

GUJARAT TECHNOLOGICAL UNIVERSITY
CIVIL AND INFRASTRUCTURE ENGINEERING
ADVANCED STRUCTURAL ANALYSIS
SUBJECT CODE: 2154001
B.E. 5th SEMESTER

Type of course: Core Subject in Civil and Infrastructure Engineering

Prerequisite: Fundamentals of Structural Analysis

Rationale:

Advanced Structural Analysis is providing conceptual understanding and applications of structural analysis. With the help of this knowledge students may be able:

1. To understand virtual work method for calculation of deflections of statically determinate beams
2. To understand the method of analyzing structural frames using moment distribution methods
3. To understand the effects of moving loads on structures
4. To develop an understanding structural analysis based on the matrix stiffness
5. To develop an understanding on the basic concepts of earthquake and their effect on structures

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		ESE (V)		PA (I)		
				PA	ALA	ESE	OEP			
3	2	0	5	70	20	10	30	0	20	150

Content:

Sr.	Topics	Hrs.	%
1	Strain Energy: Strain energy, work done by forces, Total strain energy, Minimum potential energy, Minimum complementary energy, Castigliano's theorems, computation of displacements of statically determinate beams.	06	19
2	Moment Distribution Method Analysis of continuous beams & frames including sway, use of symmetry of structure up to two storeyed / two bay frames.	08	19
3	Influence line diagrams ILD for statically determinate beams- I.L.D of support reaction, shear force and moment bending moment for beams subjected to UDL and several point loads	06	10
4	Matrix Methods: Types of skeletal structures, Internal forces and deformations. Introduction and applications of stiffness method to analyze beams, Trusses and plane frames by system approach. Introduction and applications of Flexibility method to analyze beams, trusses and plane frames by system approach.	14	33

5	<p>Basics of Earthquake Engineering: Earth interior, plate tectonics, faults, consequences of earthquake, Earthquake parameters, magnitude & intensity, scales, Seismic zones of India, damages caused during past earthquakes.</p> <p>Philosophy of earthquake resistant design, earthquake proof v/s earthquake resistant design, four virtues of earthquake resistant structures (strength, stiffness, ductility and configuration), seismic structural configuration , Introduction to IS: 1893 (Part I), IS: 875 (Part V). Seismic load: Seismic coefficient method – base shear and lateral force distribution along height.</p>	06	14
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Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	20	20	25	15	0

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

Reference Books:

1. Junarkar S. B. & Shah H. J.; Mechanics of Structures Vol-II; Charotar publishing house, Anand
2. Wang C. K.; Intermediate Structural Analysis; Tata McGraw Hill book Company, New Delhi
3. Gere & Weaver; Matrix Analysis of framed structures, CBS Publications
4. Ryder G.H.; Strength of Materials; Mcmillan
5. Gere & Timoshenko; Mechanics of Materials; CBS Publishers & Distributors, Delhi
6. Hibbler R C; Structural Analysis; Pearson Education
7. Manish Shrikhande & Pankaj Agrawal; Earthquake resistant design of structures, PHI Publication, New Delhi
8. S.K.Duggal; Earthquake resistance design of structures; Oxford University Press, New Delhi.
9. A.K.Chopra; Dynamics of structures , Pearson, New Delhi
10. Clough & Penzin; Dynamics of structures
11. Park & Pauly; Behaviour of RC structure
12. John M.Biggs; Introduction to Structural Dynamics
13. C V R Murthy - Earthquake Tips, NICEE
14. IITK-GSDMA EQ26 – V -3.0 Design Example of a Six Storey Building
15. S S Rao; Mechanical Vibration; Pearson, New Delhi.
16. Criteria for earthquake resistant design General provision & Building - IS: 1893 (Part I)- 2002
17. Code of Practice for Ductile Detailing of RC Structures - IS: 13920 (1993).
18. IS: 456 - Code of practice for plain and reinforced concrete
19. IS: 875 (Part I to V) - Code of practice for structural safety of Buildings Loading standards
20. IS: 1893 - Criteria for earthquake resistant design of structures

Course Outcome:

After learning the course the students should be able to:

1. Apply equilibrium and compatibility equations to determine response of statically determinate and indeterminate structures.
2. Determine displacements and internal forces of statically indeterminate structures by classical, iterative and matrix methods.
3. Determine internal forces and reactions in determinate and indeterminate structures subjected to moving loads.
4. Determine strain energy stored in a body.
5. Apply the concept of Earthquake Resistant Design & concept of lateral load distribution on buildings

Term-Work

The students will have to solve at least five examples and related theory from each topic as an assignment/tutorial. Practical examinations shall consist of oral based on term-work and above course.

List of Tutorials

1. Prepare working model to understand behavior of portal frame/s with different support condition and different types of joints.
2. Prepare spread sheet for analyzing structures using matrix method with help of MS-Excel.

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.

List of Open Source Software/learning website:

www.nptel.iitm.ac.in/courses/

Active learning Assignments (AL) : Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The Power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.

