

Program Name : Civil Engineering Program Group
Program Code : CE/CR/CS
Semester : Fourth
Course Title : Theory of Structures
Course Code : 22402

1. RATIONALE

Civil engineering structures are mainly made-up of column, Beam and Slabs and these structures are subjected to axial as well as eccentric loading along with different end conditions. The content on calculations of shear forces, bending moments, bending stresses, slope and deflections which are developed in various types of beams will be useful in design of these members. Analysis of members for axial forces, slope, deflection, combined direct and bending stresses will be useful in safe design of various structural members.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Analyze structural components using different methods.

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

- Analyze stresses induced in vertical members subjected to direct and bending loads.
- Analyze slope and Deflection in beams under different loading conditions.
- Analyze end moments of fixed beams.
- Analyze continuous beam under different loading conditions using the principles of Three Moments.
- Analyze continuous beam using Moment Distribution Method under different loading conditions.
- Evaluate axial forces in the members of simple truss.

4. TEACHING AND EXAMINATION SCHEME

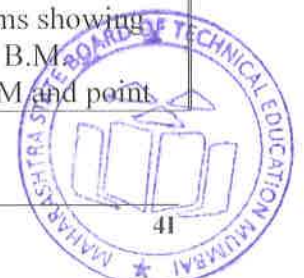
Teaching Scheme				Credit (L+T+P)	Examination Scheme											
L	T	P	Theory						Practical							
			Paper Hrs.		ESE		PA		Total		ESE		PA		Total	
Max	Min	Max		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min		
4	2	-	6	4	70	28	30*	00	100	40	--	--	--	--	--	--

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

Legends: L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P -Practical; C – Credit
 ESE -End Semester Examination; PA - Progressive Assessment.



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	<p>for the given column and chimney under given loading conditions.</p> <p>1d. Calculate the limit of eccentricity and core of a given section.</p> <p>1e. Analyze stresses in a given dam section for given loading conditions.</p> <p>1f. Draw stress distribution diagram for the given dam section.</p>	<p>core of section for rectangular and circular cross sections, Middle third rule.</p> <p>1.3 Chimneys of rectangular and circular cross section subjected to wind pressure, coefficient of wind pressure, Maximum and minimum stresses, resultant stresses and stress distribution diagram at base.</p> <p>1.4 Analysis of dams subjected to horizontal water pressure, conditions of stability, Maximum and minimum stresses, resultant stresses and stress distribution diagram at base.</p>
Unit-II Slope and Deflection	<p>2a. Calculate the slope and deflection for a cantilever beam under given loading conditions by double integration method.</p> <p>2b. Determine the slope and deflection for a simply supported beam under given loading conditions by double integration method.</p> <p>2c. Find the slope and deflection for a cantilever beam under given loading conditions by Macaulay's method.</p> <p>2d. Calculate the slope and deflection for a simply supported beam under given loading conditions by Macaulay's method.</p>	<p>2.1 Concept of slope and deflection, stiffness of beams, Relation among bending moment, slope, deflection and radius of curvature, (no derivation).</p> <p>2.2 Double integration method to find slope and deflection of cantilever and simply supported beams subjected to concentrated load and uniformly distributed load on entire span.</p> <p>2.3 Macaulay's method for slope and deflection, application to cantilever and simply supported beam subjected to concentrated and uniformly distributed load on entire span.</p>
Unit- III Fixed Beam	<p>3a. Explain the effect of fixity in the given beam section.</p> <p>3b. Calculate fixed end moments for beam subjected to the given point load.</p> <p>3c. Determine fixed end moments for the given beam subjected to UDL over entire span by first principle.</p> <p>3d. Find end moments and reactions for fixed beam under given loading condition.</p> <p>3e. Draw S.F. and B.M. diagrams for the given fixed beam using</p>	<p>3.1 Concept of fixity, effect of fixity, advantages and disadvantages of fixed beam over simply supported beam.</p> <p>3.2 Principle of superposition, Fixed end moments from first principle for beam subjected to central point load, UDL over entire span, Point load other than mid span.</p> <p>3.3 Application of standard formulae in finding end moments, end reactions and drawing S.F. diagrams showing point of contra-shear and B.M. diagrams showing net BM and point</p>



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	analytical method. 6c. Calculate axial forces for the given simple truss using method of joint and method of section. 6d. Calculate axial forces for the given simple truss using graphical method.	6.2 Calculate support reactions for trusses subjected to point loads at nodal points only. 6.3 Calculate forces in members of truss using method of joints and Method of sections. 6.4 Graphical method of analysis of truss. (No numerical on graphical method of analysis of truss)

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'.

7. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Direct And Bending Stresses	12	02	04	08	14
II	Slope And Deflection	10	02	04	06	12
III	Fixed Beam	10	00	04	04	08
IV	Continuous Beam	12	02	04	06	12
V	Moment Distribution Method	10	02	04	06	12
VI	Simple Trusses	10	02	04	06	12
Total		64	10	24	36	70

Legends: R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)

Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

8. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

- Collect the data of existing structures where direct and bending stresses have a predominant role (for example: Leaning Tower Of Pisa)
- Study the deflected shape and measure maximum deflection in a simply supported beam in laboratory. Check the results using analytical method.
- Compare Fixed Beam with Simply Supported Beam of same span and loading.
- Analyse given continuous beam using different methods and compare the results.
- Collect the data from YouTube/videos showing change in deflected shape due to change in number of supports in a beam.
- Prepare truss using given number of members and joints to carry given load (use webtools/ video games available on internet such as Xconstruction)



11. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Theory of Structures	Ramanrutham, S.	Dhanpatrai & Sons, Delhi ISBN : 978-93-84378-10-3
2	Theory of Structures	Khurmi, R. S.	S. Chand and Co., New Delhi, 2006 ISBN:978-81-21905-20-6
3	Structural Analysis Vol-1	Bhavikatti, S S	Vikas Publishing House Pvt Ltd. New Delhi; ISBN: 978-81-25927-90-7
4	Mechanics of structures, Volume-I and II	Junnarkar, S. B.	Charotar Publishing House, Anand ISBN:978-93-80358-99-4
5	Theory of Structures	Pandit, G.S. and Gupta, S.P.	Tata McGraw Hill, New Delhi, 2006 ISBN :978-00-74634-93-6

12. SUGGESTED SOFTWARE/LEARNING WEBSITES

- nptel.ac.in/courses/112107146/lects%20&%20pics/.../lecture30%20and%2031.htm
- www.nptel.ac.in/courses/105101085/downloads/lec-32.pdf
- www.facweb.iitkgp.ernet.in/~baidurya/CE21004/online_lecture_notes/m2112.pdf
- https://en.wikipedia.org/wiki/Theorem_of_three_moments
- https://en.wikipedia.org/wiki/Moment_distribution_method
- www.facweb.iitkgp.ernet.in/~baidurya/CE21004/online_lecture_notes/m3119.pdf
- www.bgstructuralengineering.com/BGSMA/ContBeams/BGSMA_CB_0201.htm
- www.facweb.iitkgp.ernet.in/~baidurya/CE21004/online_lecture_notes/m3119.pdf
- www.civilprojectsonline.com > Building Construction
- www.mathalino.com/reviewer/engineering.../method-sections-analysis-simple-trusses

13. COURSE CURRICULUM DEVELOPMENT COMMITTEE**MSBTE Resource Persons**

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