

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM

**Course Title: Structural Mechanics
(Code: 3330604)**

| Diploma Programme in which this course is offered | Semester in which offered |
|--|----------------------------------|
| Civil Engineering /Environment Engineering/Transportation Engineering | THIRD SEMESTER |

1. RATIONALE

The Applied Mechanics in Second Semester was taught to study the external effects on the body due to action of force system. The behaviour of structure under different loading conditions is needed to understand so that design can do by the engineer. In this course, analysis of determinate structures under action of transverse loading, along with, analysis of members under direct loading is to be studied. Analysis of Industrial Trusses is also incorporated to give an idea of typical structure to the students. The Structural Mechanics-I, will enable the student to analyse Steel & Concrete Structures used in Civil Engineering construction.

2. COMPETENCY

Calculate various structural material properties under direct loading condition
Analyse Statically Determinate structures like Beam, Column & Truss.

3. TEACHING AND EXAMINATION SCHEME

| Teaching Scheme (In Hours) | | | Total Credits (L+T+P) | Examination Scheme | | | | |
|---------------------------------------|----------|----------|----------------------------------|---------------------------|-----------|------------------------|-----------|------------------------|
| L | T | P | | Theory Marks | | Practical Marks | | Total Marks |
| | | | | ESE | PA | ESE | PA | |
| 04 | 01 | 02 | 07 | 70 | 30 | 20 | 30 | 150 |

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** - Practical; **C** - Credit; **ESE** - End Semester Examination; **PA** - Progressive Assessment

4. COURSE DETAILS

| Unit | Major Learning Outcomes | Topics and Sub-topics |
|---|---|--|
| Unit – I DIRECT STRESS & STRAIN | 1a. Calculate Material Properties Under Longitudinal & Lateral Loads 1b. Analyse Composite & Compound Sections 1c. Compute Strain Energy under Different Types of Loading | 1.1 Different types of Structures and Loads 1.2 Direct Stress , linear Strain , Hook's Law Numerical Problems on Direct Stress & Linear Strain . Stress Strain curve of Mild Steel . Modulus of Elasticity. Yield , Breaking & Ultimate Stress and factor of Safety along with numerical problems 1.3 Lateral Strain and Poission's ratio with numerical problems 1.4 Basics Concepts of Shear Stress , Shear Strain & Shear Modulus 1.5 Bulk Modulus , volumetric Strain along with numerical Problems 1.6 Differentiate between Sudden , Gradual & Impact Loads Define Strain Energy , Proof Resilience for Sudden , Gradual & Impact Load along with numerical problems |
| Unit – II MOMENT OF INERTIA | 2 Compute Moment of Inertia of Symmetric & asymmetric structural sections | 2.1 Moment of Inertia & its Importance 2.2 Parallel & Perpendicular Axis Theorem 2.3 Formula of Moment of Inertia of solid & Hollow sections like Rectangle , Triangle , Circle 2.4 Moment of Inertia about C.G for I section , H section , Channel Section , Angle Section , T Section and Built up Section having flange plates to I & H Section and of Double Channels back to back & toe to toe |
| Unit – III S.F & B.M IN BEAM | 3 Draw Shear Force & Bending Moment Diagram for Statically Determinate Beams | 3.1 Statically Determinate Beam Like Cantilever , Simply Supported & Over Hang Beam 3.2 Shear Force and Bending Moment and its relationship 3.3 Sagging & Hogging Bending Moment and its importance 3.4 Point of Contra-flexure & its importance 3.5 S.F & B.M Diagram for Cantilever , Simply Supported & Over Hang Beam subjected to Point Load and/ or U.D.L |
| Unit – IV BENDING & SHEAR STRESSES IN BEAM | 4 Apply Bending Theory. 4.1 Calculate Bending Stress 4.2 Draw stress distribution diagram | 4.1 Bending Theory Equation Bending stress , Sectional Modulus , Nutral Axis Apply Bending theory to Statically determinate beams having rectangular or circular section 4.2 Shear Stress equation Shear Stress Distribution Diagram for |

| Unit | Major Learning Outcomes | Topics and Sub-topics |
|---|--|---|
| | | Solid & Hollow Rectangular And Circular Section Apply shear Stress Equation & Draw Shear Stress Distribution Diagram for I , H , T , Channel & Angle Section |
| Unit – V ANALYSIS OF TRUSS | 5. Analyse Statically Determinate Trusses | 5.1 Perfect & Imperfect Truss 5.2 Various trusses for different spans and application 5.3 Analysis of Triangle , Howe , North Light & Fan trusses under Panel Point Loads using Graphical & Method of Joint |
| Unit – VI COLUMN & STRUT | 6 Calculate Load carrying Capacity of Columns & Struts | 6.1 Column & Strut 6.2 Short & Long Column 6.3 End Condition of Column and effective Length of Column & Modes of Failure in column 6.4 Radius of Gyration , Slenderness Ratio 6.5 Euler's Crippling Load 6.6 Rankin's load / Buckling Load of Column |

5. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

| Unit | Unit Title | Teaching Hours | Distribution of Theory Marks | | | |
|--------------|---|----------------|------------------------------|-----------|-----------|-------------|
| | | | R Level | U Level | A Level | Total Marks |
| I | DIRECT STRESS & STRAIN | 10 | 02 | 02 | 06 | 10 |
| II | MOMENT OF INERTIA | 06 | 02 | 00 | 08 | 10 |
| III | S.F & B.M IN BEAM | 14 | 04 | 00 | 16 | 20 |
| IV | BENDING & SHEAR STRESSES IN BEAM | 10 | 04 | 00 | 06 | 10 |
| V | ANALYSIS OF TRUSS | 10 | 04 | 02 | 06 | 12 |
| VI | COLUMN & STRUT | 06 | 02 | 02 | 04 | 08 |
| Total | | 56 | 18 | 06 | 46 | 70 |

6. SUGGESTED LIST OF EXERCISES/PRACTICAL

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills so that students are able to acquire the competency.

Following is the list of experiments for guidance.

| S. No. | Unit No. | Practical/Exercise | Apprx. Hrs. Required |
|-----------------|----------|---|----------------------|
| 1 | I | Conduct Tension test on a given sample of mild steel and draw Stress Strain Curve | 04 |
| 2 | I | Determine Young's Modulus of wire of given material | 02 |
| 3 | I | Calculate impact value of mild steel using IZOD impact test apparatus | 02 |
| 4 | I | Calculate impact value of mild steel using Charpy impact test apparatus | 02 |
| 5 | I | Solve at least six problems pertaining to Unit – I | 02 |
| 6 | II | Work out Moment of Inertia of Fly Wheel | 02 |
| 7 | II | Solve Four Problems of Moment of Inertia | 02 |
| 8 | IV | Solve at Least Eight numerical Problems of Unit- IV | 02 |
| 9 | V | Analyse Truss using Graphical Method (At least THREE Trusses) and verify using analytical method. | 06 |
| 10 | VI | Demonstrate End Conditions of Column using suitable model/example | 02 |
| 11 | VI | Solve Least Six numerical Problems pertaining Unit - VI | 02 |
| | | TOTAL | 28 |
| TUTORIAL | | | |
| 1 | III | Solve few problems of UNIT III and give similar exercises at least 12 to the students to practice | 08 |
| 11 | V | Solve PROBLEMS OF UNIT V and ask students to practice for at least 04 problems based on Method of Joint | 06 |
| | | Total | 14 |

7. SUGGESTED LIST OF STUDENT ACTIVITIES

1. Visit Industrial Shed and submit a brief report of Different Types of Trusses and its Components are in use .
2. Survey the market and prepare a list of various type of Structural Steel Sections commonly used.

8. SUGGESTED LEARNING RESOURCES

(A) List of Books:

| S. No. | Title of Books | Author | Publication |
|--------|--|-----------------|-------------|
| 1. | Strength of Material & Mechanics of Structures | Dr. B C Punamia | |

| | | | |
|----|----------------------|------------------|--|
| 2. | Strength of Material | S RAMAMURTHAN | |
| 3. | Strength of Material | Timo Shanku | |
| 4. | Theory of Structures | R S KHURMI | |
| | | | |

B. List of Major Equipment/Materials

1. Universal Testing Machine
2. SEARL'S Apparatus to find Young's Modulus
3. Working Model of End Conditions of Column
4. IZOD Impact Test Apparatus
5. CHARPY Test Apparatus
6. FLY WHEEL

C List of Software/Learning Websites

1. nptel.iitm.ac.in/courses/.../IIT.../lecture%202023%20and%2024.htm
2. en.wikipedia.org/wiki/Shear_and_moment_diagram
3. www.freestudy.co.uk/mech%20prin%20h2/stress.pdf
4. www.engineerstudent.co.uk/stress_and_strain.html
5. https://www.iit.edu/arc/workshops/pdfs/Moment_Inertia.pdf

9. INSTRUCTIONAL STRATEGICS:

Subject Teacher may use Lecture, demonstration, video films field/industry visit as instructional strategies.

10. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

1. PROF. B G RAJGOR, H.O.D, APP. MECH. , BBIT , V V NAGAR
2. PROF. K VENKATESHWARLU , H.O.D, APP. MECH. , TFG POLYTECHNIC , ADIPUR
3. PROF. J H GABRA , I/C H.O.D , APP. MECH. , G.P , GODHARA

Coordinator and Faculty Members from NITTTR Bhopal

1. Dr. A K JAIN , PROFESSOR , DEPARTMENT OF CIVIL & ENVIORNMENT ENGINEERING
2. Prof J.P.Tegar, PROFESSOR AND HEAD , DEPARTMENT OF CIVIL & ENVIORNMENT ENGINEERING