

**STRENGTH OF MATERIALS****Course Code : 313308**

|                         |                                                                                                                                                                                                                                                        |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Programme Name/s</b> | <b>: Automobile Engineering./ Agricultural Engineering/ Civil Engineering/ Civil &amp; Rural Engineering/ Construction Technology/ Civil &amp; Environmental Engineering/ Mechanical Engineering/ Manufacturing Technology/ Production Engineering</b> |
| <b>Programme Code</b>   | <b>: AE/ AL/ CE/ CR/ CS/ LE/ ME/ MRT/ PG</b>                                                                                                                                                                                                           |
| <b>Semester</b>         | <b>: Third</b>                                                                                                                                                                                                                                         |
| <b>Course Title</b>     | <b>: STRENGTH OF MATERIALS</b>                                                                                                                                                                                                                         |
| <b>Course Code</b>      | <b>: 313308</b>                                                                                                                                                                                                                                        |

**I. RATIONALE**

All civil & mechanical engineering components are subjected to different types of loads and behave in a specific way. Students can able to understand & analyze various types of loads, stresses & strains with regards to the structural behavior of components and materials. This course is a prerequisite for understanding elastic behavior of different engineering materials, structural analysis, machine design, principles and the strengths of various structural elements used in civil & mechanical industries.

**II. INDUSTRY / EMPLOYER EXPECTED OUTCOME**

Analyze the stresses & strains in the given structural elements using relevant methods.

**III. COURSE LEVEL LEARNING OUTCOMES (COS)**

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Calculate the M.I. of the given object using relevant formulae & methods.
- CO2 - Analyze the structural behavior of the given structural components under various loading conditions.
- CO3 - Draw SFD and BMD for the given structural element under given loading conditions.
- CO4 - Determine the bending and shear stresses in beams under different loading conditions
- CO5 - Analyze the direct & bending stresses in the structural members under eccentric loading conditions.

**IV. TEACHING-LEARNING & ASSESSMENT SCHEME**

| Course Code | Course Title          | Abbr | Course Category/s | Learning Scheme          |    |    |     |     |                | Credits | Assessment Scheme |       |       |     |                  |     |       |     |             |     |     |     |  |  | Total Marks |
|-------------|-----------------------|------|-------------------|--------------------------|----|----|-----|-----|----------------|---------|-------------------|-------|-------|-----|------------------|-----|-------|-----|-------------|-----|-----|-----|--|--|-------------|
|             |                       |      |                   | Actual Contact Hrs./Week |    |    | SLH | NLH | Paper Duration |         | Theory            |       |       |     | Based on LL & TL |     |       |     | Based on SL |     |     |     |  |  |             |
|             |                       |      |                   | CL                       | TL | LL |     |     |                |         | Practical         |       |       |     |                  |     |       |     |             |     |     |     |  |  |             |
|             |                       |      |                   |                          |    |    |     |     |                |         | FA-TH             | SA-TH | Total |     | FA-PR            |     | SA-PR |     | SLA         |     |     |     |  |  |             |
|             |                       |      |                   |                          |    |    |     |     |                |         |                   |       | Max   | Max | Max              | Min | Max   | Min | Max         | Min | Max | Min |  |  |             |
| 313308      | STRENGTH OF MATERIALS | SOM  | DSC               | 4                        | -  | 2  | -   | 6   | 3              | 3       | 30                | 70    | 100   | 40  | 25               | 10  | -     | -   | -           | -   | 125 |     |  |  |             |

**Total IKS Hrs for Sem. : 1 Hrs**

Abbreviations: CL- ClassRoom Learning, TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*# On Line Examination, @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.\* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. \* Self learning hours shall not be reflected in the Time Table.
7. \* Self learning includes micro project / assignment / other activities.

**V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT**

| Sr.No | Theory Learning Outcomes (TLO's) aligned to CO's. | Learning content mapped with Theory Learning Outcomes (TLO's) and CO's. | Suggested Learning Pedagogies. |
|-------|---------------------------------------------------|-------------------------------------------------------------------------|--------------------------------|
|-------|---------------------------------------------------|-------------------------------------------------------------------------|--------------------------------|

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| Sr.No | Theory Learning Outcomes (TLO's) aligned to CO's.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Suggested Learning Pedagogies.                                                                                                       |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| 1     | <p>TLO 1.1 Calculate Centroid, Moment of Inertia of Plane lamina and radius of gyration of a given lamina.</p> <p>TLO 1.2 Explain Parallel and Perpendicular axes theorems.</p> <p>TLO 1.3 Calculate Moment of inertia of standard solid shapes and hollow shapes.</p> <p>TLO 1.4 Calculate Moment of inertia of composite plane figures such as I, C, T &amp; L sections.</p> <p>TLO 1.5 Understand Moment of inertia for built-up section.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <p><b>Unit - I Moment of Inertia</b></p> <p>1.1 Concept of Moment of Inertia, M.I. of plane lamina and radius of gyration of a given lamina.</p> <p>1.2 Parallel and perpendicular axes theorems (without derivation).</p> <p>1.3 M.I. of standard basic figures like square, rectangle, triangle, circle, semi-circle, quarter-circle and Hollow Rectangular &amp; Circular sections. (without derivation).</p> <p>1.4 M.I. of Composite plane figures such as symmetrical and unsymmetrical I-section, channel section, T-section, angle section. Numerical on composite figure consisting of maximum 03 standard shapes.</p> <p>1.5 Introduction to M.I. for built-up sections. (No numerical). (IKS* Concept of Centre of Gravity &amp; M.I. used in ancient constructions like temples, forts etc.)</p>                                                                                                                                                                                                                                                                                                                                                                                      | <p>Chalk-Board</p> <p>Hands-on</p> <p>Collaborative learning</p> <p>Video</p> <p>Demonstrations</p> <p>Presentations</p>             |
| 2     | <p>TLO 2.1 Understand concept of stresses and strains in deformable bodies.</p> <p>TLO 2.2 Understand Hook's law, elastic limit, Linear and lateral strain, Poisson's ratio.</p> <p>TLO 2.3 Determine modulus of elasticity, modulus of rigidity and bulk modulus for given material.</p> <p>TLO 2.4 Articulate practical significance of stress- strain curve for given material under given loading conditions for their relevant use.</p> <p>TLO 2.5 Concept of single shear, double shear &amp; punching shear.</p> <p>TLO 2.6 Compute the total deformation for given homogeneous (compound) sections under axial load.</p> <p>TLO 2.7 Determine the stresses in each material for given composite section.</p> <p>TLO 2.8 Compute strain along x, y and z-direction for a given bi-axial or tri-axial stress system.</p> <p>TLO 2.9 Determine volumetric strain &amp; change in volume for given cube or cuboid.</p> | <p><b>Unit - II Simple Stresses, Strains &amp; Elastic Constants</b></p> <p>2.1 Concept of elastic body, definition of stress, strain, Type of stresses &amp; strains.</p> <p>2.2 Hook's law, elastic limit, Linear and lateral strain, Poisson's ratio.</p> <p>2.3 Young's Modulus, Shear Modulus, Bulk Modulus &amp; Relation between these three moduli.</p> <p>2.4 Standard stress strain curve for mild steel bar and Tor steel bar under tension test, Yield stress, proof stress, ultimate stress, breaking stress, and working stress, strain at various critical points, percentage elongation and Factor of safety.</p> <p>2.5 Shear stress and shear strain, Single shear, Double shear, Punching shear.</p> <p>2.6 Deformation of body subjected to axial force for uniformed and stepped sections. Deformation of uniform body subjected to forces at its intermediate sections.</p> <p>2.7 Concept of composite section, stresses induced and load shared by each material under axial loading only. (No numerical on stepped sections).</p> <p>2.8 Uni-axial, Bi-axial and Tri-axial stress systems.</p> <p>2.9 Strain in each direction, volumetric strain, change in volume.</p> | <p>- Chalk-Board</p> <p>- Hands-on</p> <p>- Collaborative learning</p> <p>- Video</p> <p>- Demonstrations</p> <p>- Presentations</p> |
| 3     | <p>TLO 3.1 Enlist Types of Supports &amp; Types of Beams</p> <p>TLO 3.2 Enlist types of loads acting on a beam.</p> <p>TLO 3.3 Understand the relation between SF, BM and rate of loading.</p> <p>TLO 3.4 Draw SFD and BMD for Simply supported beams, Cantilever beams &amp; overhanging beams.</p> <p>TLO 3.5 Locate point of maximum BM and point of contra-flexure.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <p><b>Unit - III Shear Force &amp; Bending Moment</b></p> <p>3.1 Types of Supports: Simple, Hinge, Roller &amp; Fixed and Beams: Cantilever, Simply supported, Roller, Hinge &amp; overhanging beams.</p> <p>3.2 Types of loads: Concentrated or Point load, Inclined point load &amp; Uniformly Distributed load.</p> <p>3.3 Meaning of SF and BM, Relation between them, Sign conventions.</p> <p>3.4 SFD &amp; BMD for Simply Supported, Cantilever and overhanging beams subjected to Vertical point load &amp; UDL only.</p> <p>3.5 Drawing SFD and BMD, Location of Point of Contra-Shear, maximum BM, Location of Point of Contra-flexure.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <p>Chalk-Board</p> <p>Hands-on</p> <p>Collaborative learning</p> <p>Video</p> <p>Demonstrations</p> <p>Presentations</p>             |

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| Sr.No | Theory Learning Outcomes (TLO's) aligned to CO's.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Suggested Learning Pedagogies.                                                                           |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| 4     | <p>TLO 4.1 Understand concept of pure bending, Neutral Axis and radius of gyration of a given lamina and section modulus.</p> <p>TLO 4.2 Determine Moment of Resistance (M.R.) &amp; section modulus (Z) using Flexural Formula.</p> <p>TLO 4.3 Determine the Bending stresses at given location in simply supported &amp; cantilever beams subjected to standard loading cases (Point load &amp; UDL only).</p> <p>TLO 4.4 Compute &amp; draw maximum and average shear stress for rectangular and circular section.</p> <p>TLO 4.5 Draw shear stress distribution diagram for given section across its depth.</p> <p>TLO 4.6 Determine shear stresses in hollow rectangular section.</p> | <p><b>Unit - IV Bending and Shear Stresses in beams</b></p> <p>4.1 Theory of pure bending, assumptions in pure bending, Concept of Neutral Axis and section modulus.</p> <p>4.2 Flexural Equation (without derivation) with meaning of each term used in equation, bending stresses and their nature, bending stress distribution diagram.</p> <p>4.3 Bending stress variation diagram across depth of given cross section for cantilever and simply supported beams for symmetrical sections only.</p> <p>4.4 Shear stress equation (without derivation), meaning of each term used in equation, relation between maximum and average shear stress for square, rectangular and circular section (numerical), shear stress distribution diagram.</p> <p>4.5 Shear stress distribution diagram for square, rectangular, circle, hollow square, hollow rectangular, hollow circle, T-section &amp; symmetrical I-section only. (no numericals)</p> <p>4.6 Use of shear stress equation for determination of shear stresses in hollow rectangular section.</p> | <p>Chalk-Board<br/>Hands-on<br/>Collaborative Learning<br/>Demonstration<br/>Video<br/>Presentations</p> |
| 5     | <p>TLO 5.1 Explain effect of direct and eccentric loads on columns.</p> <p>TLO 5.2 Draw resultant stress distribution diagram for a compression member subjected to eccentric load about one of its principal axis.</p> <p>TLO 5.3 Write No tension condition for columns, Core of the section for rectangular &amp; circular column.</p> <p>TLO 5.4 Identify the terms radius of gyration, slenderness ratio &amp; effective length for given column with different end conditions.</p> <p>TLO 5.5 Understand the concept of buckling load in columns using Euler's Formula &amp; Rankine's Formula.</p>                                                                                  | <p><b>Unit - V Direct and Bending Stresses</b></p> <p>5.1 Introduction to direct and eccentric loads, Eccentricity about one principal axis, nature of stresses.</p> <p>5.2 Maximum and minimum stresses, resultant stress distribution diagram. Condition for 'No tension' condition (Problems on Column subjected to Eccentric load about one axis only.)</p> <p>5.3 Limit of eccentricity, core of section for circular cross sections, middle third rule for rectangular section.</p> <p>5.4 Introduction to compression members, effective length, radius of gyration, slenderness ratio, type of end conditions for columns.</p> <p>5.5 Buckling (or Crippling) load for columns by Euler's Formula &amp; Rankine's Formula with meaning of each term in it. (No numericals.)</p>                                                                                                                                                                                                                                                                     | <p>Chalk-Board<br/>Collaborative learning<br/>Presentations<br/>Demonstration<br/>Videos</p>             |

**VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.**

| Practical / Tutorial / Laboratory Learning Outcome (LLO)                                 | Sr No | Laboratory Experiment / Practical Titles / Tutorial Titles                                                                                                      | Number of hrs. | Relevant COs |
|------------------------------------------------------------------------------------------|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------------|
| LLO 1.1 Identify different components of UTM.                                            | 1     | *Conduct sample compressive and tensile tests on metal using Universal Testing Machine along with introduction to machine & other tests to be conducted on UTM. | 2              | CO2          |
| LLO 2.1 Perform Tension test on mild steel as per IS:432(1).                             | 2     | *Tension test on mild steel as per IS:432(1).                                                                                                                   | 2              | CO2          |
| LLO 3.1 Perform tension test on Tor steel as per IS:1608, IS:1139.                       | 3     | Tension test on Tor steel as per IS:1608, IS:1139.                                                                                                              | 2              | CO2          |
| LLO 4.1 Conduct compression test on sample test piece using Compression Testing Machine. | 4     | *Compression test on any two metals like Mild Steel, Brass, Al etc. using Compression Testing Machine.                                                          | 2              | CO2          |
| LLO 5.1 Conduct Izod Impact test on given metals as per IS:1598.                         | 5     | *Izod Impact test on any two metals like mild steel/ brass/aluminum/ copper /cast iron etc. as per IS:1598.                                                     | 2              | CO2          |
| LLO 6.1 Conduct Charpy Impact test on given metals as per IS:1598.                       | 6     | Charpy Impact test on two metals like mild steel/ brass/aluminum/ copper /cast iron etc. as per IS:1757.                                                        | 2              | CO2          |
| LLO 7.1 Determine Compressive strength of dry and wet bricks.                            | 7     | Compressive strength of dry and wet bricks as per IS:3495 (part I), IS:1077.                                                                                    | 2              | CO2          |

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| <b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>                                                                                                                                                                                                                                           | <b>Sr No</b> | <b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>                                                                                                                                                                    | <b>Number of hrs.</b> | <b>Relevant COs</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------------|
| LLO 8.1 Perform Single Shear and double shear test on given metals as per IS:5242 .                                                                                                                                                                                                                       | 8            | *Single Shear and double shear test on any two metals like Mild steel/ brass/ Al / copper / cast iron etc. as per IS:5242 .                                                                                                          | 2                     | CO2<br>CO4          |
| LLO 9.1 Conduct Compression test on timber section along the grain and across the grain .                                                                                                                                                                                                                 | 9            | Compression test on timber section along the grain and across the grain as per IS:2408 .                                                                                                                                             | 2                     | CO1<br>CO2          |
| LLO 10.1 Plot Shear force and Bending Moment diagrams of beams subjected to different types of loads.                                                                                                                                                                                                     | 10           | *Shear force and Bending Moment diagrams of cantilever, simply supported and overhanging beams for different types of loading . (02 problems on each type of beam) .                                                                 | 4                     | CO3                 |
| LLO 11.1 Conduct Flexural test on timber beam on rectangular section.                                                                                                                                                                                                                                     | 11           | *Flexural test on timber beam on rectangular section in both orientations as per IS:1708, IS:2408 .                                                                                                                                  | 2                     | CO1<br>CO4          |
| LLO 12.1 Prepare PPT on Strain Energy.<br>LLO 12.2 Prepare PPT on Thermal Stresses & Thermal Strains.                                                                                                                                                                                                     | 12           | a) Prepare PPT of minimum 05 slides on the concept of Strain Energy & instantaneous stress induced in a material due to gradual, Sudden & impact load.<br>b) Prepare PPT of minimum 04 slides on Thermal Stresses & Thermal Strains. | 2                     | CO2                 |
| LLO 13.1 Conduct Flexure test on floor tiles/roofing tiles.                                                                                                                                                                                                                                               | 13           | Flexure test on floor tiles IS:1237, IS:13630 or roofing tiles as per IS:654, IS:2690 .                                                                                                                                              | 2                     | CO4                 |
| LLO 14.1 Determine hardness no. for given metal using Rockwell Hardness Tester.                                                                                                                                                                                                                           | 14           | Rockwell Hardness Test on any two Metals like Mild Steel, Brass Copper, Aluminum etc.                                                                                                                                                | 2                     | CO2                 |
| LLO 15.1 Determine hardness no for given metals using Brinell Hardness Tester.                                                                                                                                                                                                                            | 15           | Brinell hardness test on any two metals like Mild Steel, Brass Copper, Aluminum etc.                                                                                                                                                 | 2                     | CO2                 |
| <b>Note : Out of above suggestive LLOs -</b> <ul style="list-style-type: none"> <li>• '*' Marked Practicals (LLOs) Are mandatory.</li> <li>• Minimum 80% of above list of lab experiment are to be performed.</li> <li>• Judicial mix of LLOs are to be performed to achieve desired outcomes.</li> </ul> |              |                                                                                                                                                                                                                                      |                       |                     |

**VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)****Micro project**

- Collect the information of Indian Knowledge System (IKS) given in different units.
- Prepare charts of maximum bending moment and shear force values in standard beams.
- Two Numericals on Chimneys (of rectangular and circular cross section) subjected to wind pressure & also draw stress distribution diagram at base of it.
- Draw & identify difference between Bending stress distribution & Shear stress distribution diagrams for square, rectangular, circle, hollow square, rectangular, circle, T- section, & symmetrical I- section.

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |
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| <b>Note :</b> <ul style="list-style-type: none"> <li>• Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.</li> <li>• The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.</li> <li>• If a microproject is assigned, it is expected to be completed as a group activity.</li> <li>• SLA marks shall be awarded as per the continuous assessment record.</li> <li>• For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.</li> <li>• If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.</li> </ul> |  |
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**VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED**

| <b>Sr.No</b> | <b>Equipment Name with Broad Specifications</b> | <b>Relevant LLO Number</b> |
|--------------|-------------------------------------------------|----------------------------|
|--------------|-------------------------------------------------|----------------------------|

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| Sr.No | Equipment Name with Broad Specifications                                                                                                       | Relevant LLO Number     |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| 1     | Extensometer with least count 0.01mm, maximum extension 25 mm with dial gauge/ digital display suitable for various gauge length.              | 1,2,3                   |
| 2     | Accessories: Vernier caliper, meter scale, weighing balance, weights, punch, file, hammer, screw driver, pliers, etc.                          | 1,2,3,4,5,6,7,8,9,11,13 |
| 3     | Universal Testing Machine of capacity 1000kN, 600 kN / 400 kN, analog type/digital type with all attachments and accessories.                  | 1,2,3,8,11,13           |
| 4     | Tile flexural testing machine confirming to IS:654, capacity 200 Kg with uniform loading rate of 45 to 55 Kg/minute provided with lead shots . | 13                      |
| 5     | Brinell and Rockwell Hardness Test machine .                                                                                                   | 14,15                   |
| 6     | Compression Testing Machine of capacity 2000 kN / 1000 kN, analog / digital type with all attachments and accessories.                         | 4,7,9                   |
| 7     | Izod/Charpy impact testing machine confirming to IS: 1757.                                                                                     | 5,6                     |
| 8     | Hot Air Oven with thermostatic control having temp. range 100 to 105 degree celsius .                                                          | 7                       |

**IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)**

| Sr.No              | Unit | Unit Title                                   | Aligned COs | Learning Hours | R-Level   | U-Level   | A-Level   | Total Marks |
|--------------------|------|----------------------------------------------|-------------|----------------|-----------|-----------|-----------|-------------|
| 1                  | I    | Moment of Inertia                            | CO1         | 10             | 2         | 4         | 6         | 12          |
| 2                  | II   | Simple Stresses, Strains & Elastic Constants | CO2         | 16             | 6         | 8         | 4         | 18          |
| 3                  | III  | Shear Force & Bending Moment                 | CO3         | 14             | 2         | 4         | 10        | 16          |
| 4                  | IV   | Bending and Shear Stresses in beams          | CO4         | 10             | 2         | 4         | 6         | 12          |
| 5                  | V    | Direct and Bending Stresses                  | CO5         | 10             | 2         | 4         | 6         | 12          |
| <b>Grand Total</b> |      |                                              |             | <b>60</b>      | <b>14</b> | <b>24</b> | <b>32</b> | <b>70</b>   |

**X. ASSESSMENT METHODOLOGIES/TOOLS****Formative assessment (Assessment for Learning)**

- Two-unit tests of 30 marks each will be conducted and average of two-unit tests considered.
- For formative assessment of laboratory learning 25 marks
- Each practical will be assessed considering appropriate % weightage to process and product and other instructions of assessment.

**Summative Assessment (Assessment of Learning)**

- Pen and Paper Test (Written Test)

**XI. SUGGESTED COS - POS MATRIX FORM**

| Course Outcomes (COs) | Programme Outcomes (POs)                     |                       |                                       |                        |                                                                        |                         |                         | Programme Specific Outcomes* (PSOs) |       |       |
|-----------------------|----------------------------------------------|-----------------------|---------------------------------------|------------------------|------------------------------------------------------------------------|-------------------------|-------------------------|-------------------------------------|-------|-------|
|                       | PO-1 Basic and Discipline Specific Knowledge | PO-2 Problem Analysis | PO-3 Design/ Development of Solutions | PO-4 Engineering Tools | PO-5 Engineering Practices for Society, Sustainability and Environment | PO-6 Project Management | PO-7 Life Long Learning | PSO-1                               | PSO-2 | PSO-3 |
| CO1                   | 3                                            | 3                     | 2                                     | 2                      | 1                                                                      | --                      | 2                       |                                     |       |       |
| CO2                   | 3                                            | 3                     | 3                                     | 3                      | 1                                                                      | --                      | 3                       |                                     |       |       |
| CO3                   | 3                                            | 3                     | 2                                     | 1                      | 1                                                                      | --                      | 2                       |                                     |       |       |
| CO4                   | 3                                            | 3                     | 2                                     | 1                      | 1                                                                      | ---                     | 2                       |                                     |       |       |
| CO5                   | 3                                            | 3                     | 2                                     | 1                      | 1                                                                      | --                      | 2                       |                                     |       |       |

Legends :- High:03, Medium:02,Low:01, No Mapping: -  
 \*PSOs are to be formulated at institute level

**XII. SUGGESTED LEARNING MATERIALS / BOOKS**

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| Sr.No | Author                                             | Title                               | Publisher with ISBN Number                                           |
|-------|----------------------------------------------------|-------------------------------------|----------------------------------------------------------------------|
| 1     | Khurmi R.S., Khurmi N.                             | A Textbook of Strength of Materials | S. Chand and Co. Ltd. New Delhi, 2019, ISBN 9789352833979            |
| 2     | Ramamrutham S.                                     | Strength of Materials               | Dhanpat Rai and sons, New Delhi, 2015, ISBN 9788187433545            |
| 3     | Punmia B. C., Ashok Kumar Jain , Arun Kumar Jain . | Mechanics of Materials              | Laxmi Publications (p) Ltd. New Delhi, 2017, ISBN-13: 978-8131806463 |
| 4     | Rattan S.S.                                        | Strength of Materials               | McGraw Hill Education; New Delhi 2017, ISBN-13: 978-9385965517       |
| 5     | Rajput R. K .                                      | A Textbook of Strength of Materials | S. Chand Publishing 9789352533695, 9352533690                        |

**XIII . LEARNING WEBSITES & PORTALS**

| Sr.No | Link / Portal                                                                                                                             | Description                                                         |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| 1     | <a href="https://youtu.be/DzyIEz3dKXQ?si=beGDRqJ1olZ70LUe">https://youtu.be/DzyIEz3dKXQ?si=beGDRqJ1olZ70LUe</a>                           | Concept of Stress and Strain .                                      |
| 2     | <a href="https://youtu.be/RSImDKHDMUY?si=FHCxXE1QSaa0FqBn">https://youtu.be/RSImDKHDMUY?si=FHCxXE1QSaa0FqBn</a>                           | Standard stress-strain curve for mild steel bar and Tor steel bar . |
| 3     | <a href="https://www.youtube.com/watch?v=MFZ18Ed4HI8">https://www.youtube.com/watch?v=MFZ18Ed4HI8</a>                                     | Field Test on TMT .                                                 |
| 4     | <a href="https://www.youtube.com/watch?v=C-FEVzI8oe8">https://www.youtube.com/watch?v=C-FEVzI8oe8</a>                                     | Concept of SFD and BMD .                                            |
| 5     | <a href="https://www.youtube.com/watch?v=yvbA4mk36Kk">https://www.youtube.com/watch?v=yvbA4mk36Kk</a>                                     | Practical examples of SFD and BMD.                                  |
| 6     | <a href="https://www.youtube.com/watch?v=f2eGwNUopws">https://www.youtube.com/watch?v=f2eGwNUopws</a>                                     | Concept & Numerical on Point of Contraflexure .                     |
| 7     | <a href="https://www.youtube.com/watch?v=f08Y39UjC-o">https://www.youtube.com/watch?v=f08Y39UjC-o</a>                                     | Bending Stresses & Shear Stresses in Beams .                        |
| 8     | <a href="https://skyciv.com/structural-software/beam-analysis-software">https://skyciv.com/structural-software/beam-analysis-software</a> | Calculation & Drawing of SFD & BMD freeware Software .              |

**Note :**

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

**MSBTE Approval Dt. 02/07/2024****Semester - 3, K Scheme**