GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3164103
Semester – VI
Subject Name: Modeling and Simulation

Type of course: Professional Elective Course
Prerequisite: None

Rationale: To provide an overview of how computers are being used in mechanical component design with the use of various CAD standards and to introduce the concepts of Mathematical Modelling of Engineering Problems using FEM with 2D scalar and vector variables problems respectively.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Modelling And Assembly:** Assembly modelling – interferences of positions and orientation – tolerance analysis-mass property calculations – mechanism simulation and interference checking	7
2	**Cad Standards:** Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images- Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc. - communication standards	8
3	**Introduction To Analysis:** Basic concepts of the Finite Element Method - Discretization -Meshing – Mesh refinement- Mesh Enrichment- Natural co-ordinate systems -Types of elements- Special Elements- Crack tip Element- Introduction to Analysis Software	9
4	**Two Dimensional Scalar Variable Problems:** Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems.	9
5	**Two Dimensional Vector Variable Problems:** Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements	7

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Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10%	**40%**	-	**10%**	**40%**	-

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill Publishing Co.2007
2. Rao, S.S., "The Finite Element Method in Engineering", 5th Edition, Butterworth Heinemann,2010.
3. Donald Hearn and M. Pauline Baker "Computer Graphics"'. Prentice Hall, Inc, 1996.
4. Foley, Wan Dam, Feiner and Hughes - "Computer graphics principles & practice" Pearson,2nd edition, 1995.
5. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and
6. Applications of Finite Element Analysis", 4th Edition, Wiley Student Edition, 2002.

Course Outcomes: After learning the course the students should be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	To know the basic concepts of modelling and assembly for different mechanical components.	20%
CO-2	To know the different types of CAD standards used in modeling of mechanical components	20%
CO-3	To know about basic concepts of FEA and analysis software for analyzing mechanical.	25%
CO-4	To know about different mathematical techniques used in finite element analysis to solve structural and thermal problems.	25%

List of Experiments:

1. Solid modeling of engineering components and assembly.
2. Determination of stresses and factor of safety in critical machine components by FEM and experimental validation of the results by strain measurement.
3. Dynamic analysis of chassis frame of an automobile.
4. Crash analysis of an automobile using FEA software.

5. Kinematic and dynamic analysis of mechanisms using mechanism analysis software.

Major Equipment needed:

1. Loading and strain measuring set up.
2. Workstation configuration computers

List of Open Source Software/learning website:

- AUTO-CAD software.
- KOM, DOM Analyser.
- IMPACT Analyser