GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Civil Engineering

Subject Code : DI05006081

Subject Name : Mechanics of Structures -II

w. e. f. Academic Year:	2026-27
Semester:	5th
Category of the Course:	PEC

Prerequisite:	Engineering Mechanics, Mechanics of Structures-I
Rationale:	After learning the analysis of determinate structures in Semester III, this elective subject is introduced in the 5th semester for students who wish to specialize in the field of structural engineering. The subject introduces the concept of indeterminate structures and covers the analysis of indeterminate structural members such as fixed beams and continuous beams, it also includes the analysis of column sections, dams, and retaining walls subjected to eccentric loading, along with checking the important condition of no tension. The study of structural members under the effect of principal stresses and strains is also included to provide students with an understanding of compound stresses. After completing this subject, diploma students will develop an in-depth understanding of structural engineering concepts and will be able to apply their analytical knowledge and skills effectively in the construction industry.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Identify skeletal & continuum structures and determinate & indeterminate structures	R, U, A
02	Analyse a symmetrically loaded fixed beam with moment area method and draw SF & BM diagrams.	R, U, A
03	Analyse a symmetrically loaded continuous beam with Theorem of three Moments and Moment Distribution Method and draw SF & BM diagrams.	R, U, A
04	Analyse column, dam and retaining wall subjected to eccentric axial loading to draw stress distribution diagram and check for no tension condition	R, U, A
05	Analyse strained structural material for calculation of normal, tangential and resultant stress on a given inclined plane.	R, U, A

**Revised Bloom's Taxonomy (RBT)*

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Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA(M)	PA (I)	ESE (V)	
03	00	02	04	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Fundamentals** 1.1 Definition of skeletal structures, types of skeletal structures- Beam, Plane Truss, Plane frame, Grid, Space Truss, Space Frame. 1.2 Definition of continuum structures, types of continuum structures- Plate, Shell, Dams, Retaining Wall, Machine Parts etc. 1.3 Determinate and indeterminate structures. 1.4 Advantages and disadvantages of indeterminate structures.	03	05
2.	**Fixed Beams** 2.1 Define a Fixed beam, Advantages of fixed beam over simply supported beam. 2.2 Concept of analysis by Moment area method 2.3 μ and μ' diagram for possible symmetric loading on a fixed beam of span L 2.4 Numericals on calculating SF & BM and drawing SF & BM diagrams for fixed beam with symmetric loading (UDL & Point load only) 2.5 Locate Point of contra flexure.	06	15
3.	**Continuous Beams** 3.1 Explain theorem of three moment (Clapeyron's theorem) 3.2 Use theorem of three moment for a continuous beam up to three spans and two equations only 3.3 Numericals on calculating SF & BM and drawing SF & BM diagrams for fixed beam with symmetric loading (UDL & Point load only)	09	20
4.	**Moment Distribution Method** 4.1 Define the terms: Stiffness, flexibility, carry over factor,	09	20

	distribution factor, procedure of moment distribution method 4.2 Numerical to analyse two or three span continuous beams having end supports as overhang , fixed and /or hinge and subjected to symmetrical loading (UDL & Point load only) and draw S.F & B.M Diagram		
5.	**Direct and Bending Stresses** 5.1 Introduction to axial and eccentric loads on column section. Formulae for combined stresses on sections subjected to eccentric loads considering uniaxial and biaxial eccentricity and stress distribution diagrams. 5.2 Condition for no tension or zero stress at extreme fiber, limit of eccentricity, core of section for rectangular and circular (solid and hollow) cross sections. 5.3 Application of concept of combined stresses to find pressure at base and stability check of rectangular and trapezoidal retaining wall and dam with conditions of stability. 5.4 Numericals based on above topics to find combined stresses.	09	20
6.	**Principal planes and Principal stresses** 6.1 Normal, Tangential & Resultant stresses due to direct orthogonal and shear stresses on a given inclined plane (Only formulae no derivation). Numericals based on this. 6.2 Definition of principal plane and stress. 6.3 Location of principal planes and calculation of principal stresses (Only formulae, no derivation) Maximum tangential stress. Numericals based on this. 6.4 Mohr's circle and its application for determination of Normal, Tangential & Resultant stresses due to direct orthogonal and shear stresses on inclined plane. 6.5 Mohr's circle and its application for location of principal planes and determination of principal stresses. 6.6 Mohr's circle and its application for determination of maximum tangential stress.	09	20
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	**30**	**50**	**00**	**-**	**-**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

Sr.	Title of Books/standards	Author	Publication
1.	Theory of Structures(SMTS-II)	Dr. B.C.Punamia Ashokkumar Jain Arunkumar Jain	Laxmi Publications Pvt. Ltd.NewDelhi ISBN: 81-700-861-83
2.	A Textbook of Strength of Materials (Mechanics of Solids)	R.S.Khurmi N. Khurmi	S Chand Publishing, Delhi (2019) ISBN: 9789352833979
3.	Structural Analysis-I	S.S.Bhavikatti	Vikas Publishing House, New Delhi ISBN: 81-947-519-85
4.	Strength of Materials	S. Ramamrutham R. Narayanan	Dhanpatrai & Sons-Delhi ISBN : 978-93-5216-203-1
5.	Mechanics of Structures Volume 1 &2	Dr. H.J.Shah & S.B. Junnarkar	Charotar Publishing house Pvt Ltd-Anand-Gujarat ISBN : 978-93-80358-99-4

(b) Open source software and website:

List of open-source (or free-to-use) software tools that can be used for teaching or learning Mechanics of Structures -II are:

1) https://nptel.ac.in/courses/105104160 (NPTEL Course :- Mechanics of Solids by IIT, Kanpur)
2) https://nptel.ac.in/courses/105105166 (NPTEL Course :- Structural Analysis-I by IIT, Kharagpur)
3) https://nptel.ac.in/courses/105101085 (NPTEL Course :- Structural Analysis-I by IIT, Bombay)
4) www.vlab.co.in (Virtual Lab by Ministry of Education, Government of India)

Suggested Course Practical List:

Sr. No.	Practical Outcomes	Unit No.	Approx. Hrs. Required
1	Differentiate determinate & indeterminate structures with examples	1	02

Sr. No.	Practical Outcomes	Unit No.	Approx. Hrs. Required
2	Solve at least 4 problems each of load cases &/or combinations for fixed beams, using moment area method, draw SF & BM diagrams and locate Point of contraflexure.	2	04
3	Analyse continuous beam, at least 3 problems each for various cases of end conditions and symmetrical loads and its combinations to draw SF & BM diagrams , using Theorem of three moments.	3	06
3	Analyse continuous beam, at least 3 problems each for various cases of end conditions and symmetrical loads and its combinations to draw SF & BM diagrams , using Moment Distribution Method.	4	06
5	Analyse at least 2 problems for the column section subjected to eccentric loading and draw stress distribution diagram.	5	02
6	Analyse Dam and Retaining wall for given loading and draw pressure diagram at base and check the stability.	5	04
7	Analyse strained structural material with analytical and graphical (Mohr's circle) methods for all cases.	6	06
	Total hours		**30 Hrs.**

List of Laboratory/Learning Resources Required:

Sr. No	Learning Resources	Practical No.
1	Drawing and Detailing Equipment • Pencils, set squares, compass, scale • CAD lab access with printer/plotter (if available)	7
2	Models / Demonstration Aids • Physical models of Fixed Beam, Continuous Beams, Dams and Retaining Walls	2,3,4,6

Suggested Project List / Activities for Students:

a) Collect photographs of determinate & indeterminate structures from nearby locations.
b) Identify different situations with photographs of structural members where combined direct and bending stresses occur in the field.

c) Identify different situations with photographs of nearby retaining structures.
d) Identify situations where in a plane is subjected to complex stresses.
e) Analyse and compare B.M. and S.F. values at Supports and Mid span for simply supported beam and fixed beam having same span and loading conditions for three different cases.
f) Prepare a spreadsheet computer program or to analyse fixed beams by moment area method.
g) From a real life problem, calculate loads on a continuous beam (from slab, wall etc) and analyse the beam with a Moment Distribution Method or with structural engineering software.
h) Prepare spreadsheet or computer program to determine combined direct and bending stresses for an eccentric loaded column for given data.
i) Prepare spreadsheet or computer program to determine pressure at base for dam or retaining wall and check the stability for given data.
j) Prepare spreadsheet or computer program to analyse strained structural material and compare answer by graphical method (Mohr's Circle) with AutoCAD

Special Instructional Strategies:

a) Site Visit should be arranged for Dams and Retaining Walls
b) Arrange expert lectures related to topics.

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