SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and Technology
Master of Technology
Structural Engineering

M. Tech. I Semester I

Subject Name: Advanced Structural Analysis **Subject Code:** MTST13101

Type of course: Core-I
Prerequisite: Theory of Structures, Structural Analysis, Matrix Algebra
Rationale: This course shall provide the knowledge of advanced methods of structural analysis which is a need of current era of rapid growth in technological development. Because of the comprehensive approach of structural analysis, the matrix method is having great advantage over traditional methods. To solve the complex problems of structural analysis, the finite element method can also be used.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	150
3	0	2	4	60	25	15	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

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
	Unit:1 A member stiffness matrix approach		
1.	Introduction to structural analysis: Structural elements, Joints, Supports, Stability, Indeterminacy of Structures (Degree of Freedom). Principle of Virtual work. Flexibility & Stiffness.	02	5%
2.	Coordinate systems, Development of member stiffness matrix, Global stiffness matrix, Boundary conditions, Displacement vectors, Load vectors, Transformation of Matrices. Analysis of Continuous beams and Plane Trusses including secondary effects such as Temperature changes and End-displacements.	09	20%
3.	Coordinate systems, Development of member stiffness matrix, Global stiffness matrix, Boundary conditions, Displacement vectors, Load vectors, Transformation of Matrices. Analysis of Plane frames and Grids including secondary effects such as Temperature changes and End-displacements.	09	20%
4.	Non-linearity and non-linear analysis-The basics.	02	5%

	Unit:2 Finite Element Method		
5.	Introduction to Finite Element Methods, Principles of Discretization, Shape of elements, nodes, Element stiffness mass formulation based on direct, variational and weighted residual techniques.	04	7%
6.	Determination of element properties for bar elements, beam elements, truss elements, constant strain triangle and quadrilateral elements using polynomial forms.	08	18%
7.	Determination of element properties for bar elements, beam elements, truss elements, constant strain triangle and quadrilateral elements using natural coordinate system.	08	18%
8.	Axisymmetric solids, Iso-parametric formulation	03	7%

Suggested Specification table with Marks (Theory/Practical):

% Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	**15**	**25**	**25**	**20**	**5**

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

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

Reference Text Books:

Sr. No.	**Title of book /article**	**Author(s)**	**Publisher and details like ISBN**	**Year of publication**	**Publication Edition**
01	Matrix Analysis of Structures	Meghre&Deshmukh	Charotar Publication, Anand ISBN(13)-9788192869278	2016	2nd
02	Matrix Analysis of Framed Structures	Weaver W. and Gere J. M	CBS Publishers, Delhi. ISBN-10 : 8123911513 ISBN-13 : 978-8123911519	2004	2nd
03	Matrix Analysis of Structures	Aslam Kassimali	Cengage Learning, USA. ISBN-13: 978-1-111-42620-0 ISBN-10: 1-111-42620-1	2012	2nd
04	Elementary Matrix Analysis of Structures	H. Kardestuncer	Mc-Graw Hill, USA ISBN 10: 0070333181 ISBN 13: 9780070333185	1974	1st
05	Computer Methods in Structural Analysis,	MeekJ. L., E and FN	CRC Press ISBN-10 : 1138470384 ISBN-13 : 978-1138470385	2017	1st

Core-I

06	Computer Analysis of Structural Systems	Fleming J.F	Tata McGraw-Hill Education ISBN(10)-007021302X, ISBN(13)-9780070213029	1989	1st
07	Finite Element Analysis	S. S. Bhavikatti	New Age International ISBN-10 : 8122436714 ISBN-13 : 978-8122436716	2015	3rd
08	Finite Element Analysis	Seshu P.,	Prentice-Hall of India, ISBN-10 : 8120323157 ISBN-13 : 978-8120323155	2003	1st
09	Introduction to the Finite Element Method,	Desai and Able,	CBS Publication. ISBN-10 : 9788123908953 ISBN-13 : 978-8123908953	2005	1st
10	Introduction to Finite Elements in Engineering -	Chandrupatla, R.T. &Belegundu, A.D	Pearson ISBN-10 : 0132162741 ISBN-13 : 978-0132162746	2011	4th
11	Finite Element Method,	Zienkiewicz O.C. & Taylor R.L.	Butterworth-Heinemann, ISBN(10)-0750651601, ISBN(13)-9780750651608	2000	5th
12	Finite Element for Structural Analysis -	Weaver & Johnston	Prentice Hall ISBN-10 : 0133170993 ISBN-13 : 978-0133170993	1984	1st
13	Finite Element Method -	Y. M. Desai, T. I. Eltho and A. H. Shah	Pearson Education India ISBN-10 : 9788131724644 ISBN-13 : 978-8131724644	2011	1st
14	Finite Elements Methods -	C.S.Krishnamurthy	Tata McGraw-Hill Education ISNB-0074622102	2007	2nd
15	Finite Element Method in Engineering -	S.S.Rao	Butterworth-Heinemann ISBN-10 : 1856176614 ISBN-13 : 978-1856176613	2010	5th
16	Advanced Structural Analysis	Ashok.K. Jain	Nem Chand Brothers.	2015	3rd
17	Advanced Structural Analysis	Devdas Menon	Narosa Publishing House ISBN-10 : 8173199396 ISBN-13 : 978-8173199394	2009	1st

Course Outcome:

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	Understand the fundamental aspects of structural analysis of Indeterminate structures and non-linearity of structures.*(R,U….cognitive level)*	10%
CO-2	Analyze rigid jointed and pin jointed structures using stiffness method.*(R,U,N,E…cognitive level)*	20%
CO-3	Analyze rigid jointed and pin jointed structures having secondary effects using stiffness method.*(R,U,N,E…cognitive level)*	20%
CO-4	Explain concept of finite element method and use finite element method for analysis and determine element propertiesusing polynomial forms.*(R,U,A,N,E,C…cognitive level)*	25%
CO-5	Use finite element method for analysis and determine element propertiesusing natural coordinate system and understand the concept of axisymmetric solids and Iso-parametric formulation*(R,U,A,N,E,C…cognitive level)*	25%

LIST OF PRACTICALS:
Assignments shall consist of solution of at least three problems from each topic out of which at least one of problems shall be checked by use of standard software.

Major Equipment/Software:
STAAD-Pro, SAP2000, ETABS, ABACUS, ANSYS

List of Open Source/learning website:

- https://ndl.iitkgp.ac.in/
- www.mastan2.com/
- www.scilab.org/
- http://www.code-aster.org/forum2/ (For open source FEA program Code_Aster)
- http://www.calculix.de (For open source FEA program Calculix)
- http://www.openfoam.org (For open source FEA program OpenFOAM)
- https://nptel.ac.in/courses/105/106/105106050/
    - Matrix methods of analysis
- https://nptel.ac.in/courses/105/105/105105180/
    - Matrix methods of analysis
- https://nptel.ac.in/courses/105/105/105105041/
    - Finite element analysis
- https://nptel.ac.in/courses/105/106/105106051/
    - Finite element analysis