SARVAJANIK UNIVERSITY

Sarvajanik College of Engineering and Technology

Bachelor of Technology

Mechanical Engineering Department
B. Tech. Semester VI

Course Name:	**Simulation Software Practice for Mechanical Engineering**	**Course Code:BTME13604**
Type of course:	**Professional Core Course**	
Prerequisite:	Strength of Materials, solid modelling	
Rationale of Course:	This course will enable the students to apply knowledge of mathematics, science, and engineering to identify, formulate, and solve engineering problems by computer modelling and simulation software tools.	

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	50
0	0	2	1	--	--	--	30	20	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Contents:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	**Introduction to Finite Element Analysis (FEA) Software:** Introduction to CAD/CAM/CAE, introduction to FEM, FEA and CFD, history of FEA, types of engineering analysis, analytical and numerical FEA, necessity of FEA, system requirements, FEA software, GUI of simulation software tools, general procedure of conducting FEA, Pre-processing, Solution, Post-processing, capabilities of simulation software tools.	**2**	**5%**

Sr. No.	Topics	Teaching Hrs.	Module Weightage
2	**Part Modeling in Design Modeler and Meshing:** Introduction to modeling, modeling techniques, introduction to Design Modeler window, creating and importing model, necessity of meshing, mesh generation, global mesh settings, local mesh settings, defining manual contacts, defining and assigning materials, boundary conditions, defining joints and joints loads.	**6**	**20%**
3	**Parametric Design Language Analysis:** Geometry creation, geometry import, coordinate systems, element attributes, meshing, material properties, boundary conditions, solvers, post-processing, static structural analysis, modal analysis, thermal analysis, introduction to non-linear analysis.	**6**	**20%**
4	**Theory of Modal Analysis:** Introduction to modal analysis, need of modal analysis, theory of harmonic analysis, harmonic response analysis using mode superposition method, theory of random vibration analysis, theory of response spectrum analysis, response spectrum analysis, theory of explicit dynamic analysis.	**6**	**20%**
5	**Theory of Structural Analysis:** Theory of static structural analysis, linear vs. nonlinear static analyses, theory of transient structural analysis, axi-symmetric theory and analysis, theory of inertia relief analysis, theory of eigenvalue buckling analysis, theory of fatigue analysis, theory of explicit dynamic analysis, theory of topology optimization.	**4**	**15%**
6	**Theory of Thermal and Fluid flow Analysis:** Theory of steady state thermal analysis, theory of transient thermal analysis, CFD simulation, incompressible and compressible fluid flow analysis, convective heat transfer analysis, multiphase fluid flow analysis.	**6**	**20%**

Percentage Distribution of Marks as per Bloom's Taxonomy (Theory/Practical):

% Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
15	**20**	**25**	**20**	**10**	**10**

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create
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 from above table.

Reference Books:

Sr. No.	Title of book /article	Author(s)	Publisher	Publication Year	Publication Edition
1.	Fundamentals of Finite Element Analysis	David Hutton	McGraw Hill	2017	1st
2.	Finite Element Analysis in engineering	S.md.jalaludeen	Anuradha Pubilications	2016	2nd
3.	A First Course in the Finite Element Methods	Logan daryl L.	Cengage Learning India Private Limited	2016	6th
4.	ANSYS Mechanical APDL for Finite Element Analysis	Mary Kathryn Thompson, John M. Thompson	Butterworth-Heinemann	2017	1st
5.	Finite Element Analysis	G Lakshmi Narasaiah	BS Publications	2020	2nd

Course Outcomes (CO's):

CO. No.	CO Statements After learning this subject, students will be able to	Marks % weightage
CO-1	Identify the features available in Finite Element Analysis (FEA) software.	5
CO-2	Evaluate computer-aided design models and assemblies based on critical thinking and problem-solving skill.	20
CO-3	Review and apply finite element methods for the analysis of components.	20
CO-4	Prepare optimum design and analyzing a component.	20
CO-5	Solve structural analysis problems.	15
CO-6	Develop a solution for fluid flow problems using a CFD solver.	20

Mapping of (CO's) with Program Outcomes (PO's) and Program Specific Outcomes (PSO's):

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	3	2	1	2	2	2	2	1	1	1	1	1	3	2	1
CO-2	2	2	3	2	3	2	1	1	1	1	1	1	2	3	2
CO-3	3	2	3	2	3	2	1	1	1	1	1	1	2	3	2
CO-4	2	2	3	2	2	1	1	1	1	1	2	1	1	2	2
CO-5	2	2	3	2	3	2	2	1	2	1	1	1	2	3	2
CO-6	2	1	3	2	3	2	2	1	1	1	1	1	2	3	2
Rationale*	**14**	**11**	**16**	**12**	**16**	**11**	**9**	**6**	**7**	**6**	**7**	**6**	**12**	**16**	**11**

Rationale - Mapping of CO's with PO's and CO's with PSO's:

It states that the course will give basic understanding of engineering knowledge, design and development of solutions by using modern tool usage with real life problems. Students will able to design and analyze different mechanical systems with the aid of current computing and analysis software in their professional life.

This course highly maps with Program outcomes 1, 2, 3,4,5,6 and Program Specific Outcomes 2. It states that the course will develop engineering knowledge, problem analysis, design / development of solutions, conduct investigations of complex problems, modern tool usage, the engineer and society and finally it will lead to with the use of modern computing tools.

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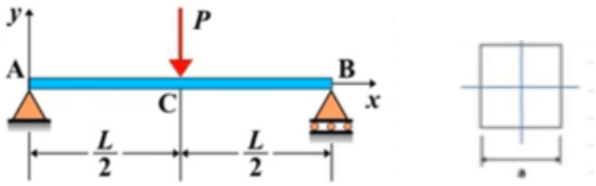
List of Practical:

1. Exercise for FEA of 1-D and 2-D structural problems.
2. Exercise for FEA of Truss and Beam Element.
3. Exercise for FEA of 1-D thermal and fluid problems.
4. Design and analyse for Rectangular bar profile with a center hole in static structural simulation.
5. Exercise for Steady state thermal analysis of a simple plate.
6. Determine the displacements and stresses in a Structural components for Random Vibration Analysis.
7. Design, analyse and optimize for Car Model for crash analysis using Explicit Dynamic.
8. Exercise for topology optimization in a Bracket.
9. Solve cantilever beam problem and compare the result of analytical and static structural simulation method.
10. Perform Modal analysis for Structural components.
11. Flow simulation through channel/enclosure/over bodies.

Student Activities:

1. Compare the result of analytical and simulation method for the problem stated below;

A simply supported beam AB is subject to a constant distributed load P over the section AB, a concentrated force P at point C. The cross section of the square beam (40x40) is shown below.
The parameters are as below;
Length of beam (L): 1000 mm; Line pressure load on beam (P): 5 N/mm; Youngs Modulus (E): 210000 N/mm$^{2;}$ Distance from neutral axis to extreme fibers (c): 20 mm; Moment of inertia (I): 213333 mm^4; Section modulus (Z): 10667 mm^3.



Calculate displacement, stress and shear force by analytical and simulation approach.

2. Perform a 2D linear elastic static analysis of a plate with a hole.
3. Prepare report for Transient thermal analysis of Heat sink.
4. Presentation of Modal and Random Vibration Analysis for square channel.
5. Flow & Heat transfer simulation for various engineering applications.

Major Equipment:

1. Computational facilities

List of Open Source/learning website:

- https://www.ualberta.ca/index.html
- https://courses.ansys.com/
- https://nptel.ac.in/courses/105105041
- https://nptel.ac.in/courses/112104193
- https://nptel.ac.in/courses/112104205
- https://www.mscsoftware.com/training-materials
- https://www.ansys.com/en-in/academic/learning-resources
- http://expertfea.com/tutorials.html
- https://www.simuleon.com/abaqus-tutorials/
- https://altairuniversity.com/modeling/hypermesh-related/
- https://discoveryforum.ansys.com/
- https://www.cfd-online.com/

List of Software: 3D Modeling and simulation Software