GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering
Level: UG
Branch: Civil Engineering
Subject Code: BE04006041
Subject Name: Basic Structural Analysis

w.e.f.AcademicYear:	2024-25
Semester:	IV
Categoryof theCourse:	Professional Core Course

Prerequisite:	Theory of Structures
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 indeterminate framed structures. In addition to this, the topics related to applications of Energy Principles, moving loads will help the students in developing the basic concepts of structural analysis. Use of professional software in structural analysis is a need of the day and hence it is included in this course.

Course Outcomes:

Sr.No.	COstatement	% weightage
CO-1	Determine response of statically determinate & indeterminate structure by Classical & Matrix methods	30
CO-2	Apply energy principles to determine the response of statically determinate & indeterminate structures.	25
CO-3	Apply approximate methods to determine internal forces in framed structure subjected to vertical and lateral loads.	10
CO-4	Determine response of indeterminate structures subjected to moving loads.	10
CO-5	Perform computer analysis of statically determinate & Indeterminate framed structure using professional software	25

TeachingandExaminationScheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	PBL*	Total no of hours per semester		ESE (E)	PA / CA (M)	PA/ CA (I)	PBL (I)	ESE (V)	
45	0	30	15	90	3	70	30	20	30	50	200

* **Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.**

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Content:

Sr.No.	Content	Total Hrs
1	**Unit-1: Statically Indeterminate structure - Basics** Types of statically indeterminate beams, Consistent Deformation method. **Propped Cantilever beam:** Analysis of propped cantilever beams & beams of varying moment of inertia using Consistent Deformation Method **Fixed beam:** Basic principles for fixed beam, Computation of fixed-end actions for various types of loads and secondary effects using basic principles, beams of varying moment of inertia.	05
2	**Unit-2: Statically Indeterminate structures – Classical methods** **Slope Deflection Method:**Basics of Slope deflection method, Analysis of continuous beams for various loading including settlement/ rotation of support, analysis of simple portal frame with sway. **Moment Distribution Method:**Basics of moment distribution method, Analysis of beams & plane frames including sway. Use of symmetry of structure	10
3	**Unit-3: Energy Principles** **Energy Principles:** Castigliano's theorems, Application of Castigliano's 1st and 2nd theorem to statically determinate and indeterminate framed structure – beams, plane truss, plane frames. Application of energy principle in two hinged arch.	10
4	**Unit-4: Structure subjected to Moving loads + Approximate methods** ILD for statically indeterminate beams: Muller-Breslau's principle, steps for obtaining I.L for reaction and internal forces in propped cantilever and continuous beams, qualitative I.L diagram for rigid jointed structures having higher degree of statically indeterminacy. **Approximate methods:** Forces in the framed structure subjected to Vertical and lateral loads.	10
5	**Unit-5 : Statically Indeterminate structures – Matrix methods** **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 by **System approach**.	10
6	**Unit-6: 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 Create Modelling, Apply properties, boundary conditions, loading, perform analysis, post processing tools.	This portion to be covered in Laboratory

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	TOTAL	45

Suggested Specification table with Marks (Theory):

Distribution ofTheory Marks					
RLevel	ULevel	ALevel	NLevel	ELevel	CLevel
10	**20**	**30**	**20**	**10**	**10**

R:Remembrance;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC: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.

ReferenceBooks:

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, NewDelhi

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

List of Experiments:

The students will have to solve at least five examples and related theory from each topic as an assignment/tutorial. Students will have to perform following experiments in laboratory and prepare the laboratory manual.

1. Compute reactions in statically indeterminate beam/truss/frame (having SI=1 or 2) subjected to loading.

2. Perform computer analysis of statically indeterminate beam, truss & frame& verify with analytical method.

Major Equipment/Software:

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1. Structural Engg. Frame with models of beam, truss, frame for measurement devices for reactions, displacement etc.

2. Professional software such as STAAD-Pro, ETAB, SAP

List of Open Source Software/learning website:

1. http://nptel.ac.in/

- **List of suggested activities for Problem Based Learning:**

Sl. No.	Name of the activity	No. of hours	Evaluation Criteria
1.	Industry/Research laboratory/Village/Places of National Importance visit	Visit = 5h, Report preparation = 5h Total = 10h	Based on report submitted. Report should contain observations and calculations based on industry/ lab data.
2.	Technical Video based learning related to the subject	Duration of video = 5h Report preparation = 5h Total = 10h	Report /presentation based on the video learning outcomes.
3.	Assignment writing. Numerical based assignment is preferable.	5 assignments of 2h each. Total = 10h	Based on the assignment submitted.
4.	Problem solving/Coding using C, C++, Python, SCILAB, MATLAB, MS-EXCEL or any other relevant software	5 small coding-based assignment of 2h each. Total = 10h	Based on the coding solution submitted.
5.	On-line courses related to the subjects	Minimum duration of the course should be 10h.	Examination based assessment at the end of course. Based on the certificate produced.
7.	Poster/chart/power point preparation on technical topics	Duration = 6 h	Based on poster/chart preparation and presentation skills
8.	Working/non-working model on technical topics	Working = 12 h Non- working = 8 h	Based on inter department/external evaluation
9.	Group Discussion on emerging/trending technical topics based on subject	Duration = 1 h each	Based on performance in group discussion, technical depth, knowledge etc.
10.	Capstone project on advances in the area of subject or Real-	Duration of data collection/study = 5h	Based on in-depth study, technical depth, data

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	world case studies-based learning	Report preparation = 5h Total = 10h	collected, fact finding, etc.
11.	Field survey of 1 to 2 days	Duration = 10 h Data collection, representation & interpretation	Based on need of the data for various societal/governance/Industry scheme/project

Note:

1. All the suggested activity should be related to the subject.

2. The number of hours is suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.

3. Minimum 03 activities shall be covered per subject.

4. Rubrics for the evaluation can be prepared by the faculty.

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