SARVAJANIK UNIVERSITY

Sarvajanik College of Engineering and Technology

Bachelor of Technology

Mechanical Engineering Department

B. Tech. Semester VII

Course Name : Finite Element Method **Course Code: BTME15602**

Type of course : Open Elective

Prerequisite : Computer Aided Design and Numerical Methods for Mechanical Engineers

Rationale of course : This subject will provide the basic principles of finite element analysis procedure also theory and characteristics of finite elements that represent engineering structures.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	100
3	0	0	3	60	25	15	0	0	

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 the course.

Content:

Sr. No.	Content	Total Hrs	Module Weightage
1	**Introduction:** Historical Background, mathematical modeling of field problems in engineering, governing equations, relevance and scope of finite element methods, application of FEM, natural and essential boundary conditions, rayleigh-ritz method, FEM procedure, discretization of domain, element shapes, types, size.	09	20
2	**Element Properties:** Natural Coordinates, shape functions and characteristics, triangular elements, rectangular elements, lagrange elements, solid elements.	07	15

3	**One Dimensional Elements:** Elimination and penalty approach, properties of global stiffness matrix, structural and thermal strains, treatment for various boundary conditions, formulation of truss element, plane truss: stiffness and force matrix, beam, euler – bernoulli element formulation, plane frames, various loading and boundary conditions.	**11**	**25**
4	**Two Dimensional Elements:** Triangular (CST, LST): shape function, jacobian matrix, strain-displacement matrix, stress-strain relationship matrix, force vector, Quadrilateral Elements (Q4, Q8): shape function, jacobian matrix, strain-displacement matrix, stress-strain relationship matrix, force vector.	**09**	**20**
5	**Thermal and Fluid Problems:** Steady state heat transfer: element formulations, treatment to boundary conditions with application to 1-D heat conduction, heat transfer through thin fins, potential flow problems.	**09**	**20**

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

Percentage Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
15	**25**	**25**	**20**	**10**	**05**

Legends: R: Remembrance, **U:** Understanding, **A:** Application**, N:** Analyze, **E:** Evaluate**, C:** Create and above Levels

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:

Sr. no.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1	CAD / CAM and Automation	Farazdak Haidery	Nirali Prakashan	2015	9th
2	A first course in Finite Element Method	D.L. Logan	Thomson Asia Pvt. Ltd	2016	6th
3	Introduction to Finite Elements Engineering	T. R. Chandrupatla and A. D. Belegundu	Pearson Education	2015	4th
4	Finite Element Analysis	S. S. Bhavikati	New Age International Publishers	2015	3rd
5	Introduction to Finite Element Method	J.N. Reddy	McGraw Hill	2020	4th

Course Outcomes (CO's):

CO No.	CO Statement After learning this subject, students will be able to	Marks % Weightage
CO-1	Explain the fundamentals of finite element method.	10
CO-2	Formulate the equations of different elements in finite element methods.	20
CO-3	Apply finite element method for bar and truss applications.	25
CO-4	Solve 2-D finite element problems involving triangular, quadrilateral elements.	25
CO-5	Apply the knowledge of FEM for heat transfer analysis and flow analysis.	20

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	2	1	0	0	1	0	0	0	0	0	0	0
CO-2	3	3	2	1	1	0	0	0	1	1	0	1
CO-3	3	3	2	2	3	1	1	0	1	0	0	1
CO-4	3	3	1	1	3	0	0	0	1	1	0	1
CO-5	3	3	3	2	3	1	0	0	1	0	1	1
Rationale*	14	13	8	6	11	2	1	0	4	2	1	4

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

It will help to give basic understanding of finite element method apply to solve various material characteristics of engineering components, develop the problem analysis skill in students as they are able to correlate with real life problems.

This course highly maps with Program outcomes 1,2,3,4,5. It states that the course will develop Engineering knowledge, Problem analysis, Design / development of solutions, Conduct investigations of complex problems, Modern tool usage.

Assignments to be given as per the requirement of the course.

List of Open learning website:

1) https://nptel.ac.in/courses/112104193
2) https://nptel.ac.in/courses/112104116

List of Open Source Software:

1. Open source FEA software