded members for minimum cost, maximum weight. Design of shafts and torsion members, design optimization of springs

8. Basic Concepts of FEA: Introduction, Weak formulations, Weighted residual methods, Variational formulations, weighted residual, collocation, sub domain, least square and Galerkin's method, virtual work principle, One Dimensional Problems: Basis steps, Discretization, Element equations, Linear and quadratic shape functions, Assembly, Local and global stiffness matrix and its properties, boundary conditions, penalty approach, multipoint constraints, Applications to solid mechanics, heat and fluid mechanics problems, axi-symmetric problems, Transient problems, Trusses, Beams and Frames, Two Dimensional Problems, Elasticity Problems, Scalar Field Problems.

D. Lesson planning

SR.NO	DATE/WEEK	UNIT NO	%WEIGHTAGE	TOPIC NO
1	1^{ST} , 2^{ND} , 3^{RD}	1,2	20	1,2
2	4^{TH} ,5^{TH} , 6^{TH}	3,4	20	3,4
3	7^{TH} ,8^{TH} , 9^{TH}	5,6	20	5,6
4	10^{TH} ,11^{TH} , 12^{TH}	7,8	20	7,8
5	13^{TH} ,14^{TH} , 15^{TH}	8	20	8

E. Instructional Method & Pedagogy

1. At the start of course, the course delivery pattern , prerequisite of the subject will be discussed
2. Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal weightage should be given to all topics while teaching and conduction of all examinations.
3. Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation.
4. One/Two internal exams may be conducted and total/average/best of the same may be converted to equivalent of 30 marks as a part of internal theory evaluation.
5. Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation.
6. Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overall internal evaluation.
7. The course includes a laboratory, where students have an opportunity to build an appreciation for the concept being taught in lectures.
8. Experiments shall be performed in the laboratory related to course contents. Proposed list of experiments are as follows.

1. Creation of working drawing, creating geometry, constraining the profile, extracting a part using tools, creating pattern of holes, translating rotating, mirroring, managing the specification tree.
2. Creating sheets and views, creating text and dimensions,
3. creating an assembly, moving components, assembling existing components, creating bill of materials, creating wire frame and surface geometry using generative shape design and sweep tools.
4. Import and export of drawing from other software.
5. Linear static analysis, Automatic calculation of rigid body modes, uses specified eigen value shift, lumped and consistent mass matrices.
6. Buckling analysis, Jacobi inverse iteration techniques.
7. Steady state harmonic response, mode superposition method,

8. Overall structural and damping, linear dynamic analysis, non linear static analysis, non- linear dynamic analysis.
9. Steady state heat transfer analysis problems.
10. Transient heat transfer analysis.
11. Familiarity with element library.
12. Defining Boundary conditions, multipoint constraint familiarity with different types of loads.
13. Solution techniques, direct and iterative solver.
14. Results and analysis.
15. Design optimization.
16. To demonstrate the Basic concepts of FEM.

9. Practical / Oral: The candidate shall be examined on the basis of term-work.

F. Students Learning Outcomes

- The student can identify different areas of Computer Aided Design.
- Can find the applications of all the areas in day to day life.

G. Recommended Demonstrate Materials

1. Mastering CAD/CAM / Ibrhim Zeid / Mc Graw Hill International. Edition
2. CAD/CAM by /Groover M.P., Pearson education
3. CAD/CAM Concepts and Applications by Alavala, PHI
4. CAD / CAM / CIM, Radhakrishnan and Subramanian, New Age
5. Principles of Computer Aided Design and Manufacturing by Farid Amirouche, Pearson
6. Optimization for Engineering Design Algorithms and Examples/ Kalyanamoy Deb/Prentice Hall of India.
7. Engineering Optimization -Theory and Practice/ Singerusu S. Rao/ New Age.
8. Optimum Design of Mechanical elements/ Johnson Ray C/ Wiley, John & Sons
9. Genetic Algorithms in search, Optimization and Machine/ Goldberg D. E. Addison/Wesley / NewYork..
10. Introduction to Optimum Design/Jasbir S. Arora/ Academic Press/ Everest/ 3
11. Reddy, J.N., "An Introduction to Finite Element Methods", 3rd Ed., Tata McGraw-Hill.
12. Rao, S.S., "The Finite Element Method in Engineering", 4th Ed.,Elsevier Science, 2005
13. Fish, J. and Belytschko, T., "A First Course in Finite Elements", 1st Ed., John Wiley and Sons, 2007
14. Chaskalovic, J., "Finite Element Methods for Engineering Sciences", 1st Ed., Springer, 2008
15. Huebner, K.H., Dewhirst, D.L., Smith, D.E. and Byrom, T.G., "The Finite Element Method for Engineers", 4th Ed., John Wiley and Sons. 2001.