GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering (Part Time)
Subject Code: 2940601
Semester IV
Subject name: Structural Analysis-I

Type of course: Professional Core course

Prerequisite: Mechanics of Solid

Rationale: This subject is conceptual applications of principles of mechanics of rigid and deformable bodies in Engineering. This subject helps in determining statics response of statically determinate and indeterminate framed structures. In addition to this, the topics related to stability checks for structure subjected to lateral loads, buckling behaviour will also helps the students in developing the basic concepts of structural analysis. Use of professional software in structural analysis is a need of the day. Though it's use will be limited to small problem in this course, but students starts to use professional software will help them much in the later course.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	2	5	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Unit-1 : Fundamentals of Statically Determinate Structures:** **Basics:** Types of statically determinate & indeterminate structures, static and kinematic indeterminacy, stability of structures, principle of superposition, Maxwell's reciprocal theorems. **Framed structure :** Computation of internal forces in statically determinate framed structures such as plane truss, plane frame, grids, **Arches and Cables :** Calculation internal forces in three hinge arches with circular and parabolic shapes subjected to various types of loading. Forces and end actions in cables due to various types of loading. **Thin cylinder:** Analysis of thin cylinder and spherical vessels under pressure.	14	25
2	**Unit-2 : Strain energy & Displacement of Statically Determinate structures** **Strain Energy :** Resilience, strain energy due to axial loads & flexure, proof resilience, modulus of resilience, impact loads, and sudden loads	14	25

	Displacement : Differential equation of elastic curve, relation between moment, slope and deflection, Displacement of beam by Macaulay's method, Moment Area Method, Conjugate Beam Method and by strain energy using first principle (i.e equating strain enery to work done)		
3	**Unit-3 : Direct and Bending stresses + Column & Struts** **(A) Direct and Bending stresses** **Basics:** Members subjected to eccentric loads, middle third rule, kernel of section, stress distribution **Applications of Direct & Bending stresses :** (1) chimney subjected to wind pressure, (2) Retaining walls subjected to earth pressure and (3) Dams subjected to hydraulic pressure. **(B) Columns and Struts** Basics: Buckling of columns, different end conditions, effective length, least radius of gyration **Applications:** Euler's and Rankine's formulae, columns with initial curvature, eccentrically loaded columns, columns with lateral loading.	14	25
4	**Unit-4 : Statically Indeterminate beams** **Basics :** Types of statically indeterminate beams, Consistent Deformation method, Basic principles for fixed beam, basics of moment distribution method. **Propped Cantilever beam :** Analysis of propped cantilever beams & beams of varying moment of inertia using Consistent Deformation Method **Fixed beam :** Computation of fixed-end actions for various types of loads and secondary effects using basic principles, beams of varying moment of inertia. **Continuous beams:** continuous beam up to 3 spans by Moment Distribution Method.	14	25
5	**Unit-5: Computer Applications in Structural Engg. (for Laboratory only)** Use of professional software such as STAAD-Pro, SAP, ETABS etc. for determining response of frames structure of the topics related to this course		

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**20**	**30**	**20**	**10**	**10**

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

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:

1. Junarkar S.B. & Shah H.J.; Mechanics of Structures Vol-I; Charotar publishing house, Anand
2. Wang C. K.; Intermediate Structural Analysis; Tata McGraw Hill book Company, New Delhi
3. Popov E.P.; Engineering Mechanics of Solids; Prentice Hall of India, New Delhi
4. Ryder G.H.; Strength of Materials; Mcmillan
5. Gere & Timoshenko; Mechanics of Materials; CBS Publishers & Distributors, Delhi
6. Hibbler R C; Mechanics of Materials; Pearson Education
7. Hibbler R C; Structural Analysis; Pearson Education

Course Outcome:

Sr. No.	CO statement	Marks % weightage
CO-1	Apply principles of statics to determine reactions, internal actions in statically determinate framed structures including arches & cables.	20
CO-2	Compute strain energy stored member subjected to axial & flexural forces.	10
CO-3	Determine displacement in a statically determinate beams by different methods	20
CO-4	Perform stability checks to various structures such as chimey, retaining wall, dam subjected to gravity and lateral loading.	20
CO-5	Differentiate the buckling behaviour of columns & struts with different end conditions.	10
CO-6	Determine response of structure using professional software.	20

List of Experiments/Tutorials:

1. The students will have to solve at least five examples and related theory from each topic as an assignment/tutorial.

2. Few problems will have to solve with professional software and compare results.
3. Experiments may be designed and carried out related to the topics of the course.
4. Practical examinations shall consist of oral based on term-work and above course.

Major Equipment/Software:

1. Any professional software of Structural analysis

List of Open Source Software/learning website:

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